

Appendix B.8 Energy Consumption per Categorized Consumer in 2001¹

Category	Baghdad kWh/Nos.	Middle kWh/Nos.	North kWh/Nos.	South kWh/Nos.	Total kWh/Nos.
Household	9,811	2,866	4,285	3,928	5,441
Commercial	4,743	1,215	1,725	2,254	3,248
Industrial	452,964	388,190	698,991	1,140,341	610,908
Governmental	192,224	49,003	66,086	61,873	88,103
Agricultural	73,198	15,666	22,589	16,280	19,628
Total	11,615	5,584	9,539	9,756	9,055

¹“North” includes Tameem, Salah al-Din, Ninewa and Dahuk. Sulaymaniyah and Erbil are not included in the data.

Appendix B.9 Regional Peak Demand for 2002 Estimated by UNDP

Governorate & Region	Summer	Winter
<i>Baghdad Region</i>		
Rasafa & Suburbs	1,150	1,055
Karkh & Suburbs	1,100	1,000
Total Baghdad Region	2,250	2,055
<i>Middle Region</i>		
Diyala	177	177
Anbar	317	317
Najaf	240	150
Kerbela	135	135
Qadissiya	147	145
Wassit	170	170
Babylon	188	188
Total Middle Region	1,374	1,282
<i>North Region</i>		
Tameem	160	180
Salah al-Din	320	350
Ninewa	600	600
Total North Region	1,080	1,130
<i>South Region</i>		
Basrah	580	550
Muthanna	109	109
Thi-Qar	165	165
Missan	125	125
Total South Region	979	949
Total the above 4 regions	5,683	5,416
<i>3 Northern Governorates</i>		
Sulaymaniyah	150	148
Erbil	230	287
Dahuk	290	335
Total 3 Northern Governorates	670	770
Grand Total	6,353	6,186

Appendix B.10 Annual Load Factors for Peak Demand Estimated by UNDP

UNDP (ObR) data

Governorate & Region	2002 Population	July 2002 Peak Demand in Summer at Distribution facilities (MW)	1990 kWh/capita at Consumers' Ends (kWh/capita)	2002 Energy Demand at Consumers' Ends (GWh)	2002 Energy Demand at T/L Network Ends (GWh)	2002 L.F.
Baghdad Region	6,054,355	2,250	1,853	11,217	13,777	70%
<i>Middle Region</i>						
Diyala	1,195,530	177	793	948	1,165	75%
Anbar	1,193,343	317	1,067	1,274	1,564	56%
Najaf	898,733	240	1,071	962	1,182	56%
Kerbela	700,063	135	903	632	777	66%
Qaddisiya	865,171	147	991	857	1,053	82%
Wasit	883,839	170	1,142	1,009	1,240	83%
Babylon	1,336,826	188	636	851	1,045	64%
Total Middle Region	7,073,503	1,374	911	6,533	8,024	67%
<i>North Region</i>						
Al-Tameem	829,757	160	965	801	983	70%
Salah-Al-Din	917,169	320	1,121	1,028	1,262	45%
Ninewa	2,382,348	600	956	2,278	2,798	53%
Total North Region	4,129,274	1,080	1,000	4,107	5,044	53%
<i>South Region</i>						
Basra	1,823,017	580	1,193	2,176	2,672	53%
Muthanna	521,472	109	791	413	507	53%
Thi Qar	1,435,866	165	608	873	1,072	74%
Missan	783,288	125	846	663	814	74%
Total South Region	4,563,644	979	882	4,124	5,065	59%
Total the above regions	21,820,776	5,683	1,180	25,981	31,910	64%
<i>3 Northern Governorates</i>						
Sulaimaniya	1,548,064	150	644	997	1,224	93%
Erbil	1,298,499	230	1,141	1,481	1,819	90%
Dohuk	785,409	290	993	780	958	38%
Total 3 Northern Governorates	3,631,972	670	884	3,258	4,001	68%
Grand Total	25,452,749	6,353	1,143	29,239	35,911	65%

Appendix B.11 Actual and Demand Peak Load for 15 May 2004

CPA Reporting Peak for 15 MAY 2004 / Report Date - 16 MAY 2004

Power transferred from North to Middle 750 MW.

Power transferred from South to Middle 100 MW.

Governorate	Peak Load MW	MWH	Average Load MW	Demand Load MW
Baghdad	1,553	30,108	1,255	1,537
Duhok	80	1,910	80	114
Naynawa	355	8,280	345	494
Tamim	139	3,107	129	182
Salah Aldeen	210	4,712	196	248
Anbar	212	4,613	192	236
Dyala	91	2,249	94	140
Babil	95	2,249	94	137
Karbala	80	1,775	74	107
Najaf	95	2,116	88	125
Kadsya	58	1,303	54	85
Wasit	89	229	85	119
Muthana	65	1,253	52	74
Nasirya	135	2,605	109	124
Misan	69	1,463	61	78
Basra	320	6,913	288	342
	3,646	74,885		4,142

Appendix B.12 Result of Demand Forecast

Governorate & Region	2004 Population	2004 Energy Demand at Consumers' Ends (GWh)	2004 Peak Demand at Consumers' Ends (MW)	2004 Energy Demand at 132kV S/S Ends (GWh)	2004 Peak Demand at 132kV S/S Ends (MW)	2004 Energy Demand at P/S Sent-out Points (GWh)	2004 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>			L.F.=81.3%	LV Nw Loss=18.2%	L.F.=81%	HV+LV Nw Loss=33.1%	L.F.=81%
Baghdad Region	6,168,782	11,429	1,605	14,539	2,041	17,084	2,399
<i>Middle Region</i>			L.F.=78%	LV Nw Loss=18%	L.F.=78%	HV+LV Nw Loss=33%	L.F.=78%
Diyala	1,258,455	998	147	1,270	187	1,492	220
Anbar	1,275,962	1,362	200	1,732	255	2,036	300
Najaf	960,908	1,029	151	1,309	193	1,538	226
Kerbela	751,272	679	100	863	127	1,014	149
Qaddisiya	911,500	903	133	1,149	169	1,350	199
Wasit	940,800	1,074	158	1,367	201	1,606	236
Babylon	1,430,780	910	134	1,158	170	1,361	200
Total Middle Region	7,529,677	6,955	1,024	8,847	1,302	10,396	1,530
<i>North Region</i>			L.F.=62%	LV Nw Loss=28%	L.F.=62%	HV+LV Nw Loss=37%	L.F.=62%
Al-Tameem	865,065	835	154	1,203	221	1,327	244
Salah-Al-Din	976,705	1,095	201	1,577	290	1,740	320
Ninewa	2,527,556	2,417	445	3,484	641	3,842	707
Total North Region	4,369,326	4,346	800	6,264	1,153	6,908	1,272
<i>South Region</i>			L.F.=69%	LV Nw Loss=12%	L.F.=69%	HV+LV Nw Loss=23%	L.F.=69%
Basra	1,924,301	2,296	382	2,648	440	2,997	498
Muthanna	556,466	440	73	508	84	575	95
Thi Qar	1,520,449	924	154	1,066	177	1,206	200
Missan	826,685	700	116	807	134	913	152
Total South Region	4,827,901	4,360	725	5,028	836	5,690	946
Total the above regions	22,895,685	27,091	4,153	34,677	5,332	40,078	6,146
<i>3 Northern Governorates</i>			L.F.=79%	LV Nw Loss=28%	L.F.=79%	HV+LV Nw Loss=37%	L.F.=79%
Sulaymaniyah	1,594,164	1,027	148	1,479	213	1,632	235
Erbil	1,358,247	1,549	223	2,233	321	2,463	355
Dohuk	816,904	811	117	1,169	168	1,289	186
Total 3 Northern Governorates	3,769,315	3,387	488	4,881	703	5,383	775
Grand Total	26,665,000	30,478	4,641	39,559	6,035	45,461	6,921

Target (Nation wide data)→

Difference→

75%

0.0%

20%

0.0%

33%

0.0%

adjusting data for calibration
calculated data from coefficient
calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2005 Energy Demand at Consumers' Ends (GWh)	2005 Peak Demand at Consumers' Ends (MW)	2005 Energy Demand at 132kV S/S Ends (GWh)	2005 Peak Demand at 132kV S/S Ends (MW)	2005 Energy Demand at P/S Sent-out Points (GWh)	2005 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=81.3%	LV Nw Loss=18.2%	L.F.=81%	HV+LV Nw Loss=32.1%	L.F.=81%
Baghdad Region	11,772	1,653	14,928	2,096	17,337	2,434
<i>Middle Region</i>		L.F.=78%	LV Nw Loss=18%	L.F.=78%	HV+LV Nw Loss=32%	L.F.=78%
Diyala	1,028	151	1,304	192	1,514	223
Anbar	1,403	206	1,779	262	2,066	304
Najaf	1,060	156	1,344	198	1,560	230
Kerbela	699	103	886	130	1,029	152
Qaddisiya	930	137	1,179	174	1,370	202
Wasit	1,107	163	1,403	207	1,630	240
Babylon	938	138	1,189	175	1,381	203
Total Middle Region	7,164	1,054	9,084	1,337	10,550	1,553
<i>North Region</i>		L.F.=62%	LV Nw Loss=28%	L.F.=62%	HV+LV Nw Loss=36%	L.F.=62%
Al-Tameem	860	158	1,232	227	1,343	247
Salah-Al-Din	1,127	208	1,616	297	1,760	324
Ninewa	2,490	458	3,569	657	3,888	716
Total North Region	4,477	824	6,417	1,181	6,991	1,287
<i>South Region</i>		L.F.=69%	LV Nw Loss=12%	L.F.=69%	HV+LV Nw Loss=23%	L.F.=69%
Basra	2,365	393	2,724	453	3,058	508
Muthanna	453	75	522	87	586	97
Thi Qar	952	158	1,096	182	1,231	205
Missan	721	120	830	138	932	155
Total South Region	4,491	746	5,173	860	5,807	965
Total the above regions	27,904	4,278	35,601	5,474	40,686	6,239
<i>3 Northern Governorates</i>		L.F.=79%	LV Nw Loss=28%	L.F.=79%	HV+LV Nw Loss=36%	L.F.=79%
Sulaymaniyah	1,057	152	1,516	218	1,651	238
Erbil	1,596	230	2,288	329	2,492	359
Dohuk	835	120	1,197	172	1,304	188
Total 3 Northern Governorates	3,489	502	5,001	720	5,448	784
Grand Total	31,392	4,780	40,602	6,194	46,133	7,023

Target (Nation wide data)→

Difference→

75%

0.0%

0.0%

32%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration

calculated data from coefficient

calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2006 Energy Demand at Consumers' Ends (GWh)	2006 Peak Demand at Consumers' Ends (MW)	2006 Energy Demand at 132kV S/S Ends (GWh)	2006 Peak Demand at 132kV S/S Ends (MW)	2006 Energy Demand at P/S Sent-out Points (GWh)	2006 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=78.1%	LV Nw Loss=17.3%	L.F.=78%	HV+LV Nw Loss=30.2%	L.F.=78%
Baghdad Region	12,478	1,824	15,571	2,276	17,877	2,613
<i>Middle Region</i>		L.F.=75%	LV Nw Loss=17%	L.F.=75%	HV+LV Nw Loss=30%	L.F.=75%
Diyala	1,090	167	1,360	208	1,561	239
Anbar	1,487	228	1,855	284	2,130	326
Najaf	1,123	172	1,401	215	1,609	246
Karbela	741	114	925	142	1,062	163
Qaddisiya	986	151	1,230	188	1,412	216
Wasit	1,173	180	1,464	224	1,681	257
Babylon	994	152	1,240	190	1,424	218
Total Middle Region	7,593	1,163	9,475	1,452	10,879	1,667
<i>North Region</i>		L.F.=60%	LV Nw Loss=26%	L.F.=60%	HV+LV Nw Loss=34%	L.F.=60%
Al-Tameem	911	175	1,275	244	1,377	264
Salah-Al-Din	1,195	229	1,672	320	1,806	346
Ninewa	2,639	506	3,691	707	3,989	764
Total North Region	4,745	909	6,638	1,272	7,172	1,374
<i>South Region</i>		L.F.=66%	LV Nw Loss=11%	L.F.=66%	HV+LV Nw Loss=21%	L.F.=66%
Basra	2,507	434	2,863	495	3,187	551
Muthanna	481	83	549	95	611	106
Thi Qar	1,009	175	1,152	199	1,282	222
Missan	764	132	872	151	971	168
Total South Region	4,761	824	5,436	940	6,051	1,047
Total the above regions	29,578	4,720	37,120	5,940	41,979	6,701
<i>3 Northern Governorates</i>		L.F.=76%	LV Nw Loss=26%	L.F.=76%	HV+LV Nw Loss=34%	L.F.=76%
Sulaymaniyah	1,121	168	1,568	235	1,694	254
Erbil	1,692	254	2,366	355	2,557	383
Dohuk	885	133	1,239	186	1,338	201
Total 3 Northern Governorates	3,698	554	5,173	775	5,589	838
Grand Total	33,276	5,274	42,292	6,715	47,568	7,538
		L.F.=72.0%	LV Nw Loss=19%	L.F.=72%	HV+LV Nw Loss=30.0%	L.F.=72%

Target (Nation wide data)→

Difference→

72%

19%

30%

0.0%

0.0%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration

calculated data from coefficient

calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2007 Energy Demand at Consumers' Ends (GWh)	2007 Peak Demand at Consumers' Ends (MW)	2007 Energy Demand at 132kV S/S Ends (GWh)	2007 Peak Demand at 132kV S/S Ends (MW)	2007 Energy Demand at P/S Sent-out Points (GWh)	2007 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=78.1%	LV Nw Loss=16.4%	L.F.=78%	HV+LV Nw Loss=28.2%	L.F.=78%
Baghdad Region	13,227	1,933	16,248	2,375	18,422	2,693
<i>Middle Region</i>		L.F.=75%	LV Nw Loss=16%	L.F.=75%	HV+LV Nw Loss=28%	L.F.=75%
Diyala	1,155	177	1,419	217	1,609	246
Anbar	1,576	241	1,936	297	2,195	336
Najaf	1,190	182	1,462	224	1,658	254
Kerbela	785	120	965	148	1,094	168
Qaddisiya	1,045	160	1,284	197	1,455	223
Wasit	1,243	190	1,527	234	1,732	265
Babylon	1,054	161	1,294	198	1,467	225
Total Middle Region	8,049	1,233	9,887	1,515	11,210	1,717
<i>North Region</i>		L.F.=60%	LV Nw Loss=25%	L.F.=60%	HV+LV Nw Loss=32%	L.F.=60%
Al-Tameem	966	185	1,319	253	1,412	271
Salah-Al-Din	1,267	243	1,730	331	1,852	355
Ninewa	2,797	536	3,820	732	4,089	784
Total North Region	5,030	964	6,869	1,316	7,353	1,409
<i>South Region</i>		L.F.=66%	LV Nw Loss=11%	L.F.=66%	HV+LV Nw Loss=20%	L.F.=66%
Basra	2,658	460	3,008	520	3,318	574
Muthanna	510	88	577	100	636	110
Thi Qar	1,069	185	1,211	209	1,335	231
Missan	810	140	917	159	1,011	175
Total South Region	5,046	873	5,712	988	6,301	1,090
Total the above regions	31,353	5,003	38,718	6,194	43,286	6,909
<i>3 Northern Governorates</i>		L.F.=76%	LV Nw Loss=25%	L.F.=76%	HV+LV Nw Loss=32%	L.F.=76%
Sulaymaniyah	1,188	178	1,622	243	1,737	260
Erbil	1,793	269	2,449	367	2,621	393
Dohuk	939	141	1,282	192	1,372	206
Total 3 Northern Governorates	3,920	587	5,353	802	5,730	859
Grand Total	35,272	5,591	44,071	6,997	49,016	7,768
		L.F.=72%	LV Nw Loss=18%	L.F.=72%	HV+LV Nw Loss=28%	L.F.=72%

Target (Nation wide data)→

Difference→

72%

18%

28%

0.0%

-0.1%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration

calculated data from coefficient

calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2008 Energy Demand at Consumers' Ends (GWh)	2008 Peak Demand at Consumers' Ends (MW)	2008 Energy Demand at 132kV S/S Ends (GWh)	2008 Peak Demand at 132kV S/S Ends (MW)	2008 Energy Demand at P/S Sent-out Points (GWh)	2008 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=75.9%	LV Nw Loss=16.0%	L.F.=76%	HV+LV Nw Loss=27.2%	L.F.=76%
Baghdad Region	14,285	2,149	17,425	2,621	19,623	2,951
<i>Middle Region</i>		L.F.=72%	LV Nw Loss=16%	L.F.=72%	HV+LV Nw Loss=27%	L.F.=72%
Diyala	1,248	197	1,522	240	1,714	270
Anbar	1,702	268	2,076	327	2,338	369
Najaf	1,286	203	1,568	247	1,766	278
Karbela	848	134	1,035	163	1,165	184
Qaddisiya	1,129	178	1,377	217	1,550	244
Wasit	1,343	212	1,638	258	1,845	291
Babylon	1,138	179	1,388	219	1,563	246
Total Middle Region	8,693	1,370	10,603	1,671	11,941	1,882
<i>North Region</i>		L.F.=58%	LV Nw Loss=24%	L.F.=58%	HV+LV Nw Loss=30%	L.F.=58%
Al-Tameem	1,043	206	1,409	278	1,500	296
Salah-Al-Din	1,368	270	1,848	364	1,968	388
Ninewa	3,021	596	4,082	805	4,345	857
Total North Region	5,433	1,071	7,339	1,447	7,814	1,541
<i>South Region</i>		L.F.=64%	LV Nw Loss=10%	L.F.=64%	HV+LV Nw Loss=19%	L.F.=64%
Basra	2,870	511	3,237	576	3,552	632
Muthanna	550	98	621	110	681	121
Thi Qar	1,155	206	1,302	232	1,429	254
Missan	874	156	986	176	1,082	193
Total South Region	5,450	970	6,146	1,094	6,745	1,201
Total the above regions	33,861	5,560	41,513	6,833	46,122	7,575
<i>3 Northern Governorates</i>		L.F.=74%	LV Nw Loss=24%	L.F.=74%	HV+LV Nw Loss=30%	L.F.=74%
Sulaymaniyah	1,283	198	1,733	267	1,845	285
Erbil	1,937	299	2,616	403	2,785	430
Dohuk	1,014	156	1,369	211	1,458	225
Total 3 Northern Governorates	4,233	653	5,719	882	6,089	939
Grand Total	38,094	6,213	47,232	7,715	52,211	8,514
		L.F.=70%	LV Nw Loss=17.5%	L.F.=70%	HV+LV Nw Loss=27%	L.F.=70%

Target (Nation wide data)→

Difference→

70%

0.0%

17.5%

0.0%

27%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration

calculated data from coefficient

calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2009 Energy Demand at Consumers' Ends (GWh)	2009 Peak Demand at Consumers' Ends (MW)	2009 Energy Demand at 132kV S/S Ends (GWh)	2009 Peak Demand at 132kV S/S Ends (MW)	2009 Energy Demand at P/S Sent-out Points (GWh)	2009 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=75.9%	LV Nw Loss=16.0%	L.F.=76%	HV+LV Nw Loss=27.2%	L.F.=76%
Baghdad Region	15,428	2,320	18,819	2,830	21,193	3,187
<i>Middle Region</i>		L.F.=72%	LV Nw Loss=16%	L.F.=72%	HV+LV Nw Loss=27%	L.F.=72%
Diyala	1,347	212	1,643	259	1,851	292
Anbar	1,838	290	2,242	353	2,525	398
Najaf	1,389	219	1,694	267	1,907	301
Kerbela	916	144	1,117	176	1,258	198
Qaddisiya	1,219	192	1,487	234	1,674	264
Wasit	1,450	229	1,769	279	1,992	314
Babylon	1,229	194	1,499	236	1,688	266
Total Middle Region	9,388	1,480	11,452	1,805	12,896	2,033
<i>North Region</i>		L.F.=58%	LV Nw Loss=24%	L.F.=58%	HV+LV Nw Loss=30%	L.F.=58%
Al-Tameem	1,127	222	1,522	300	1,621	320
Salah-Al-Din	1,477	291	1,996	394	2,125	419
Ninewa	3,263	643	4,408	869	4,693	925
Total North Region	5,867	1,157	7,926	1,563	8,439	1,664
<i>South Region</i>		L.F.=64%	LV Nw Loss=10%	L.F.=64%	HV+LV Nw Loss=19%	L.F.=64%
Basra	3,100	552	3,496	622	3,837	683
Muthanna	594	106	670	119	736	131
Thi Qar	1,247	222	1,407	250	1,544	275
Missan	944	168	1,065	190	1,169	208
Total South Region	5,886	1,048	6,637	1,182	7,285	1,297
Total the above regions	36,570	6,005	44,834	7,380	49,812	8,181
<i>3 Northern Governorates</i>		L.F.=74%	LV Nw Loss=24%	L.F.=74%	HV+LV Nw Loss=30%	L.F.=74%
Sulaymaniyah	1,386	214	1,872	289	1,993	307
Erbil	2,092	323	2,826	436	3,008	464
Dohuk	1,095	169	1,479	228	1,575	243
Total 3 Northern Governorates	4,572	705	6,177	952	6,576	1,014
Grand Total	41,142	6,710	51,011	8,333	56,388	9,195
		L.F.=70%	LV Nw Loss=17.5%	L.F.=70%	HV+LV Nw Loss=27%	L.F.=70%

Target (Nation wide data)→

70% 17.5%

27%

Difference→

0.0% 0.0%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration

calculated data from coefficient

calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2010 Energy Demand at Consumers' Ends (GWh)	2010 Peak Demand at Consumers' Ends (MW)	2010 Energy Demand at 132kV S/S Ends (GWh)	2010 Peak Demand at 132kV S/S Ends (MW)	2010 Energy Demand at P/S Sent-out Points (GWh)	2010 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=75.9%	LV Nw Loss=15.5%	L.F.=76%	HV+LV Nw Loss=26.2%	L.F.=76%
Baghdad Region	16,662	2,506	20,162	3,032	22,578	3,396
<i>Middle Region</i>		L.F.=72%	LV Nw Loss=16%	L.F.=72%	HV+LV Nw Loss=26%	L.F.=72%
Diyala	1,455	229	1,761	278	1,972	311
Anbar	1,985	313	2,402	379	2,690	424
Najaf	1,500	236	1,815	286	2,032	320
Kerbela	989	156	1,197	189	1,341	211
Qaddisiya	1,316	207	1,593	251	1,784	281
Wasit	1,566	247	1,895	299	2,122	335
Babylon	1,327	209	1,606	253	1,798	283
Total Middle Region	10,139	1,598	12,269	1,934	13,739	2,166
<i>North Region</i>		L.F.=58%	LV Nw Loss=24%	L.F.=58%	HV+LV Nw Loss=29%	L.F.=58%
Al-Tameem	1,217	240	1,624	320	1,722	340
Salah-Al-Din	1,596	315	2,130	420	2,259	445
Ninewa	3,524	695	4,703	927	4,988	984
Total North Region	6,337	1,249	8,457	1,668	8,969	1,769
<i>South Region</i>		L.F.=64%	LV Nw Loss=10%	L.F.=64%	HV+LV Nw Loss=18%	L.F.=64%
Basra	3,348	596	3,758	669	4,108	731
Muthanna	642	114	721	128	788	140
Thi Qar	1,347	240	1,512	269	1,653	294
Missan	1,020	182	1,145	204	1,251	223
Total South Region	6,357	1,132	7,136	1,270	7,799	1,388
Total the above regions	39,495	6,485	48,024	7,904	53,085	8,719
<i>3 Northern Governorates</i>		L.F.=74%	LV Nw Loss=24%	L.F.=74%	HV+LV Nw Loss=29%	L.F.=74%
Sulaymaniyah	1,497	231	1,997	308	2,118	327
Erbil	2,259	348	3,015	465	3,197	493
Dohuk	1,182	182	1,578	243	1,674	258
Total 3 Northern Governorates	4,938	761	6,590	1,016	6,989	1,078
Grand Total	44,433	7,247	54,614	8,921	60,075	9,796
		L.F.=70%	LV Nw Loss=17%	L.F.=70%	HV+LV Nw Loss=26%	L.F.=70%

Target (Nation wide data)→

70%

17%

26%

0.0%

Difference→

0.0%

-0.1%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration

calculated data from coefficient

calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2011 Energy Demand at Consumers' Ends (GWh)	2011 Peak Demand at Consumers' Ends (MW)	2011 Energy Demand at 132kV S/S Ends (GWh)	2011 Peak Demand at 132kV S/S Ends (MW)	2011 Energy Demand at P/S Sent-out Points (GWh)	2011 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=74.8%	LV Nw Loss=15.1%	L.F.=75%	HV+LV Nw Loss=25.2%	L.F.=75%
Baghdad Region	17,829	2,721	21,428	3,270	23,835	3,638
<i>Middle Region</i>		L.F.=71%	LV Nw Loss=15%	L.F.=71%	HV+LV Nw Loss=25%	L.F.=71%
Diyala	1,557	249	1,871	299	2,081	333
Anbar	2,124	340	2,553	408	2,840	454
Najaf	1,605	257	1,929	308	2,145	343
Kerbela	1,059	169	1,272	204	1,415	226
Qaddisiya	1,408	225	1,693	271	1,883	301
Wasit	1,676	268	2,014	322	2,241	358
Babylon	1,420	227	1,707	273	1,899	304
Total Middle Region	10,849	1,735	13,039	2,086	14,504	2,320
<i>North Region</i>		L.F.=57%	LV Nw Loss=23%	L.F.=57%	HV+LV Nw Loss=28%	L.F.=57%
Al-Tameem	1,302	261	1,720	344	1,814	363
Salah-Al-Din	1,707	342	2,255	451	2,379	476
Ninewa	3,771	754	4,981	997	5,254	1,051
Total North Region	6,780	1,357	8,956	1,792	9,447	1,890
<i>South Region</i>		L.F.=63%	LV Nw Loss=10%	L.F.=63%	HV+LV Nw Loss=18%	L.F.=63%
Basra	3,582	647	4,006	724	4,357	787
Muthanna	687	124	768	139	835	151
Thi Qar	1,441	260	1,612	291	1,753	317
Missan	1,091	197	1,221	220	1,328	240
Total South Region	6,802	1,229	7,607	1,374	8,274	1,494
Total the above regions	42,260	7,042	51,030	8,522	56,060	9,342
<i>3 Northern Governorates</i>		L.F.=73%	LV Nw Loss=23%	L.F.=73%	HV+LV Nw Loss=28%	L.F.=73%
Sulaymaniyah	1,601	251	2,115	331	2,231	349
Erbil	2,417	378	3,193	500	3,368	527
Dohuk	1,265	198	1,671	261	1,763	276
Total 3 Northern Governorates	5,283	827	6,979	1,092	7,362	1,152
Grand Total	47,543	7,868	58,009	9,614	63,422	10,494

Target (Nation wide data)→ 69% 16.5% 25%
Difference→ 0.0% 0.0% 0.0%

Annual Increase Ratios :

2004 to 2005 3%
2005 to 2007 6%
2007 to 2010 8%
2010 to 2015 7%
2015 to 2020 6%

adjusting data for calibration
calculated data from coefficient
calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2013 Energy Demand at Consumers' Ends (GWh)	2013 Peak Demand at Consumers' Ends (MW)	2013 Energy Demand at 132kV S/S Ends (GWh)	2013 Peak Demand at 132kV S/S Ends (MW)	2013 Energy Demand at P/S Sent-out Points (GWh)	2013 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=72.7%	LV Nw Loss=14.6%	L.F.=73%	HV+LV Nw Loss=24.2%	L.F.=73%
Baghdad Region	20,412	3,205	24,344	3,823	26,929	4,228
<i>Middle Region</i>		L.F.=69%	LV Nw Loss=15%	L.F.=69%	HV+LV Nw Loss=24%	L.F.=69%
Diyala	1,783	293	2,126	350	2,352	387
Anbar	2,432	400	2,901	477	3,209	528
Najaf	1,837	302	2,191	361	2,424	399
Kerbela	1,212	199	1,445	238	1,599	263
Qaddisiya	1,613	265	1,923	316	2,127	350
Wasit	1,919	316	2,288	377	2,531	417
Babylon	1,626	268	1,939	319	2,145	353
Total Middle Region	12,421	2,044	14,814	2,438	16,387	2,697
<i>North Region</i>		L.F.=55%	LV Nw Loss=22%	L.F.=55%	HV+LV Nw Loss=27%	L.F.=55%
Al-Tameem	1,491	307	1,946	401	2,045	421
Salah-Al-Din	1,955	402	2,552	525	2,682	552
Ninewa	4,317	889	5,636	1,160	5,923	1,219
Total North Region	7,762	1,598	10,134	2,086	10,650	2,192
<i>South Region</i>		L.F.=61%	LV Nw Loss=9%	L.F.=61%	HV+LV Nw Loss=17%	L.F.=61%
Basra	4,101	762	4,567	849	4,946	919
Muthanna	786	146	876	163	948	176
Thi Qar	1,650	307	1,838	342	1,990	370
Missan	1,250	232	1,391	259	1,507	280
Total South Region	7,787	1,447	8,671	1,612	9,392	1,745
Total the above regions	48,383	8,295	57,963	9,958	63,357	10,863
<i>3 Northern Governorates</i>		L.F.=71%	LV Nw Loss=22%	L.F.=71%	HV+LV Nw Loss=27%	L.F.=71%
Sulaymaniyah	1,833	295	2,393	385	2,515	405
Erbil	2,767	445	3,613	582	3,797	611
Dohuk	1,448	233	1,891	304	1,987	320
Total 3 Northern Governorates	6,049	974	7,897	1,271	8,299	1,336
Grand Total	54,432	9,269	65,860	11,230	71,657	12,199

Target (Nation wide data)→

Difference→

67%

0.0%

-0.1%

24%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration

calculated data from coefficient

calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2014 Energy Demand at Consumers' Ends (GWh)	2014 Peak Demand at Consumers' Ends (MW)	2014 Energy Demand at 132kV S/S Ends (GWh)	2014 Peak Demand at 132kV S/S Ends (MW)	2014 Energy Demand at P/S Sent-out Points (GWh)	2014 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=71.6%	LV Nw Loss=14.6%	L.F.=72%	HV+LV Nw Loss=24.2%	L.F.=72%
Baghdad Region	21,841	3,482	26,048	4,153	28,814	4,594
<i>Middle Region</i>		L.F.=68%	LV Nw Loss=15%	L.F.=68%	HV+LV Nw Loss=24%	L.F.=68%
Diyala	1,907	319	2,275	380	2,516	420
Anbar	2,602	435	3,104	519	3,433	574
Najaf	1,966	328	2,344	392	2,593	433
Kerbela	1,297	217	1,547	258	1,711	286
Qaddisiya	1,725	288	2,058	344	2,276	380
Wasit	2,053	343	2,449	409	2,709	453
Babylon	1,740	291	2,075	347	2,295	384
Total Middle Region	13,291	2,221	15,851	2,649	17,534	2,930
<i>North Region</i>		L.F.=55%	LV Nw Loss=22%	L.F.=55%	HV+LV Nw Loss=27%	L.F.=55%
Al-Tameem	1,595	333	2,082	435	2,188	457
Salah-Al-Din	2,092	437	2,731	571	2,870	600
Ninewa	4,619	966	6,030	1,261	6,337	1,325
Total North Region	8,306	1,736	10,843	2,267	11,395	2,382
<i>South Region</i>		L.F.=60%	LV Nw Loss=9%	L.F.=60%	HV+LV Nw Loss=17%	L.F.=60%
Basra	4,388	828	4,887	922	5,293	999
Muthanna	841	159	937	177	1,015	191
Thi Qar	1,766	333	1,966	371	2,130	402
Missan	1,337	252	1,489	281	1,612	304
Total South Region	8,333	1,572	9,278	1,751	10,049	1,896
Total the above regions	51,770	9,012	62,020	10,819	67,793	11,802
<i>3 Northern Governorates</i>		L.F.=70%	LV Nw Loss=22%	L.F.=70%	HV+LV Nw Loss=27%	L.F.=70%
Sulaymaniyah	1,962	321	2,561	419	2,691	440
Erbil	2,961	484	3,865	632	4,062	664
Dohuk	1,550	253	2,023	331	2,126	348
Total 3 Northern Governorates	6,472	1,058	8,450	1,381	8,880	1,452
Grand Total	58,243	10,070	70,470	12,200	76,673	13,254
		L.F.=66%	LV Nw Loss=16%	L.F.=66%	HV+LV Nw Loss=24%	L.F.=66%

Target (Nation wide data)→

Difference→

66%

0.0%

-0.1%

24%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration

calculated data from coefficient

calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2015 Energy Demand at Consumers' Ends (GWh)	2015 Peak Demand at Consumers' Ends (MW)	2015 Energy Demand at 132kV S/S Ends (GWh)	2015 Peak Demand at 132kV S/S Ends (MW)	2015 Energy Demand at P/S Sent-out Points (GWh)	2015 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=70.5%	LV Nw Loss=13.7%	L.F.=71%	HV+LV Nw Loss=23.2%	L.F.=71%
Baghdad Region	23,370	3,784	27,539	4,459	30,430	4,927
<i>Middle Region</i>		L.F.=67%	LV Nw Loss=14%	L.F.=67%	HV+LV Nw Loss=23%	L.F.=67%
Diyala	2,041	346	2,405	408	2,657	451
Anbar	2,785	473	3,281	557	3,626	615
Najaf	2,103	357	2,479	421	2,739	465
Kerbela	1,388	235	1,635	278	1,807	307
Qaddisiya	1,846	313	2,176	369	2,404	408
Wasit	2,197	373	2,589	439	2,861	485
Babylon	1,861	316	2,193	372	2,424	411
Total Middle Region	14,221	2,413	16,758	2,844	18,517	3,143
<i>North Region</i>		L.F.=54%	LV Nw Loss=21%	L.F.=54%	HV+LV Nw Loss=26%	L.F.=54%
Al-Tameem	1,707	362	2,189	465	2,306	490
Salah-Al-Din	2,238	475	2,870	609	3,024	642
Ninewa	4,943	1,049	6,338	1,346	6,678	1,418
Total North Region	8,887	1,887	11,396	2,419	12,008	2,549
<i>South Region</i>		L.F.=60%	LV Nw Loss=9%	L.F.=60%	HV+LV Nw Loss=16%	L.F.=60%
Basra	4,696	900	5,192	995	5,615	1,076
Muthanna	900	173	995	191	1,077	206
Thi Qar	1,889	362	2,089	400	2,260	433
Missan	1,431	274	1,582	303	1,711	328
Total South Region	8,916	1,709	9,858	1,889	10,662	2,043
Total the above regions	55,394	9,793	65,550	11,612	71,617	12,662
<i>3 Northern Governorates</i>		L.F.=69%	LV Nw Loss=21%	L.F.=69%	HV+LV Nw Loss=26%	L.F.=69%
Sulaymaniyah	2,099	348	2,692	447	2,836	471
Erbil	3,168	526	4,063	674	4,281	711
Dohuk	1,658	275	2,127	353	2,241	372
Total 3 Northern Governorates	6,926	1,150	8,881	1,474	9,358	1,554
Grand Total	62,320	10,943	74,431	13,086	80,975	14,216

Target (Nation wide data)→

65%

15%

23%

Difference→

0.0%

0.0%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration

calculated data from coefficient

calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2016 Energy Demand at Consumers' Ends (GWh)	2016 Peak Demand at Consumers' Ends (MW)	2016 Energy Demand at 132kV S/S Ends (GWh)	2016 Peak Demand at 132kV S/S Ends (MW)	2016 Energy Demand at P/S Sent-out Points (GWh)	2016 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=71.6%	LV Nw Loss=13.3%	L.F.=72%	HV+LV Nw Loss=22.2%	L.F.=72%
Baghdad Region	24,772	3,950	29,007	4,625	31,841	5,077
<i>Middle Region</i>		L.F.=68%	LV Nw Loss=13%	L.F.=68%	HV+LV Nw Loss=22%	L.F.=68%
Diyala	2,163	361	2,533	423	2,781	465
Anbar	2,952	493	3,456	578	3,794	634
Najaf	2,230	373	2,611	436	2,866	479
Karbela	1,471	246	1,722	288	1,891	316
Qaddisiya	1,957	327	2,292	383	2,515	420
Wasit	2,329	389	2,727	456	2,993	500
Babylon	1,973	330	2,310	386	2,536	424
Total Middle Region	15,074	2,519	17,651	2,950	19,376	3,238
<i>North Region</i>		L.F.=55%	LV Nw Loss=20%	L.F.=55%	HV+LV Nw Loss=25%	L.F.=55%
Al-Tameem	1,809	378	2,298	480	2,408	503
Salah-Al-Din	2,372	496	3,013	630	3,158	660
Ninewa	5,239	1,095	6,654	1,391	6,974	1,458
Total North Region	9,421	1,969	11,964	2,501	12,539	2,621
<i>South Region</i>		L.F.=60%	LV Nw Loss=9%	L.F.=60%	HV+LV Nw Loss=16%	L.F.=60%
Basra	4,977	939	5,483	1,035	5,902	1,114
Muthanna	954	180	1,051	198	1,132	214
Thi Qar	2,003	378	2,206	416	2,375	448
Missan	1,516	286	1,671	315	1,798	339
Total South Region	9,451	1,783	10,412	1,965	11,207	2,115
Total the above regions	58,718	10,221	69,034	12,040	74,963	13,050
<i>3 Northern Governorates</i>		L.F.=70%	LV Nw Loss=20%	L.F.=70%	HV+LV Nw Loss=25%	L.F.=70%
Sulaymaniyah	2,225	364	2,826	462	2,962	484
Erbil	3,358	549	4,265	697	4,470	731
Dohuk	1,758	287	2,232	365	2,340	382
Total 3 Northern Governorates	7,341	1,200	9,323	1,524	9,771	1,597
Grand Total	66,059	11,421	78,357	13,564	84,734	14,647
		L.F.=66%	LV Nw Loss=14.5%	L.F.=66%	HV+LV Nw Loss=22%	L.F.=66%

Target (Nation wide data)→ 66% 14.5% 22%
 Difference→ 0.0% 0.0% 0.0%

Annual Increase Ratios :
 2004 to 2005 3%
 2005 to 2007 6%
 2007 to 2010 8%
 2010 to 2015 7%
 2015 to 2020 6%

adjusting data for calibration
calculated data from coefficient
calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2017		2017		2017		2017	
	Energy Demand at Consumers' Ends (GWh)	Peak Demand at Consumers' Ends (MW)	Energy Demand at 132kV S/S Ends (GWh)	Peak Demand at 132kV S/S Ends (MW)	Energy Demand at P/S Sent-out Points (GWh)	Peak Demand at P/S Sent-out Points (MW)	Energy Demand at P/S Sent-out Points (GWh)	Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=72.7%	LV Nw Loss=13.3%	L.F.=73%	HV+LV Nw Loss=22.2%	L.F.=73%		
Baghdad Region	26,258	4,123	30,747	4,828	33,751	5,300		
<i>Middle Region</i>		L.F.=69%	LV Nw Loss=13%	L.F.=69%	HV+LV Nw Loss=22%	L.F.=69%		
Diyala	2,293	377	2,685	442	2,947	485		
Anbar	3,129	515	3,664	603	4,022	662		
Najaf	2,363	389	2,767	455	3,038	500		
Kerbela	1,559	257	1,826	300	2,004	330		
Qaddisiya	2,074	341	2,429	400	2,666	439		
Wasit	2,468	406	2,890	476	3,173	522		
Babylon	2,092	344	2,449	403	2,688	442		
Total Middle Region	15,979	2,630	18,710	3,079	20,538	3,380		
<i>North Region</i>		L.F.=55%	LV Nw Loss=20%	L.F.=55%	HV+LV Nw Loss=25%	L.F.=55%		
Al-Tameem	1,918	395	2,435	501	2,552	525		
Salah-Al-Din	2,515	518	3,194	657	3,347	689		
Ninewa	5,553	1,143	7,053	1,452	7,392	1,522		
Total North Region	9,986	2,056	12,682	2,611	13,292	2,736		
<i>South Region</i>		L.F.=61%	LV Nw Loss=9%	L.F.=61%	HV+LV Nw Loss=16%	L.F.=61%		
Basra	5,276	981	5,812	1,080	6,256	1,163		
Muthanna	1,012	188	1,114	207	1,199	223		
Thi Qar	2,123	395	2,339	435	2,518	468		
Missan	1,607	299	1,771	329	1,906	354		
Total South Region	10,018	1,862	11,036	2,051	11,880	2,208		
Total the above regions	62,241	10,670	73,176	12,569	79,460	13,624		
<i>3 Northern Governorates</i>		L.F.=71%	LV Nw Loss=20%	L.F.=71%	HV+LV Nw Loss=25%	L.F.=71%		
Sulaymaniyah	2,358	380	2,995	482	3,139	505		
Erbil	3,560	573	4,521	728	4,738	763		
Dohuk	1,863	300	2,366	381	2,480	399		
Total 3 Northern Governorates	7,782	1,253	9,882	1,591	10,358	1,667		
Grand Total	70,022	11,923	83,058	14,160	89,818	15,291		
		L.F.=67%	LV Nw Loss=14.5%	L.F.=67%	HV+LV Nw Loss=22%	L.F.=67%		

Target (Nation wide data)→

Difference→

67%

14.5%

22%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration

calculated data from coefficient

calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2018		2018		2018	
	Energy Demand at Consumers' Ends (GWh)	Peak Demand at Consumers' Ends (MW)	Energy Demand at 132kV S/S Ends (GWh)	Peak Demand at 132kV S/S Ends (MW)	Energy Demand at P/S Sent-out Points (GWh)	Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=73.7%	LV Nw Loss=12.8%	L.F.=74%	HV+LV Nw Loss=21.2%	L.F.=74%
Baghdad Region	27,834	4,311	32,355	5,012	35,322	5,471
<i>Middle Region</i>		L.F.=70%	LV Nw Loss=13%	L.F.=70%	HV+LV Nw Loss=21%	L.F.=70%
Diyala	2,431	395	2,825	459	3,085	501
Anbar	3,317	538	3,855	626	4,209	683
Najaf	2,505	407	2,912	473	3,179	516
Kerbela	1,653	268	1,921	312	2,097	340
Qaddisiya	2,199	357	2,556	415	2,790	453
Wasit	2,617	425	3,042	494	3,320	539
Babylon	2,217	360	2,577	418	2,813	457
Total Middle Region	16,937	2,750	19,689	3,196	21,494	3,489
<i>North Region</i>		L.F.=56%	LV Nw Loss=20%	L.F.=56%	HV+LV Nw Loss=24%	L.F.=56%
Al-Tameem	2,033	413	2,553	518	2,666	541
Salah-Al-Din	2,666	541	3,348	680	3,496	710
Ninewa	5,887	1,195	7,394	1,501	7,720	1,568
Total North Region	10,585	2,150	13,295	2,700	13,882	2,819
<i>South Region</i>		L.F.=62%	LV Nw Loss=8%	L.F.=62%	HV+LV Nw Loss=15%	L.F.=62%
Basra	5,593	1,025	6,135	1,125	6,577	1,206
Muthanna	1,072	197	1,176	216	1,261	231
Thi Qar	2,250	413	2,469	453	2,646	485
Missan	1,704	312	1,869	343	2,004	367
Total South Region	10,619	1,947	11,649	2,136	12,488	2,289
Total the above regions	65,975	11,157	76,988	13,043	83,186	14,069
<i>3 Northern Governorates</i>		L.F.=72%	LV Nw Loss=20%	L.F.=72%	HV+LV Nw Loss=24%	L.F.=72%
Sulaymaniyah	2,500	397	3,140	499	3,279	521
Erbil	3,773	599	4,739	753	4,949	786
Dohuk	1,975	314	2,481	394	2,590	411
Total 3 Northern Governorates	8,248	1,310	10,360	1,645	10,818	1,718
Grand Total	74,224	12,467	87,348	14,689	94,004	15,787
		L.F.=68%	LV Nw Loss=14%	L.F.=68%	HV+LV Nw Loss=21%	L.F.=68%

Target (Nation wide data) → 68% 14% 21%
 Difference → 0.0% 0.0% 0.0%

Annual Increase Ratios :
 2004 to 2005 3%
 2005 to 2007 6%
 2007 to 2010 8%
 2010 to 2015 7%
 2015 to 2020 6%

adjusting data for calibration
 calculated data from coefficient
 calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2019 Energy Demand at Consumers' Ends (GWh)	2019 Peak Demand at Consumers' Ends (MW)	2019 Energy Demand at 132kV S/S Ends (GWh)	2019 Peak Demand at 132kV S/S Ends (MW)	2019 Energy Demand at P/S Sent-out Points (GWh)	2019 Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=74.8%	LV Nw Loss=12.8%	L.F.=75%	HV+LV Nw Loss=21.2%	L.F.=75%
Baghdad Region	29,504	4,503	34,296	5,234	37,442	5,714
<i>Middle Region</i>		L.F.=71%	LV Nw Loss=13%	L.F.=71%	HV+LV Nw Loss=21%	L.F.=71%
Diyala	2,577	412	2,995	479	3,270	523
Anbar	3,516	562	4,087	654	4,461	714
Najaf	2,655	425	3,087	494	3,370	539
Kerbela	1,752	280	2,036	326	2,223	356
Qaddisiya	2,331	373	2,709	433	2,958	473
Wasit	2,774	444	3,224	516	3,520	563
Babylon	2,350	376	2,732	437	2,982	477
Total Middle Region	17,954	2,872	20,870	3,338	22,784	3,644
<i>North Region</i>		L.F.=57%	LV Nw Loss=20%	L.F.=57%	HV+LV Nw Loss=24%	L.F.=57%
Al-Tameem	2,155	431	2,706	542	2,826	565
Salah-Al-Din	2,625	565	3,549	710	3,706	741
Ninewa	6,240	1,249	7,837	1,568	8,184	1,637
Total North Region	11,220	2,245	14,093	2,820	14,715	2,944
<i>South Region</i>		L.F.=63%	LV Nw Loss=8%	L.F.=63%	HV+LV Nw Loss=15%	L.F.=63%
Basra	5,928	1,071	6,503	1,175	6,971	1,259
Muthanna	1,137	205	1,247	225	1,337	241
Thi Qar	2,385	431	2,617	473	2,805	507
Missan	1,806	326	1,981	358	2,124	384
Total South Region	11,256	2,033	12,348	2,231	13,237	2,391
Total the above regions	69,934	11,653	81,607	13,623	88,177	14,694
<i>3 Northern Governorates</i>		L.F.=73%	LV Nw Loss=20%	L.F.=73%	HV+LV Nw Loss=24%	L.F.=73%
Sulaymaniyah	2,650	415	3,328	521	3,475	544
Erbil	4,000	626	5,024	786	5,246	821
Dohuk	2,094	328	2,630	411	2,746	430
Total 3 Northern Governorates	8,743	1,368	10,982	1,718	11,467	1,794
Grand Total	78,677	13,021	92,589	15,341	99,644	16,488
		L.F.=69%	LV Nw Loss=14%	L.F.=69%	HV+LV Nw Loss=21%	L.F.=69%

Target (Nation wide data)→

69%

14%

21%

Difference→

0.0%

0.0%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration
calculated data from coefficient
calculated data

Appendix B.12 Result of Demand Forecast

Governorate & Region	2020		2020		2020		2020	
	Energy Demand at Consumers' Ends (GWh)	Peak Demand at Consumers' Ends (MW)	Energy Demand at 132kV S/S Ends (GWh)	Peak Demand at 132kV S/S Ends (MW)	Energy Demand at P/S Sent-out Points (GWh)	Peak Demand at P/S Sent-out Points (MW)	Energy Demand at P/S Sent-out Points (GWh)	Peak Demand at P/S Sent-out Points (MW)
<i>Baghdad Region</i>		L.F.=75.9%	LV Nw Loss=11.9%	L.F.=76%	HV+LV Nw Loss=20.2%	L.F.=76%		
Baghdad Region	31,274	4,704	35,938	5,405	39,191	5,894		
<i>Middle Region</i>		L.F.=72%	LV Nw Loss=12%	L.F.=72%	HV+LV Nw Loss=20%	L.F.=72%		
Diyala	2,731	431	3,138	495	3,422	539		
Anbar	3,726	587	4,282	675	4,670	736		
Najaf	2,815	444	3,235	510	3,527	556		
Karbela	1,857	293	2,134	336	2,327	367		
Qaddisiya	2,471	389	2,839	448	3,096	488		
Wasit	2,940	463	3,378	533	3,684	581		
Babylon	2,491	393	2,862	451	3,122	492		
Total Middle Region	19,031	3,000	21,869	3,447	23,848	3,759		
<i>North Region</i>		L.F.=58%	LV Nw Loss=18%	L.F.=58%	HV+LV Nw Loss=23%	L.F.=58%		
Al-Tameem	2,284	450	2,820	556	2,952	582		
Salah-Al-Din	2,995	591	3,698	729	3,871	763		
Ninewa	6,614	1,304	8,166	1,610	8,549	1,686		
Total North Region	11,893	2,345	14,683	2,895	15,372	3,031		
<i>South Region</i>		L.F.=64%	LV Nw Loss=8%	L.F.=64%	HV+LV Nw Loss=14%	L.F.=64%		
Basra	6,284	1,119	6,846	1,219	7,329	1,305		
Muthanna	1,205	214	1,313	234	1,405	250		
Thi Qar	2,529	450	2,755	490	2,949	525		
Missan	1,914	341	2,086	371	2,233	397		
Total South Region	11,931	2,124	12,999	2,314	13,916	2,477		
Total the above regions	74,130	12,173	85,489	14,062	92,327	15,162		
<i>3 Northern Governorates</i>		L.F.=74%	LV Nw Loss=18%	L.F.=74%	HV+LV Nw Loss=23%	L.F.=74%		
Sulaymaniyah	2,809	433	3,468	535	3,631	560		
Erbil	4,240	654	5,234	807	5,480	845		
Dohuk	2,219	342	2,740	422	2,868	442		
Total 3 Northern Governorates	9,268	1,429	11,442	1,764	11,979	1,847		
Grand Total	83,398	13,602	96,931	15,826	104,305	17,009		
		L.F.=70%	LV Nw Loss=13%	L.F.=70%	HV+LV Nw Loss=20%	L.F.=70%		

Target (Nation wide data)→

Difference→

0.0%

0.0%

0.0%

Annual Increase Ratios :

2004 to 2005 3%

2005 to 2007 6%

2007 to 2010 8%

2010 to 2015 7%

2015 to 2020 6%

adjusting data for calibration
calculated data from coefficient
calculated data

Appendix C : Generation Expansion Plan

Appendix C.1 Existing Main Power Stations in Iraq

	No.	Plant Name	Generation Type	Status	Unit Type	Loading	Fuel Class	Annual Energy GWh	No of units	Installation Year	Operating Life	Rated Capacity	Available Capacity	No.of Maintenance	Forced Outage Rate	Heat Rate	Capacity	Variable O&M Cost	Retirement Year	Reired Capacity
												MW	MW	Weeks/Year	btu/kWh	Factor %	US\$/MWh	Year	MW	
Steam Turbine Plants	1	Baji	TPS	E	Steam	B	FO	3942.00	5	1988	30	1320	450	6	0.124	10300	0.34	0.8	2018	1320
	2	Baghdad South	TPS	E	Steam	B	FO	1533.00	6	1965, 1983	30	355	175	6	0.124	10300	0.49	0.8	2013	355
	3	Dibis	TPS	E	Steam	B	GAS	280.32	4	1959	50	60	32	4	0.124	10300	0.53	0.8	2009	60
	4	Doura	TPS	E	Steam	B	FO	3626.64	4	1981	35	640	414	6	0.124	10300	0.65	0.8	2016	640
	5	Hartha	TPS	E	Steam	B	GAS	1379.70	1	1979	35	400	157.5	4	0.124	10300	0.39	0.8	2014	400
	6	Hartha	TPS	E	Steam	B	CO	1379.70	1	1979	35	400	157.5	7	0.124	10300	0.39	0.8	2014	400
	7	Musayab	TPS	E	Steam	B	FO	3390.12	2	1996	24	600	387	4	0.124	10300	0.65	0.8	2020	600
	8	Musayab	TPS	E	Steam	B	CO	3390.12	2	1996	24	600	387	7	0.124	10300	0.65	0.8	2020	600
	9	Najibiyah	TPS	E	Steam	B	GAS	630.72	1	1979	30	100	72	4	0.124	10300	0.72	0.8	2009	100
	10	Najibiyah	TPS	E	Steam	B	CO	630.72	1	1979	30	100	72	7	0.124	10300	0.72	0.8	2009	100
	11	Nasiriyah	TPS	E	Steam	B	CO	4730.40	4	1975	42	840	540	7	0.124	10300	0.64	0.8	2017	840
Gas Plants	12	Baji	GPS	E	Gas	B	GAS	919.80	1	1990	35	159	105	4	0.082	13127	0.66	2.5		
	13	Baji	GPS	E	Gas	B	CO	919.80	1	1990	35	159	105	7	0.082	13127	0.66	2.5		
	14	Dibis	GPS	E	Gas	B	GAS	516.84	3	1983	35	84	59	4	0.082	13127	0.70	2.5	2018	84
	15	Dibis (Mobile)	GPS	E	Gas	B	GAS	289.08	5	1982	35	50	33	4	0.082	13127	0.66	2.5	2017	50
	16	Doura	GPS	E	Gas	B	GAS	350.40	4	1983, 1989	35	100	40	4	0.082	13127	0.40	2.5		
	17	Hilla (or Hella)	GPS	E	Gas	B	GAS	560.64	4	1973	35	80	64	4	0.082	13127	0.80	2.5	2008	80
	18	Khor Alzubeir	GPS	E	Gas	B	GAS	1576.80	4	1990	30	252	180	4	0.082	13127	0.71	2.5		
	19	Mosul (Mansor)	GPS	E	Gas	B	GAS	1314.00	12	1976, 1982	30	240	150	4	0.082	13127	0.63	2.5	2012	240
	20	Mullah Abdullah (Old)	GPS	E	Gas	B	GAS	1314.00	12	1982	30	240	150	4	0.082	13127	0.63	2.5	2012	240
	21	Mullah Abdullah (New)	GPS	E	Gas	B	GAS	1314.00	6	1988	30	222	150	4	0.082	13127	0.68	2.5	2018	222
	22	Najaf	GPS	E	Gas	B	GAS	963.60	3	1976	35	189	110	4	0.082	13127	0.58	2.5	2011	189
	23	Al Quds	GPS	E	Gas	B	GAS	700.80	1	2003	30	123	80	4	0.082	13127	0.65	2.5		
	24	Al Quds	GPS	E	Gas	B	CO	700.80	1	2003	30	123	80	4	0.082	13127	0.65	2.5		
	25	Shua'yba	GPS	E	Gas	P	GAS	175.20	2	1973	35	40	20	4	0.082	13127	0.50	2.5	2008	40
26	Taji	GPS	E	Gas	B	GAS	700.80	7	1980	30	140	80	4	0.082	13127	0.57	2.5	2010	140	
27	Taji Mobile	GPS	E	Gas	P	GAS	157.68	2	1980	30	60	17	4	0.082	13127	0.30	2.5	2010	60	
Diesel Power Plants	28	Erbil	DPS	E	Diesel	B	MSD	177.83	4	2003	20	29	26	7	0.140	10800	0.70	2.8		
	29	Dahuk	DPS	E	Diesel	B	MSD	177.83	4	2003	20	29	26	7	0.140	10800	0.70	2.8		
	30	Mobile Generators Sets	DPS	E	Diesel	B	MSD	367.92	1	2004	20	60	0	7	0.140	10800	0.70	2.8		
	31	SDMO	DPS	E	Diesel	B	MSD	1655.64	27	1991	20	270	192	7	0.140	10800	0.70	2.8	2011	270
	32	Sulaymaniah	DPS	E	Diesel	B	MSD	177.83	4	2003	20	29	26	7	0.140	10800	0.70	2.8		
	33	Zaferina	DPS	E	Diesel	B	MSD	306.60	7	2004	20	39	35	7	0.140	10800	0.90	2.8		
Hydropower Plants	34	Derban Dikhan	HPS	E	Hydro	P		872.50	3	1992	50	249	165	1	0.008	0	0.40	0		
	35	Dokan	HPS	E	Hydro	P		1436.64	5	1983	50	410	168	1	0.008	0	0.40	0		
	36	Haditha Dam	HPS	E	Hydro	P		1734.48	5	1986	50	660	160	1	0.008	0	0.30	0		
	37	Himreen	HPS	E	Hydro	P		175.20	2	1981	50	50	21	1	0.008	0	0.40	0		
	38	Mosul-Main	HPS	E	Hydro	P		2628.00	4	1986	50	750	600	1	0.008	0	0.40	0		
	39	Mosul-Regulation	HPS	E	Hydro	P		210.24	4	1985	50	60	60	1	0.008	0	0.40	0		
	40	Mosul-Pumped Storage	HPS	E	Hydro	P		840.96	2	1989	50	240	120	1	0.008	0	0.40	0		
	41	Sad'at Al Hind'iya	HPS	E	Hydro	P		43.80	4	1989	50	15	5	1	0.008	0	0.33	0		
	42	Samara	HPS	E	Hydro	P		294.34	3	1972	50	84	55	1	0.008	0	0.40	0		

* Status: E=Existing, C=Committed, G=Generic (Candidate)

48487.48

10650

5926

7030

*Loading: P=Peaking, I=Intermediate, B=Base Load

* MSD=Medium Speed Diesel, FO=Fuel Oil

* GAS= Natural Gas

Appendix C.2 Committed Power Stations in Iraq

	No.	Plant Name	Generation	Status	Unit Type	Loading	Fuel	Annual	No of	Installation	Operating	Rated	Available	No.of	Forced	Heat Rate	Capacity	Variable	First Year
			Type				Class	Energy GWh	units	Year	Life	Capacity MW	Capacity MW	Weeks/Year	Outage Rate	btu/kWh	Factor %	O&M Cost US\$/MWh	available for Installation
Gas Turbine Plants	1	Buzurgan	GPS	C	Gas	B	GAS	280.32	1	2005	20	43	32	4	0.082	13127	0.74	2.5	2005
	2	Baghdad South	GPS	C	Gas	B	GAS	1515.48	2	2005	20	240	173	4	0.082	13127	0.72	2.5	2005
	3	Baji	GPS	C	Gas	B	FO	2207.52	4	2005	20	318	252	6	0.082	13127	0.79	2.5	2005
	4	Baji Mobile	GPS	C	Gas	B	GAS	1261.44	8	2005	20	184	144	4	0.082	13127	0.78	2.5	2005
	5	Hartha	GPS	C	Gas	B	GAS	1497.96	2	2005	20	246	171	4	0.082	13127	0.70	2.5	2005
	6	Kirkuk (New)	GPS	C	Gas	B	GAS	2076.12	2	2005	20	325	237	4	0.082	13127	0.73	2.5	2005
	7	Al Quds	GPS	C	Gas	B	GAS	2557.92	8	2005	20	422	292	4	0.082	13127	0.69	2.5	2005
	8	Musayab (New)	GPS	C	Gas	B	MSD	2759.40	10	2005	20	500	315	7	0.082	13127	0.63	2.5	2005
	9	Nasiriyah (New)	GPS	C	Gas	B	MSD	254.04	1	2005	20	40	29	7	0.082	13127	0.73	2.5	2005
Diesel	10	Baghdad W.G.	DPS	C	Diesel	B	MSD	508.08	39	2005	20	100	58	7	0.140	10800	0.58	2.8	2005
	11	Northern Industries	DPS	C	Diesel	B	MSD	499.32	39	2005	20	78	57	7	0.140	10800	0.73	2.8	2005
								15417.6	116			2496	1760						

* Status: E=Existing, C=Committed, G=Generic (Candidate)

* Loading: P=Peaking, I=Intermediate, B=Base Load

* MSD=Medium Speed Diesel, FO=Fuel Oil

* GAS= Natural Gas

Appendix C.3 Candidate Power Stations in Iraq

Option Case (1)

	No.	Plant Name	Generation	Status	Unit Type	Loading	Fuel	Annual	No of	Operating	Rated	No.of	Forced	Heat Rate	Capacity	Installation	Levelized	Fixed O&M	Variable	First Year
			Type				Class	Energy GWh			units						Life	Capacity	Maintenance	
																	Charge %	US\$/kW/Y	US\$/MWh	Installation
Steam	1	Salah Al Din	TPS	G	Steam	B	FO	7726.32	6	20	1260	6	0.124	10300	0.70	1100	10.6	28.0	0.8	2006
	2	Al Wassit	TPS	G	Steam	B	FO	5665.97	6	20	924	6	0.124	10300	0.70	1100	10.6	28.0	0.8	2011
	3	Yousifiyah	TPS	G	Steam	B	FO	6438.60	5	20	1050	6	0.124	10300	0.70	1100	10.6	28.0	0.8	2014
Gas T. Plants	4	Hartha (New)	GPS	G	Gas	B	GAS	2452.80	2	20	400	4	0.082	13127	0.70	700	11.8	14.0	2.5	2007
	5	Al Anbar	GPS	G	Gas	B	GAS	3728.26	4	20	608	4	0.082	13127	0.70	700	11.8	14.0	2.5	2009
	6	Al Samawah	GPS	G	Gas	B	GAS	6438.60	5	20	1050	4	0.082	13127	0.70	700	11.8	14.0	2.5	2008
	7	Al Shamal	GPS	G	Gas	B	GAS	7456.51	8	20	1216	4	0.082	13127	0.70	700	11.8	14.0	2.5	2010
	8	Al Basrah	GPS	G	Gas	B	GAS	11184.77	12	20	1824	4	0.082	13127	0.70	700	11.8	14.0	2.5	2012
	9	Kirkuk	GPS	G	Gas	B	GAS	22369.54	24	20	3648	4	0.082	13127	0.70	700	11.8	14.0	2.5	2013 & 2018

Option Case (2)

	No.	Plant Name	Generation	Status	Unit Type	Loading	Fuel	Annual	No of	Operating	Rated	No.of	Forced	Heat Rate	Capacity	Installation	Levelized	Fixed O&M	Variable	First Year
			Type				Class	Energy GWh			units						Life	Capacity	Maintenance	
																	Charge %	US\$/kW/Y	US\$/MWh	Installation
Steam	1	Salah Al Din	TPS	G	Steam	B	FO	7358.40	8	20	1200	6	0.124	10300	0.70	1100	10.6	22.0	0.8	2006
	3	Al Wassit	TPS	G	Steam	B	FO	1839.60	2	20	300	6	0.124	10300	0.70	1100	10.6	22.0	0.8	2011
	4	Yousifiyah	TPS	G	Steam	B	FO	3679.20	2	20	600	6	0.124	10300	0.70	1100	10.6	22.0	0.8	2019
Gas T. Plants	5	Al Anbar	GPS	G	Gas (S/C)	B	GAS	7358.40	4	20	1200	4	0.082	13127	0.70	700	11.8	14.0	2.5	2009
	2	Al Samawah	GPS	G	Gas (S/C)	B	GAS	5518.80	3	20	900	4	0.082	13127	0.70	700	11.8	14.0	2.5	2008
	6	Al Shamal	GPS	G	Gas (S/C)	B	GAS	7358.40	8	20	1200	4	0.082	13127	0.70	700	11.8	14.0	2.5	2010
	7	Al Basrah	GPS	G	Gas (S/C)	B	GAS	20235.60	11	20	3300	4	0.082	13127	0.70	700	11.8	14.0	2.5	2012
	8	Kirkuk	GPS	G	Gas (S/C)	B	GAS	18396.00	10	20	3000	4	0.082	13127	0.70	700	11.8	14.0	2.5	2013
Hydro	9	Bakhma	HPS	G	Hydro	P		1401.60	2	50	400	1	0.008	0	0.40	1500	10.1	15.0	0.0	2012
	10	Al Mokuhol	HPS	G	Hydro	P		1047.70	4	50	260	1	0.008	0	0.46	1500	10.1	15.0	0.0	2017

Option Case (3)

	No.	Plant Name	Generation	Status	Unit Type	Loading	Fuel	Annual	No of	Operating	Rated	No.of	Forced	Heat Rate	Capacity	Installation	Levelized	Fixed O&M	Variable	First Year
			Type				Class	Energy GWh			units						Life	Capacity	Maintenance	
																	Charge %	US\$/kW/Y	US\$/MWh	Installation
Steam	1	Salah Al Din	TPS	G	Steam	B	FO	7358.40	8	20	1200	6	0.124	10300	0.70	1100	10.6	22.0	0.8	2006
	3	Al Wassit	TPS	G	Steam	B	FO	1839.60	2	20	300	6	0.124	10300	0.70	1100	10.6	22.0	0.8	2011
	4	Yousifiyah	TPS	G	Steam	B	FO	3679.20	2	20	600	6	0.124	10300	0.70	1100	10.6	22.0	0.8	2019
C/C Gas Plants	5	Al Anbar	GPS	G	Gas (C/C)	B	GAS	7358.40	4	20	1200	4	0.082	9200	0.70	1100	11	22.0	2.0	2009
	2	Al Samawah	GPS	G	Gas (C/C)	B	GAS	5518.80	3	20	900	4	0.082	9200	0.70	1100	11	22.0	2.0	2008
	6	Al Shamal	GPS	G	Gas (C/C)	B	GAS	7358.40	8	20	1200	4	0.082	9200	0.70	1100	11	22.0	2.0	2010
	7	Al Basrah	GPS	G	Gas (C/C)	B	GAS	20235.60	11	20	3300	4	0.082	9200	0.70	1100	11	22.0	2.0	2012
	8	Kirkuk	GPS	G	Gas (C/C)	B	GAS	18396.00	10	20	3000	4	0.082	9200	0.70	1100	11	22.0	2.0	2013
Hydro	9	Bakhma	HPS	G	Hydro	P		1401.60	2	50	400	1	0.008	0	0.40	1500	10.1	15.0	0.0	2012
	10	Al Mokuhol	HPS	G	Hydro	P		1047.70	4	50	260	1	0.008	0	0.46	1500	10.1	15.0	0.0	2017

* Status: E=Existing, C=Committed, G=Generic (Candidate)

* Loading: P=Peaking, I=Intermediate, B=Base Load

* MSD=Medium Speed Diesel, FO=Fuel Oil

* GAS= Natural Gas

Appendix C.4 Recommended Generation Expansion Plans

Plan (1): Conventional Thermal Candidates Only

Calendar Year	Peak Power Demand MW	Installed Capacity MW	Total Capacity MW	Retired Capacity MW	Net Capacity MW	Reserve Margin %	Added Plant	Added Units	Plant Type
2004	7363.0	5926	5926	0	5926				
2005	7472.0	1974	7900	0	7900	5.73			
2006	8019.0	630	8530	0	8530	6.37	Salah Al Din	3x210	Steam
2007	8264.0	630	9160	0	9160	10.84	Salah Al Din	3x210	Steam
2008	9057.0	1050	10210	120	10090	11.41	Al Samawah	5x210	Gas
2009	9782.0	912	11122	260	10862	11.04	Al Anbar Al Shamal	4x152 2x152	Gas Gas
2010	10422.0	912	12034	200	11834	13.55	Al Shamal	6x152	Gas
2011	11164.0	924	12958	459	12499	11.96	Al Wassit	6x154	Steam
2012	12124.0	400	13358	490	12868	6.14	Hartha	2x200	Gas
2013	12978.0	912	14270	355	13915	7.22	Al Basrah	6x152	Gas
2014	14100.0	912	15182	800	14382	2.00	Al Basrah	6x152	Gas
2015	15123.0	912	16094	0	16094	6.42	Kirkuk	6x152	Gas
2016	15582.0	912	17006	640	16366	5.03	Kirkuk	6x152	Gas
2017	16267.0	912	17918	890	17028	4.68	Kirkuk	6x152	Gas
2018	16795.0	912	18830	1655	17175	2.26	Kirkuk	6x152	Gas
2019	17540.0	630	19460	0	19460	10.95	Yousifiyah	3x210	Steam
2020	18095.0	420	19880	1200	18680	3.23	Yousifiyah	2x210	Steam
		19880		7069		7.43			

Appendix C.4 Recommended Generation Expansion Plans (Cont.)

Plan (2): Thermal and Hydropower Stations Candidates

Calendar Year	Peak Power Demand MW	Installed Capacity MW	Total Capacity MW	Retired Capacity MW	Net Capacity MW	Reserve%	Added Plant	Added Units	Plant Type
2004	7363.0	5926	5926	0	5926				
2005	7472.0	1974	7900	0	7900	5.73			
2006	8019.0	600	8500	0	8500	6.00	Salah Al Din	4x150	Steam
2007	8264.0	600	9100	0	9100	10.12	Salah Al Din	4x150	Steam
2008	9057.0	900	10000	120	9880	9.09	Al Samawah	3x300	Gas
2009	9782.0	900	10900	260	10640	8.77	Al Anbar	3x300	Gas
2010	10422.0	900	11800	200	11600	11.30	Al Anbar	1x300	Gas
							Al Shamal	4x150	Gas
2011	11164.0	900	12700	459	12241	9.65	Al Shamal	4x150	Gas
							Al Wassit	2x150	Steam
2012	12124.0	1060	13760	490	13270	9.45	Bakhma	1x160	Hydro
							Al Basrah	3x300	Gas
2013	12978.0	900	14660	355	14305	10.22	Kirkuk	2x300	Gas
							Al Basrah	1x300	Gas
2014	14100.0	1200	15860	800	15060	6.81	Kirkuk	2x300	Gas
							Al Basrah	2x300	Gas
2015	15123.0	1200	17060	0	17060	12.81	Kirkuk	2x300	Gas
							Al Basrah	2x300	Gas
2016	15582.0	900	17960	640	17320	11.15	Kirkuk	2x300	Gas
							Al Basrah	1x300	Gas
2017	16267.0	720	18680	890	17790	9.36	Al Basrah	2x300	Gas
							Al Mokuhhol	1x120	Hydro
2018	16795.0	600	19280	1655	17625	4.94	Kirkuk	2x300	Gas
2019	17540.0	0	19280	0	19280	9.92			
2020	18095.0	600	19880	1200	18680	3.23	Yousifiyah	2x300	Steam
		19880		7069		8.66			

Appendix C.4 Recommended Generation Expansion Plans (Cont.)

Plan (3): Thermal, High Efficient Combined Cycle and Hydropower Stations Candidates

Calendar Year	Peak Power Demand MW	Installed Capacity MW	Total Capacity MW	Retired Capacity MW	Net Capacity MW	Reserve%	Added Plant	Added Units	Plant Type
2004	7363.0	5926	5926	0	5926				
2005	7472.0	1974	7900	0	7900	5.73			
2006	8019.0	600	8500	0	8500	6.00	Salah Al Din	4x150	Steam
2007	8264.0	600	9100	0	9100	10.12	Salah Al Din	4x150	Steam
2008	9057.0	900	10000	120	9880	9.09	Al Samawah	3x300	C/C
2009	9782.0	900	10900	260	10640	8.77	Al Anbar	3x300	C/C
2010	10422.0	900	11800	200	11600	11.30	Al Anbar	1x300	C/C
							Al Shamal	2x300	C/C
2011	11164.0	900	12700	459	12241	9.65	Al Shamal	2x300	C/C
							Al Wassit	2x150	Steam
2012	12124.0	1060	13760	490	13270	9.45	Bakhma	1x160	Hydro
							Al Basrah	3x300	C/C
2013	12978.0	900	14660	355	14305	10.22	Kirkuk	2x300	C/C
							Al Basrah	1x300	C/C
2014	14100.0	1200	15860	800	15060	6.81	Kirkuk	2x300	C/C
							Al Basrah	2x300	C/C
2015	15123.0	1200	17060	0	17060	12.81	Kirkuk	2x300	C/C
							Al Basrah	2x300	C/C
2016	15582.0	900	17960	640	17320	11.15	Kirkuk	2x300	C/C
							Al Basrah	1x300	C/C
2017	16267.0	720	18680	890	17790	9.36	Al Basrah	2x300	C/C
							Al Mokuhol	1x120	Hydro
2018	16795.0	600	19280	1655	17625	4.94	Kirkuk	2x300	C/C
2019	17540.0	0	19280	0	19280	9.92			
2020	18095.0	600	19880	1200	18680	3.23	Yousifiyah	2x300	Steam
		19880		7069		8.66			

Appendix C.5 Annual Fuel Usage & Cost

Option Case 1

Year	GAS						Diesel					
	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/MSCF)	Fuel Used (MSCF)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/ton)	Fuel Used (ton)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)
2006	12,098	13035	1.00	157,697,430	440	36.35	581	10800	42.86	146,402	26	45.14
2007	13,256	13043	1.00	172,898,008	486	36.63	764	10800	42.86	192,515	35	45.59
2008	15,043	13127	1.00	197,469,461	558	37.12	640	10800	42.86	161,269	29	46.04
2009	20,527	13127	1.00	269,457,929	767	37.38	497	10800	42.86	125,236	23	46.50
2010	24,083	13127	1.00	316,137,541	907	37.64	578	10800	42.86	145,646	27	46.97
2011	21,576	13127	1.00	283,228,152	818	37.91	441	10800	42.86	111,125	21	47.44
2012	24,482	13127	1.00	321,375,214	935	38.17	731	10800	42.86	184,200	35	47.91
2013	31,484	13127	1.00	413,290,468	1,210	38.44	440	10800	42.86	110,873	21	48.39
2014	38,349	13127	1.00	503,407,323	1,484	38.71	346	10800	42.86	87,186	17	48.88
2015	42,761	13127	1.00	561,323,647	1,667	38.98	365	10800	42.86	91,974	18	49.37
2016	49,490	13127	1.00	649,655,230	1,943	39.25	369	10800	42.86	92,982	18	49.86
2017	72,400	13127	1.00	950,394,800	2,862	39.53	446	10800	42.86	112,385	22	50.36
2018	80,453	13127	1.00	1,056,106,531	3,202	39.80	344	10800	42.86	86,682	17	50.86
2019	86,636	13127	1.00	1,137,270,772	3,472	40.08	337	10800	42.86	84,918	17	51.37
2020	89,893	13127	1.00	1,180,025,411	3,628	40.36	450	10800	42.86	113,392	23	51.88
	Total			8,169,737,917	24,378	38.42	Total			1,846,785	352	48.44

Year	Fuel Oil						Crude Oil					
	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/ton)	Fuel Used (ton)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/ton)	Fuel Used (ton)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)
2006	20,387	10300	40.87	5,137,903	738	36.22	9,453	10100	40.08	2,382,118	296	31.30
2007	20,428	10300	40.87	5,148,236	747	36.58	9,453	10100	40.08	2,382,118	299	31.61
2008	23,662	10522	40.87	6,091,793	893	37.74	9,453	10100	40.08	2,382,118	302	31.93
2009	23,836	10472	40.87	6,107,428	904	37.94	8,982	10100	40.08	2,263,428	290	32.25
2010	23,994	10488	40.87	6,157,305	921	38.38	8,982	10100	40.08	2,263,428	293	32.57
2011	28,009	10438	40.87	7,153,363	1,080	38.58	8,982	10100	40.08	2,263,428	295	32.90
2012	28,724	10502	40.87	7,380,951	1,126	39.20	8,982	10100	40.08	2,263,428	298	33.23
2013	26,677	10432	40.87	6,809,260	1,049	39.33	8,982	10100	40.08	2,263,428	301	33.56
2014	26,417	10403	40.87	6,724,151	1,046	39.61	7,957	10100	40.08	2,005,132	270	33.89
2015	26,423	10404	40.87	6,726,325	1,057	40.01	7,957	10100	40.08	2,005,132	272	34.23
2016	23,670	10417	40.87	6,033,041	958	40.46	7,957	10100	40.08	2,005,132	275	34.58
2017	9,341	10653	40.87	2,434,785	390	41.79	4,446	10100	40.08	1,120,374	155	34.92
2018	6,165	10719	40.87	1,616,898	262	42.47	4,446	10100	40.08	1,120,374	157	35.27
2019	5,998	10720	40.87	1,573,246	257	42.90	4,446	10100	40.08	1,120,374	158	35.62
2020	9,773	10638	40.87	2,543,802	420	43.00	1,879	10100	40.08	473,500	68	35.98
	Total			77,638,487	11,850	39.61	Total			28,313,515	3,729	35.59

Appendix C.5 Annual Fuel Usage & Cost (Cont.)

Option Case 2

Year	GAS						Diesel					
	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/MSCF)	Fuel Used (MSCF)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/ton)	Fuel Used (ton)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)
2006	12,425	13038	1.00	161,997,150	452	36.36	615	10800	42.86	154,970	28	45.14
2007	13,571	13045	1.00	177,033,695	497	36.63	805	10800	42.86	202,846	37	45.59
2008	15,300	13127	1.00	200,843,100	568	37.12	580	10800	42.86	146,150	27	46.04
2009	20,791	13127	1.00	272,923,457	777	37.38	456	10800	42.86	114,904	21	46.50
2010	24,324	13127	1.00	319,301,148	916	37.64	540	10800	42.86	136,071	25	46.97
2011	27,446	13127	1.00	360,283,642	1,040	37.91	490	10800	42.86	123,472	23	47.44
2012	28,082	13127	1.00	368,632,414	1,072	38.17	907	10800	42.86	228,549	43	47.91
2013	34,182	13127	1.00	448,707,114	1,314	38.44	773	10800	42.86	194,783	37	48.39
2014	40,191	13127	1.00	527,587,257	1,556	38.71	802	10800	42.86	202,091	39	48.88
2015	45,418	13127	1.00	596,202,086	1,770	38.98	691	10800	42.86	174,120	34	49.37
2016	50,789	13127	1.00	666,707,203	1,994	39.25	752	10800	42.86	189,491	37	49.86
2017	67,746	13127	1.00	889,301,742	2,678	39.53	775	10800	42.86	195,287	39	50.36
2018	76,339	13127	1.00	1,002,102,053	3,038	39.80	620	10800	42.86	156,230	32	50.86
2019	81,432	13127	1.00	1,068,957,864	3,264	40.08	692	10800	42.86	174,372	36	51.37
2020	89,000	13127	1.00	1,168,303,000	3,592	40.36	565	10800	42.86	142,371	29	51.88
	Total			8,228,882,925	24,528	38.42	Total			2,535,707	488	48.44

Year	Fuel Oil						Crude Oil					
	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/ton)	Fuel Used (ton)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/ton)	Fuel Used (ton)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)
2006	20,001	10300	40.87	5,040,624	724	36.22	9,453	10100	40.08	2,382,118	296	31.30
2007	20,039	10300	40.87	5,050,201	733	36.58	9,453	10100	40.08	2,382,118	299	31.61
2008	23,636	10557	40.87	6,105,340	895	37.87	9,453	10100	40.08	2,382,118	302	31.93
2009	23,661	10503	40.87	6,080,535	900	38.05	8,982	10100	40.08	2,263,428	290	32.25
2010	23,842	10521	40.87	6,137,550	918	38.50	8,982	10100	40.08	2,263,428	293	32.57
2011	23,606	10538	40.87	6,086,617	919	38.94	8,982	10100	40.08	2,263,428	295	32.90
2012	22,140	10665	40.87	5,777,419	881	39.81	8,982	10100	40.08	2,263,428	298	33.23
2013	21,375	10632	40.87	5,560,533	857	40.08	8,982	10100	40.08	2,263,428	301	33.56
2014	21,352	10629	40.87	5,552,983	864	40.47	7,957	10100	40.08	2,005,132	270	33.89
2015	20,970	10583	40.87	5,430,034	853	40.70	7,957	10100	40.08	2,005,132	272	34.23
2016	18,293	10650	40.87	4,766,833	757	41.37	7,957	10100	40.08	2,005,132	275	34.58
2017	12,112	10949	40.87	3,244,783	520	42.95	4,446	10100	40.08	1,120,374	155	34.92
2018	6,682	11099	40.87	1,814,620	294	43.98	4,446	10100	40.08	1,120,374	157	35.27
2019	7,228	11113	40.87	1,965,372	321	44.47	4,446	10100	40.08	1,120,374	158	35.62
2020	7,766	10928	40.87	2,076,507	343	44.17	1,879	10100	40.08	473,500	68	35.98
	Total			70,689,952	10,781	40.28	Total			28,313,515	3,729	35.59

Appendix C.5 Annual Fuel Usage & Cost (Cont.)

Option Case 3

Year	GAS						Diesel					
	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/MSCF)	Fuel Used (MSCF)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/ton)	Fuel Used (ton)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)
2006	12,425	13038	1.00	161,997,150	452	36.36	615	10800	42.86	154,970	28	45.14
2007	13,571	13045	1.00	177,033,695	497	36.63	805	10800	42.86	202,846	37	45.59
2008	9,439	13127	1.00	123,905,753	350	37.12	580	10800	42.86	146,150	27	46.04
2009	15,480	10874	1.00	168,329,520	479	30.96	456	10800	42.86	114,904	21	46.50
2010	19,595	10457	1.00	204,904,915	588	29.99	540	10800	42.86	136,071	25	46.97
2011	24,621	10173	1.00	250,469,433	723	29.38	490	10800	42.86	123,472	23	47.44
2012	26,043	10341	1.00	269,310,663	783	30.07	907	10800	42.86	228,549	43	47.91
2013	33,494	9906	1.00	331,791,564	972	29.01	773	10800	42.86	194,783	37	48.39
2014	40,444	9692	1.00	391,983,248	1,156	28.58	802	10800	42.86	202,091	39	48.88
2015	48,115	9548	1.00	459,402,020	1,364	28.35	691	10800	42.86	174,120	34	49.37
2016	53,013	9540	1.00	505,744,020	1,512	28.53	752	10800	42.86	189,491	37	49.86
2017	67,128	9749	1.00	654,430,872	1,971	29.35	775	10800	42.86	195,287	39	50.36
2018	77,319	9504	1.00	734,839,776	2,228	28.82	620	10800	42.86	156,230	32	50.86
2019	80,830	9502	1.00	768,046,660	2,345	29.01	692	10800	42.86	174,372	36	51.37
2020	86,615	9443	1.00	817,905,445	2,515	29.03	565	10800	42.86	142,371	29	51.88
	Total			6,020,094,734	17,935	30.75	Total			2,535,707	488	48.44

Year	Fuel Oil						Crude Oil					
	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/ton)	Fuel Used (ton)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)	Generated Energy (GWh)	Average Heat Rate (btu/kWh)	Heat Content (Mbtu/ton)	Fuel Used (ton)	Fuel Cost (Million US\$)	Fuel Cost (US\$/MWh)
2006	20,001	10300	40.87	5,040,624	724	36.22	9,453	10100	40.08	2,382,118	296	31.30
2007	20,039	10300	40.87	5,050,201	733	36.58	9,453	10100	40.08	2,382,118	299	31.61
2008	27,897	9964	40.87	6,801,216	997	35.74	9,453	10100	40.08	2,382,118	302	31.93
2009	26,972	9953	40.87	6,568,444	973	36.06	8,982	10100	40.08	2,263,428	290	32.25
2010	26,571	9949	40.87	6,468,189	967	36.40	8,982	10100	40.08	2,263,428	293	32.57
2011	24,331	9944	40.87	5,919,928	894	36.75	8,982	10100	40.08	2,263,428	295	32.90
2012	22,759	9949	40.87	5,540,232	845	37.14	8,982	10100	40.08	2,263,428	298	33.23
2013	20,810	9919	40.87	5,050,511	778	37.39	8,815	10100	40.08	2,221,345	296	33.56
2014	18,042	9905	40.87	4,372,547	680	37.71	7,587	10100	40.08	1,911,894	257	33.89
2015	17,062	9880	40.87	4,124,604	648	38.00	7,248	10100	40.08	1,826,467	248	34.23
2016	15,690	9841	40.87	3,777,962	600	38.22	7,172	10100	40.08	1,807,315	248	34.58
2017	11,012	9670	40.87	2,605,482	418	37.94	4,446	10100	40.08	1,120,374	155	34.92
2018	7,801	9577	40.87	1,827,996	296	37.95	4,446	10100	40.08	1,120,374	157	35.27
2019	6,207	9588	40.87	1,456,147	238	38.37	4,446	10100	40.08	1,120,374	158	35.62
2020	8,659	9639	40.87	2,042,185	337	38.96	1,879	10100	40.08	473,500	68	35.98
	Total			66,646,267	10,130	37.29	Total			27,801,712	3,660	33.59

Appendix C.6 Annual Gas Consumption in MSCF

Year	Case		
	Option Case 1	Option Case 2	Option Case 3
2006	157,697,430	161,997,150	161,997,150
2007	172,898,008	177,033,695	177,033,695
2008	197,469,461	200,843,100	123,905,753
2009	269,457,929	272,923,457	168,329,520
2010	316,137,541	319,301,148	204,904,915
2011	283,228,152	360,283,642	250,469,433
2012	321,375,214	368,632,414	269,310,663
2013	413,290,468	448,707,114	331,791,564
2014	503,407,323	527,587,257	391,983,248
2015	561,323,647	596,202,086	459,402,020
2016	649,655,230	666,707,203	505,744,020
2017	950,394,800	889,301,742	654,430,872
2018	1,056,106,531	1,002,102,053	734,839,776
2019	1,137,270,772	1,068,957,864	768,046,660
2020	1,180,025,411	1,168,303,000	817,905,445
Total	8,169,737,917	8,228,882,925	6,020,094,734

Appendix C.7 Annual Diesel Consumption in Tons

Year	Case		
	Option Case 1	Option Case 2	Option Case 3
2006	146,402	154,970	154,970
2007	192,515	202,846	202,846
2008	161,269	146,150	146,150
2009	125,236	114,904	114,904
2010	145,646	136,071	136,071
2011	111,125	123,472	123,472
2012	184,200	228,549	228,549
2013	110,873	194,783	194,783
2014	87,186	202,091	202,091
2015	91,974	174,120	174,120
2016	92,982	189,491	189,491
2017	112,385	195,287	195,287
2018	86,682	156,230	156,230
2019	84,918	174,372	174,372
2020	113,392	142,371	142,371
Total	1,846,785	2,535,707	2,535,707

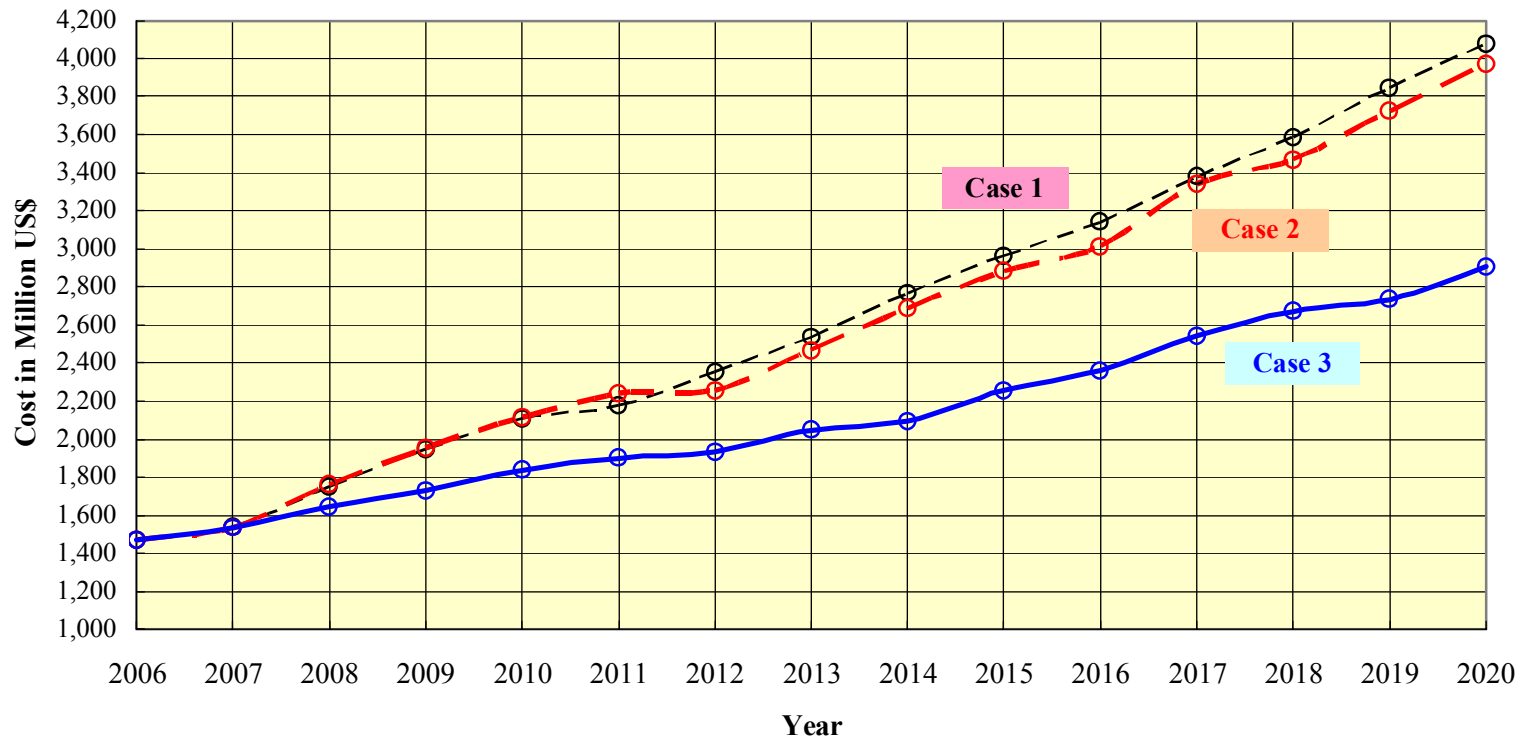
Appendix C.8 Annual Fuel Oil Consumption in Tons

Year	Case		
	Option Case 1	Option Case 2	Option Case 3
2006	5,137,903	5,040,624	5,040,624
2007	5,148,236	5,050,201	5,050,201
2008	6,091,793	6,105,340	6,801,216
2009	6,107,428	6,080,535	6,568,444
2010	6,157,305	6,137,550	6,468,189
2011	7,153,363	6,086,617	5,919,928
2012	7,380,951	5,777,419	5,540,232
2013	6,809,260	5,560,533	5,050,511
2014	6,724,151	5,552,983	4,372,547
2015	6,726,325	5,430,034	4,124,604
2016	6,033,041	4,766,833	3,777,962
2017	2,434,785	3,244,783	2,605,482
2018	1,616,898	1,814,620	1,827,996
2019	1,573,246	1,965,372	1,456,147
2020	2,543,802	2,076,507	2,042,185
Total	77,638,487	70,689,952	66,646,267

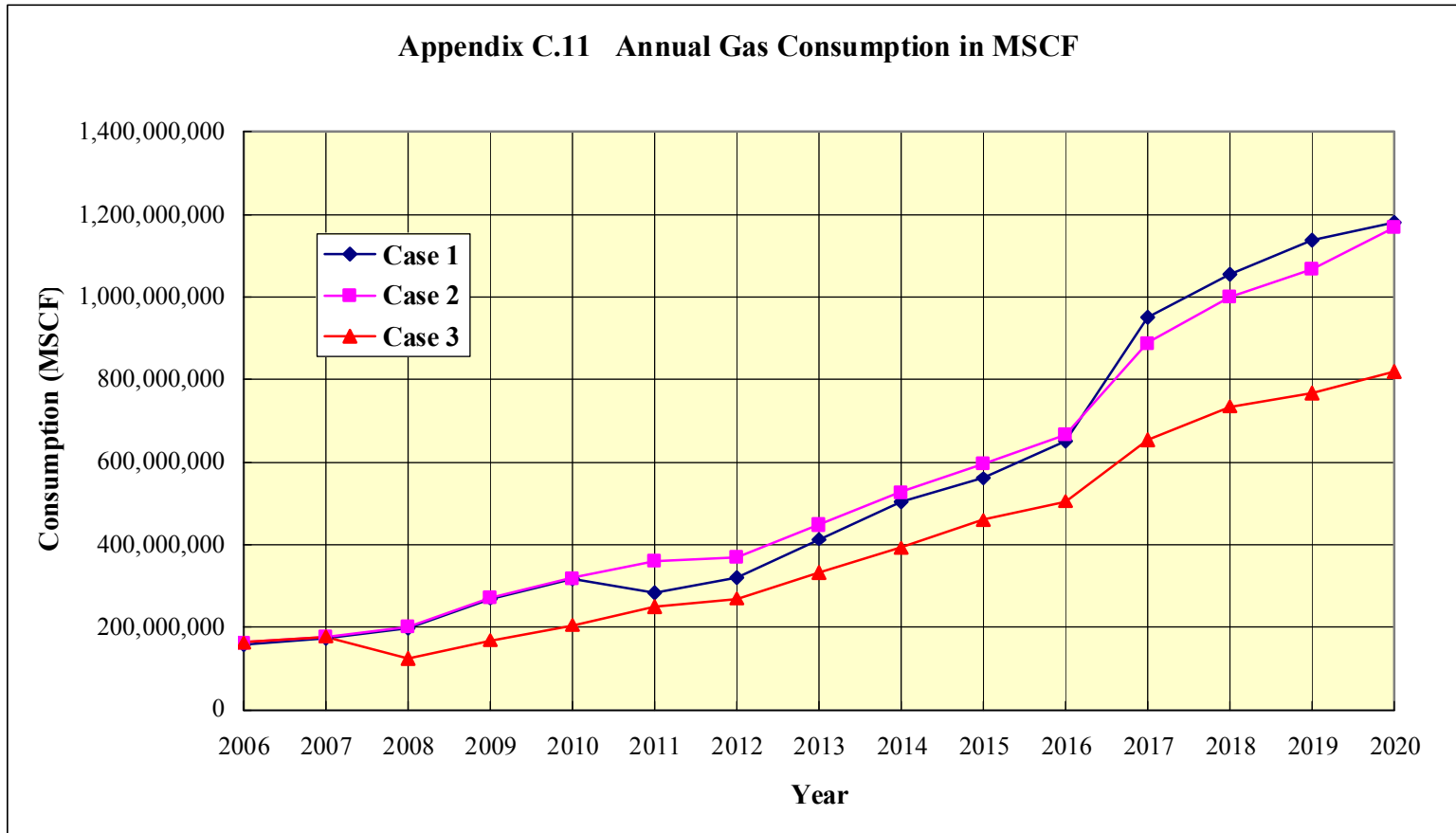
Appendix C.9 Annual Crude Oil Consumption in Tons

Year	Case		
	Option Case 1	Option Case 2	Option Case 3
2006	2,382,118	2,382,118	2,382,118
2007	2,382,118	2,382,118	2,382,118
2008	2,382,118	2,382,118	2,382,118
2009	2,263,428	2,263,428	2,263,428
2010	2,263,428	2,263,428	2,263,428
2011	2,263,428	2,263,428	2,263,428
2012	2,263,428	2,263,428	2,263,428
2013	2,263,428	2,263,428	2,221,345
2014	2,005,132	2,005,132	1,911,894
2015	2,005,132	2,005,132	1,826,467
2016	2,005,132	2,005,132	1,807,315
2017	1,120,374	1,120,374	1,120,374
2018	1,120,374	1,120,374	1,120,374
2019	1,120,374	1,120,374	1,120,374
2020	473,500	473,500	473,500
Total	28,313,515	28,313,515	27,801,712

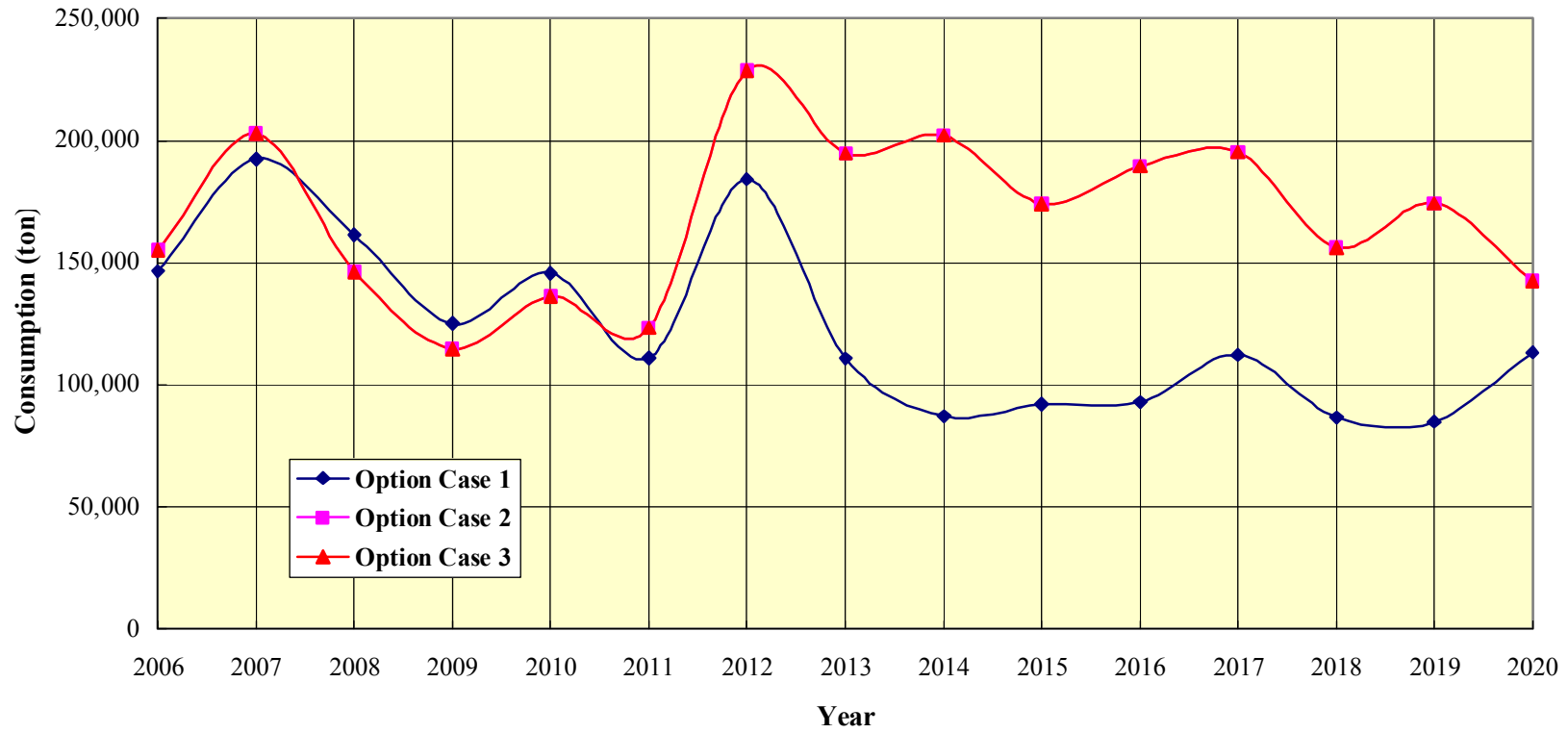
Appendix C.10 Annual Estimated Fuel Cost in Million US\$



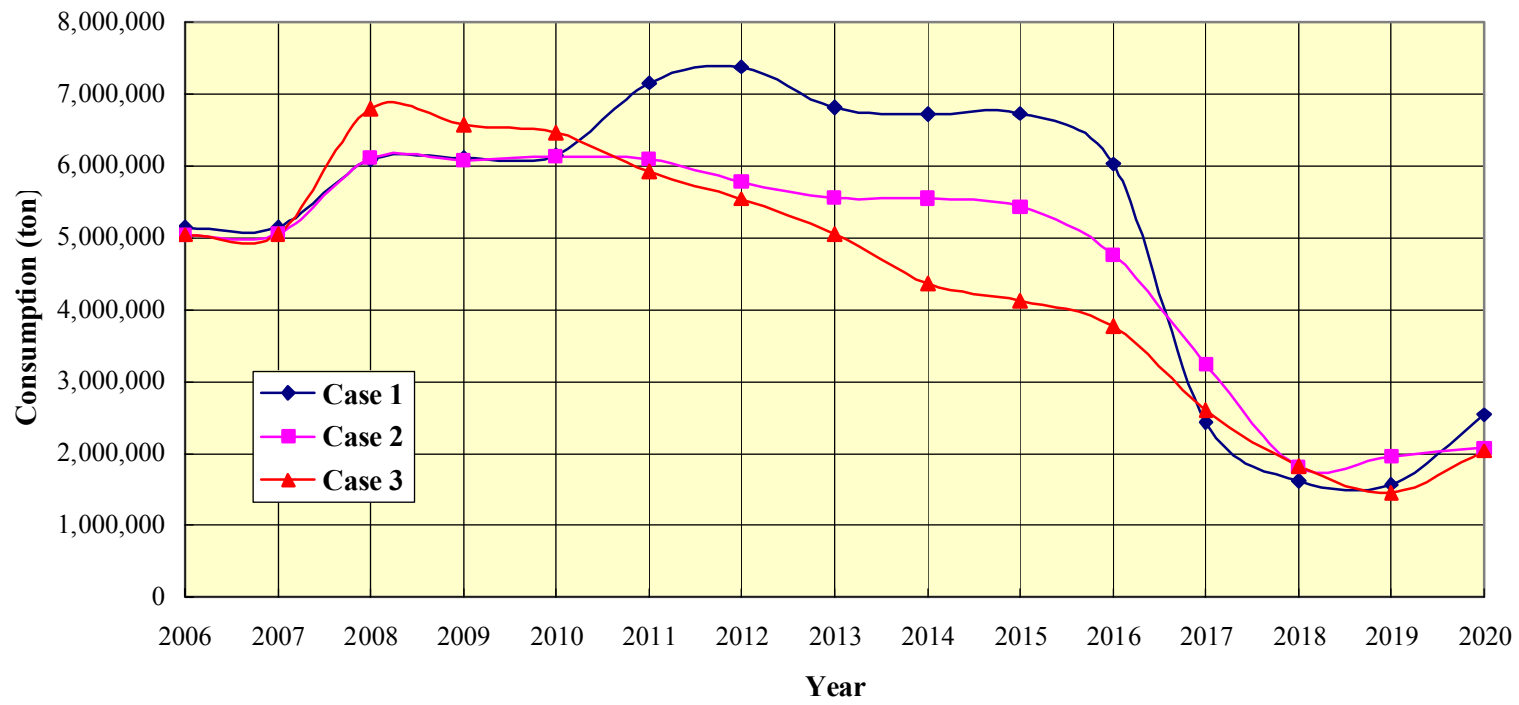
Appendix C.11 Annual Gas Consumption in MSCF



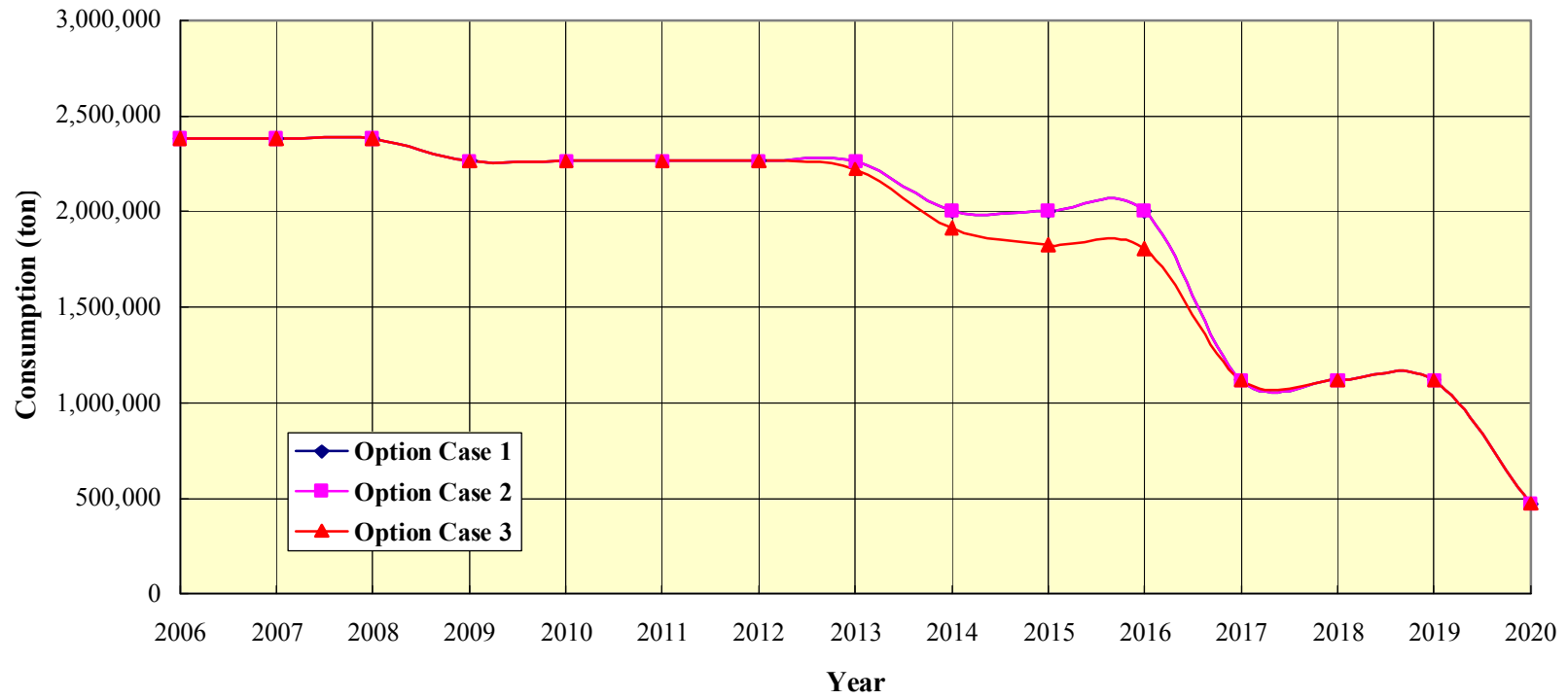
Appendix C.12 Annual Diesel Consumption in Ton



Appendix C.13 Annual Fuel Oil Consumption in Ton



Appendix C.14 Annual Crude Oil Consumption in Ton



Appendix C.15 Annual Emission Reduction

CO₂ Annual Emission of (Case 1)

Operating Year	Energy Generated (GWh)					CO ₂ Emission (ton)					Total Energy	Total Emission	Annual CER (ton)
	Hydro	FO	Diesel	GAS	CO	FO	Diesel	GAS	CO				
2006	7779	20,387	581	12,098	9,453	13,618,516	388,108	6,121,588	6,314,604	50298	26,442,816	69,674	
2007	7779	20,428	764	13,256	9,453	13,645,904	510,352	6,707,536	6,314,604	51680	27,178,396	73,074	
2008	7779	23,662	640	15,043	9,453	15,806,216	427,520	7,611,758	6,314,604	56577	30,160,098	46,724	
2009	7779	23,836	497	20,527	8,982	15,922,448	331,996	10,386,662	5,999,976	61621	32,641,082	486,322	
2010	7779	23,994	578	24,083	8,982	16,027,992	386,104	12,185,998	5,999,976	65416	34,600,070	574,876	
2011	7779	28,009	441	21,576	8,982	18,710,012	294,588	10,917,456	5,999,976	66787	35,922,032	883,402	
2012	7779	28,724	731	24,482	8,982	19,187,632	488,308	12,387,892	5,999,976	70698	38,063,808	3,077,186	
2013	7779	26,677	440	31,484	8,982	17,820,236	293,920	15,930,904	5,999,976	75362	40,045,036	2,791,208	
2014	7779	26,417	346	38,349	7,957	17,646,556	231,128	19,404,594	5,315,276	80848	42,597,554	4,476,982	
2015	7779	26,423	365	42,761	7,957	17,650,564	243,820	21,637,066	5,315,276	85285	44,846,726	3,799,868	
2016	7779	23,670	369	49,490	7,957	15,811,560	246,492	25,041,940	5,315,276	89265	46,415,268	3,816,538	
2017	7779	9,341	446	72,400	4,446	6,239,788	297,928	36,634,400	2,969,928	94412	46,142,044	1,331,632	
2018	7779	6,165	344	80,453	4,446	4,118,220	229,792	40,709,218	2,969,928	99187	48,027,158	308,588	
2019	7779	5,998	337	86,636	4,446	4,006,664	225,116	43,837,816	2,969,928	105196	51,039,524	2,561,084	
2020	7779	9,773	450	89,893	1,879	6,528,364	300,600	45,485,858	1,255,172	109774	53,569,994	2,326,000	
Total	116685	303504	7329	622531	112357	202,740,672	4,895,772	315,000,686	75,054,476	1,162,406	597,691,606	26,623,158	

Fuel Type	FO	CO	GAS	Diesel	Hydro
CO ₂ Emission Rate (ton/GWh)	668	668	506	668	0

Sources: IPIECA, IETA, UNIDO

CO₂ Annual Emission (Case 2)

Operating Year	Energy Generated (GWh)					CO ₂ Emission (ton)					Total Energy	Total Emission	Annual CER (ton)
	Hydro	FO	Diesel	GAS	CO	FO	Diesel	GAS	CO				
2006	7779	20,001	615	12,425	9,453	13,360,668	410,820	6,287,050	6,314,604	50273	26,373,142	0	
2007	7779	20,039	805	13,571	9,453	13,386,052	537,740	6,866,926	6,314,604	51647	27,105,322	0	
2008	7779	23,636	580	15,300	9,453	15,788,848	387,440	7,741,800	6,314,604	56748	30,232,692	119,318	
2009	7779	23,661	456	20,791	8,982	15,805,548	304,608	10,520,246	5,999,976	61669	32,630,378	475,618	
2010	7779	23,842	540	24,324	8,982	15,926,456	360,720	12,307,944	5,999,976	65467	34,595,096	569,902	
2011	7779	22,606	490	27,446	8,982	15,100,808	327,320	13,887,676	5,999,976	67303	35,315,780	277,150	
2012	9139	23,140	907	28,082	8,982	15,457,520	605,876	14,209,492	5,999,976	70250	36,272,864	1,286,242	
2013	9139	21,375	773	34,182	8,982	14,278,500	516,364	17,296,092	5,999,976	74451	38,090,932	837,104	
2014	9139	21,352	802	40,191	7,957	14,263,136	535,736	20,336,646	5,315,276	79441	40,450,794	2,330,222	
2015	9139	20,970	691	45,418	7,957	14,007,960	461,588	22,981,508	5,315,276	84175	42,766,332	1,719,474	
2016	10159	18,293	752	50,789	7,957	12,219,724	502,336	25,699,234	5,315,276	87950	43,736,570	1,137,840	
2017	10159	12,112	775	67,746	4,446	8,090,816	517,700	34,279,476	2,969,928	95238	45,857,920	1,047,508	
2018	10159	8,682	620	76,339	4,446	5,799,576	414,160	38,627,534	2,969,928	100246	47,811,198	92,628	
2019	10159	7,228	692	81,432	4,446	4,828,304	462,256	41,204,592	2,969,928	103957	49,465,080	986,640	
2020	10159	7,766	565	89,000	1,879	5,187,688	377,420	45,034,000	1,255,172	109369	51,854,280	610,286	
Total	134025	274703	10063	627036	112357	183,501,604	6,722,084	317,280,216	75,054,476	1,158,184	582,558,380	11,489,932	

Fuel Type	FO	CO	GAS	Diesel	Hydro
CO ₂ Emission Rate (ton/GWh)	668	668	506	668	0

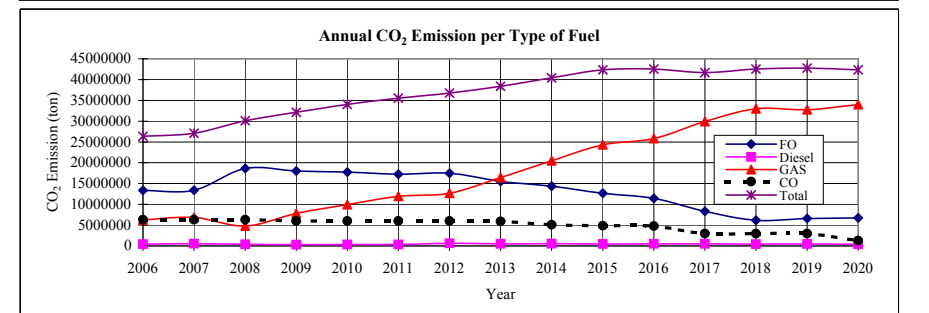
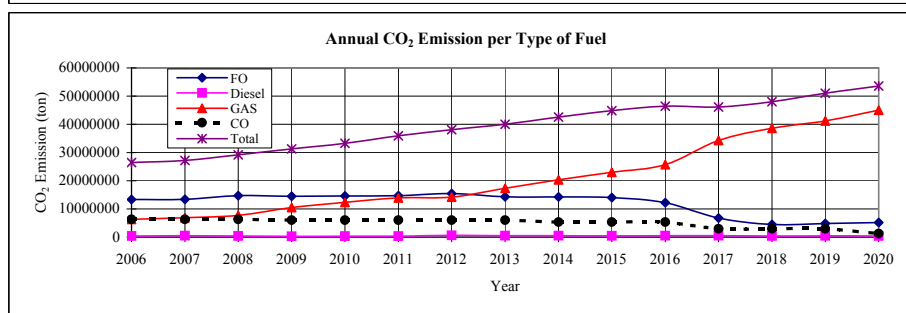
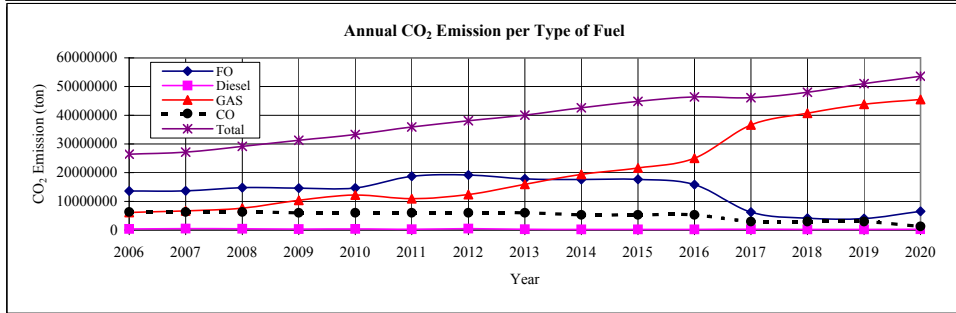
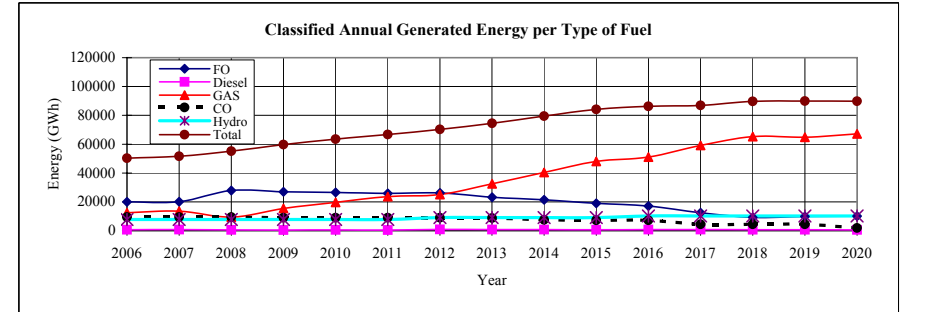
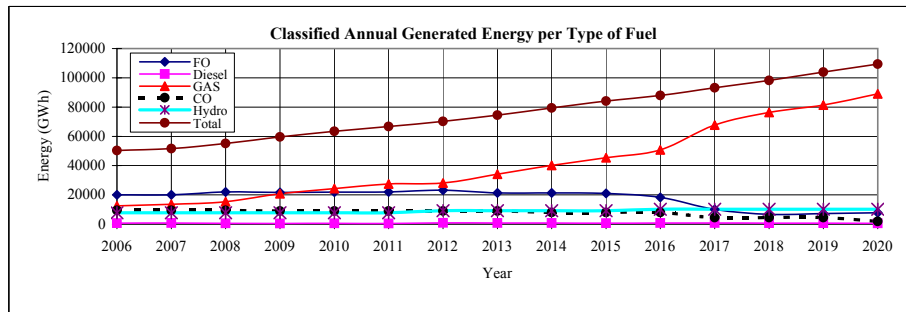
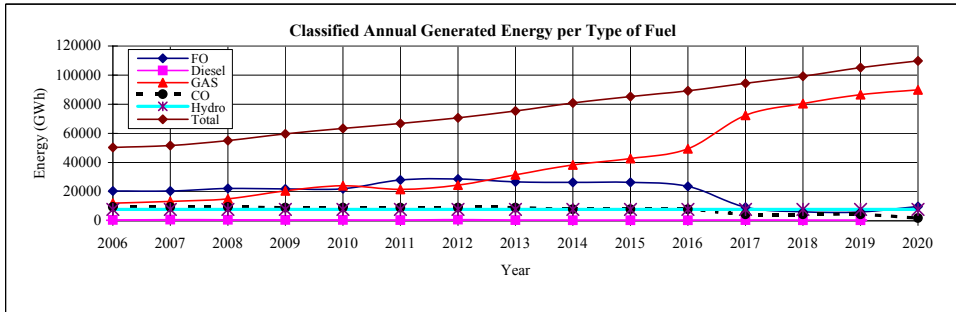
Sources: IPIECA, IETA, UNIDO

CO₂ Annual Emission (Case 3)

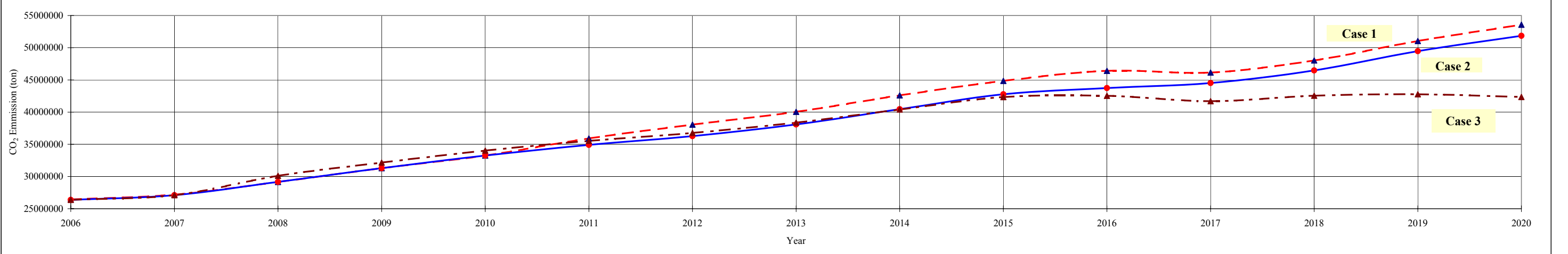
Operating Year	Energy Generated (GWh)					CO ₂ Emission (ton)					Total Energy	Total Emission	Annual CER (ton)
	Hydro	FO	Diesel	GAS	CO	FO	Diesel	GAS	CO				
2006	7779	20,001	615	12,425	9,453	13,360,668	410,820	6,287,050	6,314,604	50273	26,373,142	0	
2007	7779	20,039	805	13,571	9,453	13,386,052	537,740	6,866,926	6,314,604	51647	27,105,322	0	
2008	7779	27,897	580	9,439	9,453	18,635,196	387,440	4,776,134	6,314,604	55148	30,113,374	30,113,374	
2009	7779	26,972	456	15,480	8,982	18,017,296	304,608	7,832,880	5,999,976	59669	32,154,760	32,154,760	
2010	7779	26,571	540	19,595	8,982	17,749,428	360,720	9,915,070	5,999,976	63467	34,025,194	34,025,194	
2011	7779	24,331	490	24,621	8,982	16,253,108	327,320	12,458,226	5,999,976	66203	35,038,630	35,038,630	
2012	9139	22,759	907	26,043	8,982	15,203,012	605,876	13,177,758	5,999,976	67830	34,986,622	34,986,622	
2013	9139	20,810	773	33,944	8,815	13,901,080	516,364	16,947,964	5,888,420	73031	37,253,828	37,253,828	
2014	9139	18,042	802	40,444	7,587	12,052,056	535,736	20,464,664	5,068,116	76014	38,120,572	38,120,572	
2015	9139	17,062	691	48,115	7,248	11,397,416	461,588	24,346,190	4,841,664	82255	41,046,858	41,046,858	
2016	10159	15,690	752	53,013	7,172	10,480,920	502,336	26,824,578	4,790,896	86786	42,598,730	42,598,730	
2017	10159	11,012	775	67,128	4,446	7,356,016	517,700	33,966,768	2,969,928	93520	44,810,412	44,810,412	
2018	10159	7,801	620	77,319	4,446	5,211,068	414,160	39,123,414	2,969,928	100345	47,718,570	47,718,570	
2019	10159	6,207	692	80,830	4,446	4,146,276	462,256	40,899,980	2,969,928	102334	48,478,440	48,478,440	
2020	10159	8,659	565	86,615	1,879	5,784,212	377,420	43,827,190	1,255,172	107877	51,243,994	51,243,994	
Total	134025	273853	10063	608132	110326	182,933,804	6,722,084	307,714,792	73,697,768	1,136,399	571,068,448	571,068,448	

Fuel Type	FO	CO	GAS	Diesel	Hydro
CO ₂ Emission Rate (ton/GWh)	668	668	506	668	0

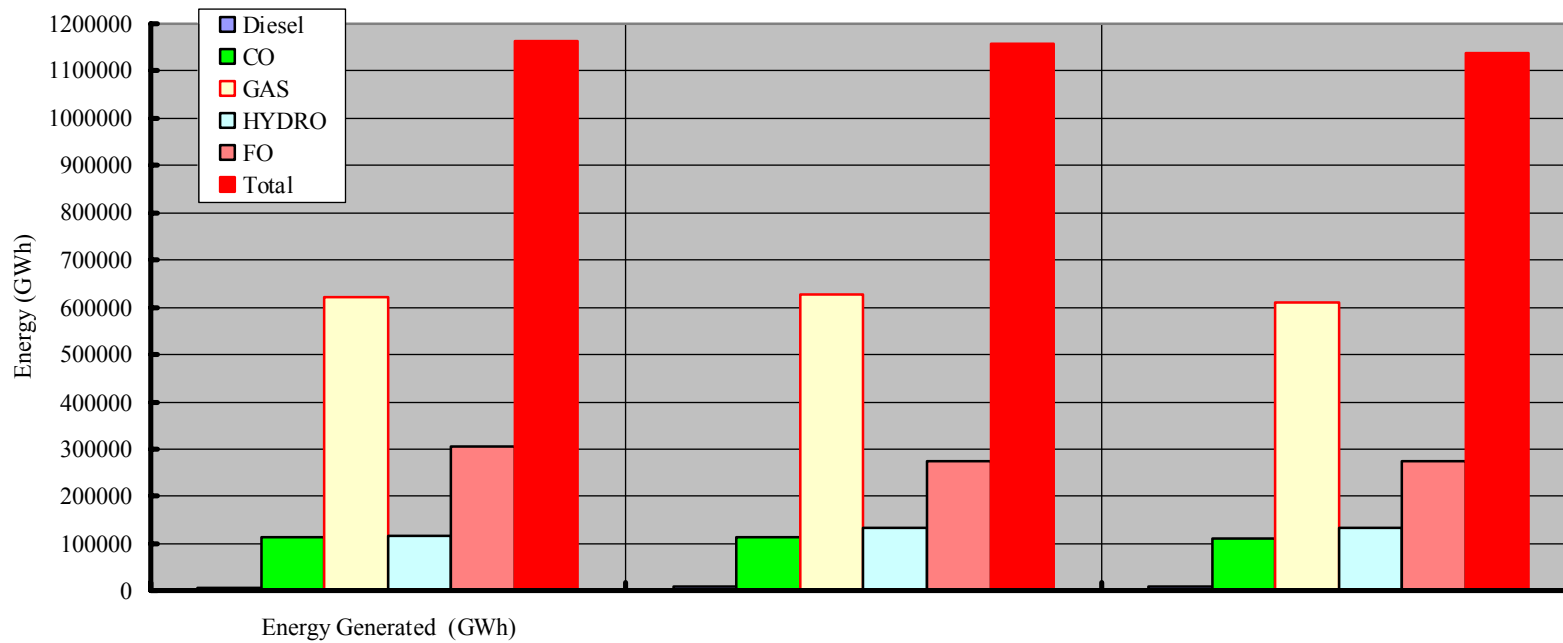
Sources: IPIECA, IETA, UNIDO



Annual CO₂ Emission for various Cases



Appendix C.16 Total Generated Energy per Type of Fuel between 2006 & 2020



Appendix D : Standards related to the Electricity Sector

Appendix D.1 Environmental Quality Standards for Air Pollution (For main substance)

	Japan	US	UK
Substance	Environmental Regulation		
Sulfur dioxide	Daily average of hourly values shall not exceed 0.04ppm, and hourly values shall not exceed 0.1ppm	3-hr: Not to be at or above this level more than once per calendar year: 550ppb (Secondary) 24-hr: Not to be at or above this level more than once per calendar year: 145ppb (Primary) Annual: Not to be at or above this level: 35ppb (Primary)	
Carbon monoxide	Daily average of hourly values shall not exceed 10ppm, and average of hourly values in eight consecutive hours shall not exceed 20ppm	1-hr: Not to be at or above this level more than once per calendar year: 35.5ppm 8-hr: Not to be at or above this level more than once per calendar year: 9.5ppm	
Suspended particulate substance	Daily average of hourly values shall not exceed 0.10mg/m ³ , and hourly values shall not exceed 0.2mg/m ³		
Nitrogen dioxide	Daily average of hourly values shall be within the range from 0.04ppm to 0.06ppm or below.		

Flue Gas Standards

1) Sulfur Oxide Emission Regulation

$$q = K \times 10^{-3} \text{He}^2$$

q : Permissible emission volume of Sulfur oxides (m_N h)

K : Each region value shown in Table

He (Effective stack height) = Ho + 0.65(Hm + Ht) (m)

Ho : Actual height of the outlet (m)

Q : Amount of exhausted gas at 15°C (m³/s)

V : Exhausted gas velocity (m/s)

T : Exhausted gas temperature (K)

$$H_m = \frac{0.795\sqrt{Q/V}}{1 + \frac{2.58}{V}}$$

$$H_t = 2.01 \times 10^{-3} \cdot Q(T-288) \cdot (2.30 \log J + \frac{1}{J})$$

$$J = \frac{1}{\sqrt{Q \cdot V}} (1.460 - 296 \times \frac{V}{T-288}) + 1$$

Region Name	K Value
Tokyo(city), Yokohama, Kawasaki, Nagoya, Osaka, Kobe	3.0
Hitachi	4.5
Shizuoka	10.0

2) Nitrogen Oxide Emission Regulation

(refer to other sheet)

Appendix D.2 Environmental Quality Standards for Water Pollution

1) Standards related to the Protection of Human Health (yearly average)

Item	Standard Values	Item	Standard Values
Cadmium	0.01 mg/l or less	1,1,1-trichloroethane	1 mg/l or less
Total cyanogens	Not detectable	1,1,2- trichloroethane	0.006mg/l or less
Lead	0.01 mg/l or less	Trichloroethylene	0.03mg/l or less
Sexivalent Chrome	0.05mg/l or less	Tetrachloroethylene	0.01 mg/l or less
Arsenic	0.01 mg/l or less	1,3-dichloropropene	0.002mg/l or less
Total Mercury	0.0005mg/l or less	Thiram	0.006mg/l or less
Alkyl Mercury	Not detectable	Simazine	0.003mg/l or less
PCB	Not detectable	Thiobcarb	0.02mg/l or less
Dichlomethane	0.02mg/l or less	Benzene	0.01 mg/l or less
Carbon tetrachloride	0.002mg/l or less	Selenium	0.01 mg/l or less
1,2- dichloroethane	0.004mg/l or less	Nitra-N and nitrite-N	10mg/l or less
1,1- dichloroethylene	0.02mg/l or less	Fluoride	0.81 mg/l or less
Cis 1,2- dichloroethylene	0.04mg/l or less	Boron	11 mg/l or less

2) Standard related to the Preservation of the Living Environment(Coastal Value)

Class	A	B	C
Water use	Bathing	Industrial water	Conservation of the environment
Hydrogen ion exponent(pH)	7.8 ~ 8.3	7.8 ~ 8.3	7.8 ~ 8.3
Chemical Oxygen Demand(COD)	2mg/l or less	3mg/l or less	8mg/l or less
Dissolved Oxygen(DO)	7.5mg/l or less	5mg/l or less	2mg/l or less
Total coliform	1,000MPN/100ml or less	--	--
N-hexane Extracts(oil content etc)	Not detectable	Not detectable	Not detectable

Waste Water Standards

Type Toxic Substance	Permissible Limits
Cadmium and its compounds	Cadmium 0.01mg/l
Cyanide compounds	Cyanide 1mg/l
Organic Phosphorous compounds(parathion, methal parathion, methyl dimethone and EPN only)	1mg/l
Lead and its compounds	0.1mg/l or less
Sexivalent Chrome compounds	Sexivalent Chrome 0.5mg/l
Arsenic and its compounds	Arsenic 0.1mg/l
Mercury, Alkyl Mercury, and other mercury compounds	Mercury 0.005mg/l or less
Alkyl Mercury compounds	Not detectable
PCB	0.003mg/l
Trichloroethylene	0.3mg/l or less
Tetrachloroethylene	0.1mg/l or less
Dichl methane	0.2mg/l or less
Carbon tetrachloride	0.02mg/l or less
1,2- dichloroethane	0.04mg/l or less
1,1- dichloroethylene	0.2mg/l or less
Cis 1,2- dichloroethylene	0.4mg/l or less
1,1,1-trichloroethane	3mg/l or less
1,1,2- trichloroethane	0.06mg/l or less
1,3-dichloropropene	0.02mg/l or less
Thiram	0.06mg/l or less
Simazine	0.03mg/l or less
Thiobcarb	0.2mg/l or less
Benzene	0.01mg/l or less
Selenium and its compounds	0.03mg/l or less

Appendix D.3 Design parameter for 400/132 kV Transmission Lines and Substation Equipment

400 kV Transmission Line

- Tower Structure : Single circuit twin earth peaks
- Conductor : DIN ACSR 490/65 in double bundle
- Earth wire : OPGW with equivalent electric characteristic to ACSR 'Dorking' conductor
- Insulator set : Glass insulator, 27 and 33 units for suspension and tension set respectively
- Tower type : Tangent/minor deviation, medium angle and heavy angle/terminal
- Design span : 300 – 330m

132 kV Transmission Line

- Tower Structure : Double circuits and single peak
- Conductor : ACSR Teal in double bundle
- Earth wire : OPGW with equivalent electric characteristic to ACSR 'Dorking' conductor
- Insulator set : Glass insulator, 10 and 12 units for suspension and tension set respectively
- Tower type : Tangent/minor deviation, medium angle and heavy angle/terminal
- Design span : 300 – 330m

Substation Equipment

Highest System Voltage	420kV	145kV
Nominal Voltage	400kV	132kV
Frequency	50Hz	50Hz
Neutral Point earthed	Solidly earthed	Solidly earthed
Three Phase Short Circuit Current	31.5kA; 40kA	25kA; 31.5kA
Duration of Short Circuit	1 sec; 3sec	1 sec; 3 sec
Lightning Impulse Withstand Voltage <ul style="list-style-type: none"> Switchgear Equipment Transformer Windings Neutral Point 	1425kV 1300kV	650kV 550kV 325 kV
Power Frequency Withstand Voltage/1 min <ul style="list-style-type: none"> Switchgear Equipment Transformer Windings Neutral Point 	630kV 570kV	275kV 230kV
Minimum Creepage Distance (mm/kV) for System Highest Voltage <ul style="list-style-type: none"> Outdoor Exposed Insulators 	25mm	25mm
Current Ratings <ul style="list-style-type: none"> Busbar Switchgear 	4,000A 2,000A	1,600A 1,250A
Auto/Transformer Data <ul style="list-style-type: none"> Transformer nominal rated voltage Cooling method Continuous maximum rating On- load tap changer rate Nos of Step HV Side (On Load Tap Changer) MV Side (Off Load Tap Changer) LV Side Vector groupe 	400/138.6/11kV ONAN/ONAF/OFAF 250MVA 400+-10 % kV 21 - - - - Yy0d11	132/33/11kV - - - - 132+-8x1.25% kV 33+-2x2.5% kV 11.5 kV -
Current Transformer Rated ratio <ul style="list-style-type: none"> OH Line bay Transformer bay Bus Coupler bay 	2000/1A 2000-1000/1A 2000-1000/1A	1200-600/5A(1A) 300-150/5A (1A) 1600-800/5A (1A)

Voltage Transformer		
<ul style="list-style-type: none"> Nominal system voltage Rated secondary voltage 	<p>400/$\sqrt{3}$ kV</p> <p>110/$\sqrt{3}$ / 110/$\sqrt{3}$V</p>	<p>132/$\sqrt{3}$ kV</p> <p>110/$\sqrt{3}$ / 110/$\sqrt{3}$ V</p>
Lightning Arrester Rated Voltage		
<ul style="list-style-type: none"> Phase to Earth connection 132kV Neutral to Earth connection Lightning Arrester Discharge Current 	<p>390kV</p> <p>360kV</p> <p>10kA</p>	<p>120kV</p> <p>84kV</p> <p>10kA</p>

Substation design condition is shown on table

1. Indoor	
Maximum indoor ambient temperature	50 °C
(in absence or failure of air-conditioning)	
2. Outdoor	
Altitude	< 1000 m above sea level
Ambient temperature	
<ul style="list-style-type: none"> Maximum outdoor-peak Maximum outdoor daily average Maximum outdoor yearly average Minimum outdoor Maximum round at depth 1m Design ambient temperature 	<p>+ 50 °C</p> <p>+ 40 °C</p> <p>+ 30 °C</p> <p>- 10 °C</p> <p>+ 35 °C</p> <p>+ 50 °C</p>
Relative Humidity	
<ul style="list-style-type: none"> Maximum Minimum Yearly average 	<p>92 %</p> <p>12 %</p> <p>44 %</p>
Maximum wind velocity	
<ul style="list-style-type: none"> Maximum Minimum Maximum in one day Yearly average 	<p>500 m/m</p> <p>50 m/m</p> <p>65 m/m</p> <p>150 m/m</p>
Atmosphere	subject to sand storms and wind blown dust
Average number of days per year of dust storm	21.5
Average number of days per year of thunder storm	15

Appendix E : Specific Features of Thermal Plant

Appendix E.2 Sample of Rated Repair Interval (by Toshiba)

1. Recommended Inspection period of high temperature parts of gas turbine
(based on the rated load: long term continuous operating gas turbine: gas fuelled)

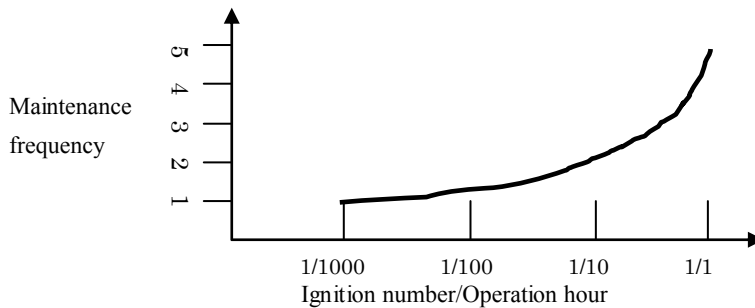
Parts Name	Rated Repair interval(hour)(RI)
Combustion chamber liner	8,000
Transition piece	8,000~12,000
Fuel nozzle	8,000
Flare transmission tube	8,000
Turbine: First stage nozzle	24,000
Turbine: Second stage nozzle	24,000
Turbine: Third stage nozzle	24,000
Turbine; First stage bucket	24,000
Turbine: Second stage bucket	24,000
Turbine: Third stage bucket	24,000

2. Factor of maintenance frequency

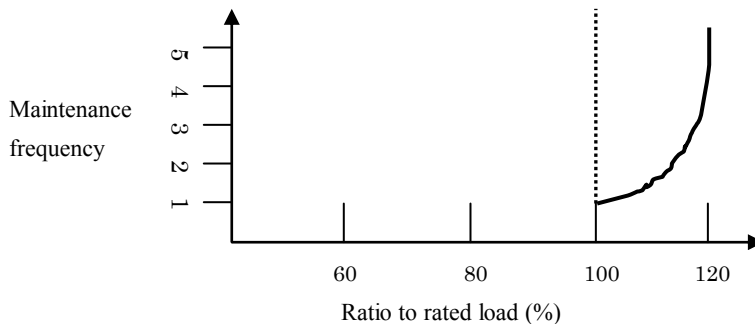
2-1 Factor of Fuel(F_f)

Kind of Fuel	Factor of Fuel(F _f)
Heavy oil residue	3
Heavy Oil (Fuel Oil)	2
Distilled Oil	1.5
Natural Gas	1

2-2 Factor of Start Frequency (F_s)



2-3 Factor of Loading(F_L)



3. Guideline of Inspection/Repair Interval=

$$\frac{\text{Rated Repair Interval(RI)}}{(F_f) \times (F_s) \times (F_L)}$$

Appendix E.3 Derating Factor Method to decide inspection and repair interval (Proposed by Toshiba)

1. Recommended Inspection interval of high temperature parts of gas turbine
(based on the rated load: long term continuous operating gas turbine: gas fuelled)

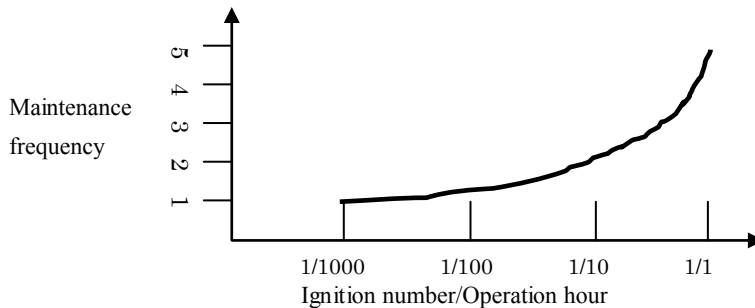
Parts Name	Rated Repair interval(hour)(RI)
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Transition piece	8,000~12,000
Fuel nozzle	8,000
Flare transmission tube	8,000
Turbine: First stage nozzle	24,000
Turbine: Second stage nozzle	24,000
Turbine: Third stage nozzle	24,000
Turbine; First stage bucket	24,000
Turbine: Second stage bucket	24,000
Turbine: Third stage bucket	24,000

2. Factor of maintenance frequency

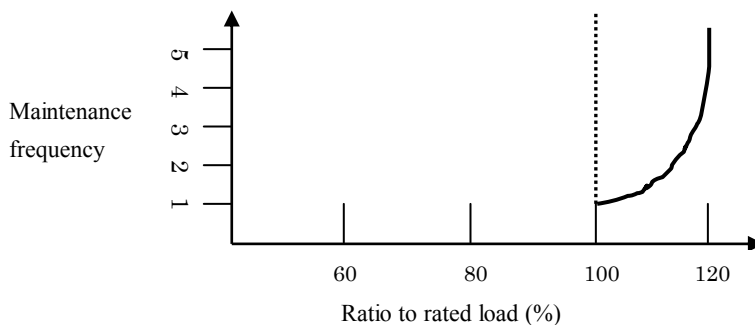
2-1 Factor of Fuel(F_f)

Kind of Fuel	Factor of Fuel(F _f)
Heavy oil residue	3
Heavy Oil (Fuel Oil)	2
Distilled Oil	1.5
Natural Gas	1

2-2 Factor of Start Frequency (F_s)



2-3 Factor of Loading(F_L)



3. Guideline of Inspection/Repair Interval=

$$\frac{\text{Rated Repair Interval(RI)}}{(F_f) \times (F_s) \times (F_L)}$$

Reference: "Preventive Maintenance and Residual Life Diagnosis of Power Generation Plant" Thermal and Nuclear Power Engineering Society of Japan, 2002