2008 Long Term Acquisition Plan

BC hydro

Appendix

F11

Estimated Unit Energy Cost Adjustment Values

1.1 Estimated UEC Cost Adjustment Values

In the 2005 Resource Options Report (ROR), BC Hydro presented Unit Energy Costs (UEC) at a base level only (e.g. costs at the plant gate with interconnection) and the full impact of adding alternative resources to the system was undertaken through portfolio analysis. While both the BCUC and several intervenors accepted the need and benefit of portfolio modelling, a concern was raised during the 2008 LTAP Intervenor Engagement sessions that the UEC tables provided in the 2006 IEP/ LTAP were being used out of context and that it was difficult to compare resource options on base unit energy costs when there are other costs and credits associated with the resource options. These can include the cost of firm transmission, line losses, GHG offset costs, carbon tax, capacity credit and wind integration costs.

As such, the 2008 LTAP has included an adjustment to the UEC calculations to provide an "indicative "allowance for these additional cost factors. These adjusted UECs are shown in the supply curves of Figures 3-9 and 3-10, and Table 3-21 of Section 3.3, and are taken from the "Mid" case in the table below. It should be noted that these numbers are directional and will not necessarily reflect the end result of the LTAP portfolio modeling exercise. The following outlines the basis for the adjustment factors:

- **Cost of incremental Firm Transmission (CIFT)** – A capacity charge for firm transmission based on delivery from the project gate to the Lower Mainland using values from the BCTC Bulk Transmission System CIFT for the NITS 2004 Facilities Study, Supplemental CIFT posting - 24 August 2007, Scenario 2. The CIFT values, in $/kW-yr, were applied against the installed capacity for the associated project. The BCTC document is located at: http://www.bctc.com/NR/rdonlyres/3B501B1C-4661-476B-A103-A26DF4E96651/0/CIFT2005supplemental24August2007.pdf

- **Carbon Tax and Greenhouse Gas (GHG) offset Costs**– These are estimates of ~~GHG offset costs applicable to GHG~~ emission~~s~~ costs from gas-fired generating plants based on 30 year levelized ~~values~~ prices over the period ~~2012~~2008-20~~37~~. It is assumed that the carbon tax is only paid from 2008 to 2011, prior to the onset of GHG offsets in 2012. Pricing is based on the BC Carbon Tax applicable to natural gas generation. See Section

1.2 in the following document: http://www.bcbudget.gov.bc.ca/2008/bfp/2008_Budget_Fiscal_Plan.pdf . The ~~27, derived from~~ GHG price forecasts are derived from ~~in~~ the Natsource report "2007 Greenhouse Gas Offset Forecast Report for BC Hydro, December 1, 2007" applied to the emission factors of the resource option.

~~**Carbon Tax** – Based on a 30 year levelized price assuming the carbon tax is no longer paid from 2012 onward when GHG offsets are assumed to be in place. Pricing is based on the BC Carbon Tax applicable to natural gas penetration. See Section 1.2 in the following document: http://www.bcbudget.gov.bc.ca/2008/bfp/2008_Budget_Fiscal_Plan.pdf~~

The "Mid" case value for the 30 year levelized medium GHG price forecast combined with the carbon tax is $25 per tonne.

- ~~[ND, should we merge GHG and Carbon Tax sections? We didn't calculate 30-yr levelized value for both, did we? Anwyays, feel little bit confusing here…]The real levelized medium GHG price forecast used to calculate the UECs for the "Mid" case was $21 per tonne.~~

- **Line Losses** –These are the estimated costs for project energy losses based on delivery to the Lower Mainland using the methodology outlined in the BCTC report "Peak Load Incremental Losses for the Bulk Transmission System, November 27, 2007". This document is located at: http://www.bctc.com/NR/rdonlyres/5CF35AA8-9D67-4825-87E4-A251F1D99CD0/0/BULKSYSTEMINCREMENTAL_LOSSES_2008.pdf

- **Capacity Credit** – Applied to project dependable capacity, and ELCC for intermittent resources, using a unit value of $25.9/kW-yr for capacity in the Lower Mainland, and dividing by the average annual energy.

- **Wind Integration Cost** – Based on $10/MWh of average annual wind energy. See Appendix F-3.

- ~~**Carbon Tax** – Based on the 2012 (approximately $1.50/GJ) and onward, BC Carbon Tax, applicable to natural gas generation. See Section 1.2 in the following document: http://www.bcbudget.gov.bc.ca/2008/bfp/2008_Budget_Fiscal_Plan.pdf~~

In addition to the "Mid" calculation of adjusted UEC for each project, Table 1 also shows a range of "Low" and "High" values. These values are based on the following variations in input data assumptions:

Capital Costs Uncertainty – assumed as per the cost uncertainties identified in the 2005 ROR (i.e. -10% / +20% for "Low" cost uncertainty, -10% / +40% for "Mid" cost uncertainty, -10% / +60% for "High" cost uncertainty).

Gas Price Uncertainty – assumed as: the "Medium" gas price of $6.98~~85~~/GJ for the "Low" calculation, the "High' gas price of $10.~~95~~71/GJ for the "Mid" and High" UEC calculations. The low gas price scenario is not used given its associated low probability of occurrence.

Carbon Tax and GHG Offset ~~and Carbon Tax~~ Cost Uncertainty – assumed as: $~~17~~ 20 per tonne for the "low" UEC calculation and $~~42~~ 39 per tonne for the "High" UEC calculation.

Table 1 – Detailed Adjusted Unit Energy Costs

Resource Option	Project Name	Installed Capacity	Effective Capacity[1] (MW)	Average Annual Energy (GWh/)	Annual Firm /Effective Energy[2] (GWh)	Base UEC @ 6% Cost of Capital	CIFT ($/MWh)	GHG Offset and Carbon Tax Cost ($/MWh)	Line Losses ($/MWh)	Capacity Credit ($/MWh)	Wind Integration Cost Adder ($/MWh)	Total Adjusted UEC ($/MWh)		
												Mid	Low	High
Biomass	Bundle-Biogas with Existing Capture	5	5	40	38	44	3	-	3	(3)	-	46	44	54
Small Hydro	LM Small Hydro Bundle1	32	11	168	106	54	-	-	-	(2)	-	53	47	74
Geothermal	South Meager Geothermal Project	100	100	800	800	59	-	-	-	(3)	-	55	51	79
Biomass	Bundle - Biogas with No Capture	8	8	64	61	63	1	-	2	(3)	-	63	60	76
Small Hydro	LM Small Hydro Bundle2	87	25	458	319	65	-	-	-	(1)	-	64	57	90
Small Hydro	LM Small Hydro Bundle3	179	49	898	637	75	-	-	-	(1)	-	74	66	104
Small Hydro	CI Small Hydro Bundle1	35	1	142	112	74	4	-	4	(0)	-	82	74	111
Small Hydro	KLY Small Hydro Bundle1	36	2	148	100	78	3	-	2	(0)	-	82	75	113
Biomass	Biomass - Municipal Solid Waste	51	51	408	408	88	(3)	-	0	(3)	-	82	78	100
Small Hydro	LM Small Hydro Bundle4	212	33	1,012	716	84	-	-	-	(1)	-	84	75	117
Small Hydro	EK Small Hydro Bundle1	25	0	95	71	75	5	-	4	(0)	-	84	77	114
Small Hydro	KLY Small Hydro Bundle2	32	2	128	93	84	3	-	2	(0)	-	89	80	122
Wind	Peace Wind Bundle 1	117	25	492	492	70	5	-	5	(1)	10	89	82	117
Wind	Peace Wind Bundle 2	232	49	947	947	72	5	-	5	(1)	10	91	84	120
Small Hydro	NC Small Hydro Bundle1	79	12	360	272	84	4	-	4	(1)	-	91	83	125
Small Hydro	NIC Small Hydro Bundle1	81	2	325	244	85	3	-	3	(0)	-	91	83	125
Small Hydro	EK Small Hydro Bundle2	115	2	432	297	83	5	-	5	(0)	-	92	84	125
Small Hydro	VI Small Hydro Bundle1	10	4	37	28	97	-	-	-	(3)	-	94	84	133
Small Hydro	LM Small Hydro Bundle5	156	29	709	526	96	-	-	-	(1)	-	95	86	134

[1] Effective Load Carrying Capacity for intermittent resources and Dependable Capacity for non-intermittent resources.

[2] Firm Energy Load Carrying Capability for intermittent resources and Annual Firm Energy for non-intermittent resources.

Resource Option	Project Name	Installed Capacity	Effective Capacity[1] (MW)	Average Annual Energy (GWh/)	Annual Firm /Effective Energy[2] (GWh)	Base UEC @ 6% Cost of Capital	CIFT ($/MWh)	GHG Offset and Carbon Tax Cost ($/MWh)	Line Losses ($/MWh)	Capacity Credit ($/MWh)	Wind Integration Cost Adder ($/MWh)	Total Adjusted UEC ($/MWh)		
												Mid	Low	High
Wind	Peace Wind Bundle 3	354	74	1,366	1,366	77	5	-	6	(1)	10	97	89	128
Small Hydro	SE Small Hydro Bundle1	44	0	166	116	88	5	-	5	(0)	-	98	89	133
Small Hydro	PR Small Hydro Bundle1	21	0	74	53	87	6	-	6	(0)	-	100	91	135
Small Hydro	NIC Small Hydro Bundle2	66	1	234	153	93	3	-	3	(0)	-	100	90	137
Small Hydro	KLY Small Hydro Bundle3	2	0	10	5	96	2	-	3	(0)	-	101	92	140
Wind	VI Wind Bundle 1	127	27	416	416	93	-	-	-	(2)	10	101	92	139
Wind	Peace Wind Bundle 4	408	86	1,476	1,476	82	6	-	6	(2)	10	103	94	135
Small Hydro	CI Small Hydro Bundle2	20	1	83	66	94	4	-	5	(0)	-	103	93	140
Small Hydro	NC Small Hydro Bundle2	83	13	362	271	95	4	-	5	(1)	-	103	93	141
Small Hydro	LM Small Hydro Bundle6	154	31	664	466	104	-	-	-	(1)	-	103	93	145
Small Hydro	PR Small Hydro Bundle2	16	0	54	39	92	6	-	7	(0)	-	105	96	142
Biomass	Bundle - Biomass Sawmill Wood Waste	100	100	800	800	104	2	-	3	(3)	-	105	95	147
Small Hydro	VI Small Hydro Bundle2	34	12	118	103	108	-	-	-	(3)	-	105	94	148
Natural Gas - High Gas Price	Small Gas Co-generation Projects (Med GHG)	300	300	2400	2400	104	-	6	-	(3)		106	84	117
Small Hydro	EK Small Hydro Bundle3	23	1	88	57	96	5	-	5	(0)	-	107	97	145
Small Hydro	SE Small Hydro Bundle2	34	0	128	90	97	5	-	5	(0)	-	107	97	146
Natural Gas - High Gas Price	Burrard Full CCGT - CCGT (Med GHG)	1,100	1,100	8,798	8,798	102	-	9	-	(3)	-	108	75	117
Wind	Peace Wind Bundle 5	353	74	1,195	1,195	87	6	-	6	(2)	10	108	99	143
Natural Gas - High Gas Price	Burrard Half CCGT - CCGT (Med GHG)	550	550	4,399	4,399	102	-	9	-	(3)	-	108	76	118
Wind	VI Wind Bundle 2	102	22	312	312	100	-	-	-	(2)	10	108	98	148
Small Hydro	KLY Small Hydro Bundle4	31	1	111	84	104	3	-	3	(0)	-	110	100	152

Resource Option	Project Name	Installed Capacity	Effective Capacity[1] (MW)	Average Annual Energy (GWh/)	Annual Firm /Effective Energy[2] (GWh)	Base UEC @ 6% Cost of Capital	CIFT ($/MWh)	GHG Offset and Carbon Tax Cost ($/MWh)	Line Losses ($/MWh)	Capacity Credit ($/MWh)	Wind Integration Cost Adder ($/MWh)	Total Adjusted UEC ($/MWh)		
												Mid	Low	High
Small Hydro	NIC Small Hydro Bundle3	27	1	101	72	104	3	-	4	(0)	-	111	100	152
Natural Gas - High Gas Price	Greenfield Combined Cycle Gas Turbine – 500 MW (Med GHG)	494	479	3,833	3,833	101	2	9	3	(3)	-	112	79	119
Small Hydro	CI Small Hydro Bundle3	38	1	149	112	104	4	-	6	(0)	-	114	103	155
Small Hydro	PR Small Hydro Bundle3	33	0	123	89	101	6	-	7	(0)	-	114	104	154
Wind	VI Wind Bundle 3	112	8	320	320	107	-		-	(2)	10	115	104	158
Small Hydro	NC Small Hydro Bundle3	131	0	551	452	107	4	-	5	(1)		115	104	158
~~Natural Gas - High Gas Price~~	~~Small Gas Co-generation Projects (Med GHG)~~	~~300~~	~~300~~	~~2400~~	~~2400~~	~~106~~	~~-~~	~~5~~	~~-~~	~~(3)~~		~~115~~	~~91~~	~~127~~
Natural Gas - High Gas Price	Greenfield Combined Cycle Gas Turbine – 250 MW (Med GHG)	243	236	1,887	1,887	105	2	9	3	(3)	-	115	83	123
Wind	LM Wind Bundle 1	24	2	67	67	108		-		(2)	10	116	105	159
Small Hydro	EK Small Hydro Bundle4	81	1	286	190	105	6	-	6	(0)	-	117	106	159
Natural Gas - High Gas Price	VI Combined Cycle Gas Turbine – 500 MW (Med GHG)	494	479	3,831	3,831	111	-	9	-	(3)	-	117	84	124
Small Hydro	SE Small Hydro Bundle3	65	3	201	98	105	6	-	6	(0)	-	117	107	159
Wind	Peace Wind Bundle 6	342	72	1,053	1,053	96	7	-	7	(2)	10	118	108	156
~~Natural Gas - High Gas Price~~	~~Burrard Full CCGT - CCGT (Med GHG)~~	~~1,100~~	~~1,100~~	~~8,798~~	~~8,798~~	~~105~~	~~-~~	~~8~~	~~-~~	~~(3)~~	~~-~~	~~120~~	~~85~~	~~132~~
~~Natural Gas - High Gas Price~~	~~Burrard Half CCGT - CCGT (Med GHG)~~	~~550~~	~~550~~	~~4,399~~	~~4,399~~	~~106~~	~~-~~	~~9~~	~~-~~	~~(3)~~	~~-~~	~~121~~	~~86~~	~~133~~
Natural Gas - High Gas Price	VI Combined Cycle Gas Turbine – 250 MW (Med GHG)	243	236	1,887	1,887	114	-	9	-	(3)	-	120	87	128
Wind	KLY Wind Bundle 1	73	15	201	201	108	5	-	3	(2)	10	124	113	167
Wind	NIC Wind Bundle 1	79	17	217	217	108	4	-	4	(2)	10	124	113	167
~~Natural Gas - High Gas Price~~	~~Greenfield Combined Cycle Gas Turbine – 500 MW (Med GHG)~~	~~494~~	~~479~~	~~3,833~~	~~3,833~~	~~105~~	~~2~~	~~8~~	~~3~~	~~(3)~~	~~-~~	~~125~~	~~89~~	~~135~~

Resource Option	Project Name	Installed Capacity	Effective Capacity[1] (MW)	Average Annual Energy (GWh/)	Annual Firm /Effective Energy[2] (GWh)	Base UEC @ 6% Cost of Capital	CIFT ($/MWh)	GHG Offset and Carbon Tax Cost ($/MWh)	Line Losses ($/MWh)	Capacity Credit ($/MWh)	Wind Integration Cost Adder ($/MWh)	Total Adjusted UEC ($/MWh)		
												Mid	Low	High
Wind	NC Onshore Wind Bundle 1	115	24	396	396	107	5	-	5	(2)	10	126	115	169
Wind	VI Wind Bundle 4	226	48	571	571	120	-	-	-	(2)	10	128	116	176
~~Natural Gas - High Gas Price~~	~~Greenfield Combined Cycle Gas Turbine – 250 MW (Med GHG)~~	~~243~~	~~236~~	~~1,887~~	~~1,887~~	~~108~~	~~2~~	~~8~~	~~3~~	~~(3)~~	~~-~~	~~128~~	~~93~~	~~139~~
Wind	SE Wind Bundle 1	69	14	189	189	108	8	-	6	(2)	10	130	118	172
Wind	EK Wind Bundle 1	137	29	378	378	108	8	-	6	(2)	10	130	119	173
~~Natural Gas - High Gas Price~~	~~VI Combined Cycle Gas Turbine – 500 MW (Med GHG)~~	~~494~~	~~479~~	~~3,831~~	~~3,831~~	~~115~~	~~-~~	~~8~~	~~-~~	~~(3)~~	~~-~~	~~130~~	~~93~~	~~140~~
~~Natural Gas - High Gas Price~~	~~VI Combined Cycle Gas Turbine – 250 MW (Med GHG)~~	~~243~~	~~236~~	~~1,887~~	~~1,887~~	~~118~~	~~-~~	~~8~~	~~-~~	~~(3)~~	~~-~~	~~134~~	~~97~~	~~144~~
Wind	NC Onshore Wind Bundle 2	93	19	299	299	115	6	-	6	(2)	10	135	123	180
Biomass	Bundle - Biomass Roadside Wood Waste	200	200	1,600	1,600	132	2	-	4	(3)	-	135	121	214
Wind	LM Wind Bundle 2	35	7	79	79	132	-	-	-	(2)	10	140	126	192
Wind	NC Onshore Wind Bundle 3	102	21	308	308	122	6	-	6	(2)	10	142	130	191
Natural Gas - High Gas Price	Greenfield Combined Cycle Gas Turbine – 50 MW (Med GHG)	50	49	391	392	131	2	10	4	(3)	-	143	108	157
Wind	NC Offshore Wind Bundle 2	191	55	662	662	135	5	-	0	(2)	10	148	134	202
Wind	KLY Wind Bundle 2	106	22	237	237	132	6	-	4	(2)	10	149	136	202
Wind	NIC Wind Bundle 2	114	24	256	256	132	5	-	6	(2)	10	150	136	202
Wind	NC Offshore Wind Bundle 1	175	51	614	614	133	5	-	6	(2)	10	153	139	206
Wind	SE Wind Bundle 2	99	21	223	223	132	9	-	7	(2)	10	156	143	209
Wind	EK Wind Bundle 2	199	42	446	446	132	9	-	8	(2)	10	156	143	209
~~Natural Gas - High Gas Price~~	~~Greenfield Combined Cycle Gas Turbine – 50 MW (Med GHG)~~	~~50~~	~~49~~	~~391~~	~~392~~	~~135~~	~~2~~	~~8~~	~~4~~	~~(3)~~	~~-~~	~~156~~	~~118~~	~~170~~
Wind	NC Onshore Wind Bundle 4	205	43	553	553	137	7	-	7	(2)	10	158	144	213

Resource Option	Project Name	Installed Capacity	Effective Capacity[1] (MW)	Average Annual Energy (GWh/)	Annual Firm /Effective Energy[2] (GWh)	Base UEC @ 6% Cost of Capital	CIFT ($/MWh)	GHG Offset and Carbon Tax Cost ($/MWh)	Line Losses ($/MWh)	Capacity Credit ($/MWh)	Wind Integration Cost Adder ($/MWh)	Total Adjusted UEC ($/MWh)		
												Mid	Low	High
Wind	NC Offshore Wind Bundle 3	203	59	685	685	139	5	-	7	(2)	10	159	145	214
Biomass	Biomass Standing Timber (Beetle Kill Timber)	170	170	1,360	1,360	158	2	-	5	(3)	-	161	145	224
Wind	NC Offshore Wind Bundle 4	207	60	680	680	142	6	-	7	(2)	10	162	143	212
Wind	NC Offshore Wind Bundle 5	203	59	649	649	146	6	-	7	(2)	10	166	152	225
Wind	NC Offshore Wind Bundle 6	191	55	594	594	150	6	-	7	(2)	10	171	156	231
Wind	NC Offshore Wind Bundle 7	173	50	522	522	155	6	-	8	(2)	10	176	160	238