

References:

- [1] - CEB Generation Planning Branch Chief Engineer, Interview by Author (June 2009)
- [2] - "Standard Power Purchase Agreement for purchasing of electrical energy between The Ceylon Electricity Board and Renewable source small power Producer", Ceylon Electricity Board, 2004
- [3] - CEB System Control Center Engineer Interview by Author (June 2008, September 2010).
- [4] - "Long Term Generation Expansion Plan year 2006 – 2020", Ceylon Electricity Board, 2005
- [5] - "Monthly Generation Report of System Control Center", System Control Center, CEB, August 2008
- [6] - "National Energy Policy", Ministry of Power & Energy, 2008
- [7] - "Long Term Transmission Expansion Plan year 2006 -2015", Ceylon Electricity Board, 2005
- [8] - SEA, Director Planning, Interview by Author (September 2008)
- [9] - CEB, Power purchase branch Engineer, Interview by Author (August 2008)
- [10] - Article on Carbon Credit.
- [11] - "Electricity generation from renewable energy – Experience & Requirement", University of Peradeniya, February 2008
- [12] - "Explanation notes on new tariff structure", Sustainable Energy Authority, 2010.
- [13] - "Avoided Cost Tariff Calculations", Ceylon Electricity Board, 2008.
- [14] - "Study on Grid connected small power tariff", Resource Management Association, 2001
- [15] - "Pricing of Embedded generation by incorporation of externalities and avoided network losses", Asanka S. Rodrigo, Priyantha D.C Wijayatunga, 2007
- [16] - "Oil Price History and Analysis", www.wtrg.com
- [17] - "Coal Prices", www.globalcoal.com
- [18] - "Wind Energy Resources Atlas of Sri Lanka", U.S Agency for international development, 2003
- [19] - "National Energy Balance", www.energy.gov.lk
- [20] - "Dendro Fuel for Power Generation", www.bioenergysrilanka.org
- [21] - "Implication of Carbon Credit on Sri Lankan power sector", Asiri Jayawardena, 2007

[22] – “State and trends of the Carbon Market 2010”, www.forestcarbonportal.com

[23] – “Energy Purchase”, www.ccb.lk.com

[24] – “Information on Historical Prices”, Ceylon Petroleum Corporation, 2010

[25] – “Non Conventional Renewable Energy Tariff Announcement”, Sustainable Energy Authority, 2010.



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

CEB Avoided cost calculations for individual thermal plants

Small Power Purchases Tariff (2006)

Exchange rate: 1 US\$ = Rs. 110.94
 Auto Diesel Price (Rs/litre) 76.42

	GT OLD	GT NEW	KPS-JREC	Laksharavi	ANIP Power	BARGE	Sara Gd	Gambes	Matipo	ICOM	recharged	AES COP	Embaraya
Fuel Price (Rs/ton)	70.42	76.42	14.13					46.03					
Heat Content (kCal/ton)	8,652	8,652	7,413					8,652					
Heat Rate (kCal/kWh)	4.13	4.13	1,019					2,232					
Auto Diesel Price (Rs/kWh)	0.47	0.47	0.19					0.43					
Var. Cost (Rs/kWh)	30.15	33.64	10.95		12.89			16.92			12.22	11.51	11.70
Variable CSM cost													
US CSM cost	0.234	0.234	0.188					0.24					
2% ATW	0.23	0.23	0.17					0.24					
Stand-Loaded (%)	3%	3%	3%					3%					
5% ATW	1.29	0.41	0.29					0.89					
Transmission Losses (%)	0.28	0.28	0.13		0.28			0.28				0.28	0.28
(0.5% ATW)	1.23	0.85	0.19		0.41			0.95				0.77	0.43
Avoided Cost													
at 33 KV level (Rs/kWh)	34.70	34.61	14.02	13.73	33.13	12.64	11.29	13.55	13.37	12.81	11.98	11.98	13.91

Variable costs at 13kV level (Rs/kWh) for each plant

GT OLD	18.79
Karagallaya	11.16
GT NEW	14.81
Embaraya	10.93
Laksharavi	13.77
Matipo	13.57
Horena	13.55
BARGE	13.35
Sara Power	13.13
Sara Gd	12.84
recharged	12.61
AES COP	11.51
KPS-JREC	11.82
Sara Ext	11.09

55 GT OLD	14.76
129 Karagallaya	13.16
115 GT NEW	14.81
100 Embaraya	10.93
225 Laksharavi	13.77
24 Matipo	13.57
24 Horena	13.55
58 BARGE	13.35
49 Sara Power	13.13
72 Sara Gd	12.84
100 recharged	12.61
165 AES COP	11.51
115 KPS-JREC	11.82
12 Sara Ext	11.09

Exchange rate: 1 US\$ = Rs. 110.94

Auto Diesel Price (Rs/litre)

CEB avoided cost calculation

System Control Centre Dispatch Schedule 2008 - GWh

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Capacity	Cost
	GWh												MW	Rs/ kWh	
Hydro	1	1	1	1	1	1	1	1	1	1	1	1	12	12	12
Thermal	2	2	2	2	2	2	2	2	2	2	2	2	24	24	24
Wind	3	3	3	3	3	3	3	3	3	3	3	3	36	36	36
Solar	4	4	4	4	4	4	4	4	4	4	4	4	48	48	48
Geothermal	5	5	5	5	5	5	5	5	5	5	5	5	60	60	60
Biomass	6	6	6	6	6	6	6	6	6	6	6	6	72	72	72
Small Hydro	7	7	7	7	7	7	7	7	7	7	7	7	84	84	84
Renewable	8	8	8	8	8	8	8	8	8	8	8	8	96	96	96
Other	9	9	9	9	9	9	9	9	9	9	9	9	108	108	108
Total	400	400	400	400	400	400	400	400	400	400	400	400	4800		

Fixed Plant Factors

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Capacity	Cost
Hydro	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10	1.20	12	12
Thermal	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	2.40	24	24
Wind	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.60	36	36
Solar	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.60	6	6
Geothermal	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	8.40	84	84
Biomass	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.20	12	12
Small Hydro	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.60	6	6
Renewable	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.60	36	36
Other	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.60	6	6
Total	2.60	2.50	2.40	2.30	2.20	2.10	2.00	1.90	1.80	1.70	1.60	1.50	2.60		

Location of Line in the margin

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Capacity	Cost
Hydro	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10	1.20	12	12
Thermal	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	2.40	24	24
Wind	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.60	36	36
Solar	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.60	6	6
Geothermal	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	8.40	84	84
Biomass	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.20	12	12
Small Hydro	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.60	6	6
Renewable	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.60	36	36
Other	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.60	6	6
Total	2.60	2.50	2.40	2.30	2.20	2.10	2.00	1.90	1.80	1.70	1.60	1.50	2.60		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Hydro	12.00	11.00	10.00	9.00	8.00	7.00	6.00	5.00	4.00	3.00	2.00	1.00	12.00
Thermal	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	28.80
Wind	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	43.20
Solar	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	7.20
Geothermal	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	100.80
Biomass	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	14.40
Small Hydro	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	7.20
Renewable	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	43.20
Other	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	7.20
Total	26.00	25.00	24.00	23.00	22.00	21.00	20.00	19.00	18.00	17.00	16.00	15.00	26.00

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hydro	12.00	11.00	10.00	9.00	8.00	7.00	6.00	5.00	4.00	3.00	2.00	1.00	12.00	12.00
Thermal	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	28.80	28.80
Wind	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	43.20	43.20
Solar	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	7.20	7.20
Geothermal	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	8.40	100.80	100.80
Biomass	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	14.40	14.40
Small Hydro	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	7.20	7.20
Renewable	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	43.20	43.20
Other	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	7.20	7.20
Total	26.00	25.00	24.00	23.00	22.00	21.00	20.00	19.00	18.00	17.00	16.00	15.00	26.00	26.00

APPENDIX – B: SEA's Cost Based Tariff Announcement on April 2009

Non Conventional Renewable Energy Tariff Announcement

Purchase of Electricity to the National Grid under Small Power Purchase Agreements (SPPA)

Sri Lanka Sustainable Energy Authority (SLSEA) of the Ministry of Power and Energy is pleased to announce the new rates for electricity purchased by the Ceylon Electricity Board (CEB) from Non-conventional Renewable Energy (NCRE) Sources under (SPPAs) signed from today onwards. The tariffs and the SPPA will continue to be standardised and non-negotiable. The tariff will be cost-based and technology specific, and the developers have the option of selecting either a three-tier tariff or a flat tariff. The SPPAs will continue to be applicable to projects with a rated generating capacity up to 10 MW, and will be valid for a period of 20 years and extendable by mutual consent.

This tariff will remain unchanged until further notice and the tariff review process is initiated strictly on necessity.

The tariff for electricity produced using Non-conventional Renewable Energy (NCRE) sources based on Small Power Purchase Agreements (SPPAs) signed from today onwards would be as follows:
All prices are in Sri Lanka Rupees per kilowatt hour (LKR/kWh).

Option 1: Three-tier Tariff

This will consist of a fixed rate, operations and maintenance (O&M) rate and a fuel rate.

Technology	Escalable Base O&M Rate	Escalable Base Fuel rate	Non-escalable fixed rate		Escalable Year 16+ Base rate	Royalty to Govt. paid direct by the power purchaser Year 16+
			Year 1-8	Year 9-15		
Mini hydro	1.55	None	14.18	5.16	1.62	10% of total tariff
Wind	2.46	None	22.53	8.19	1.62	10% of total tariff
Biomass (Dendro)	1.24 (1-15 years)	7.14	8.50	3.09	1.62	No royalty
	1.55 (16th year onwards)					
Agricultural & Industrial Waste	1.24 (1-15 years)	None	8.50	3.09	1.62	No royalty
	1.55 (16th year onwards)					
Municipal Waste	1.13	None	12.26	4.46	1.62	No royalty
Waste Heat Recovery	0.49	None	10.15	3.69	1.62	No royalty
Escalation rate for year 2009	8.06%	5.37%	None	None	5.37%	

Note 1: Escalation of O&M rate and fuel rate shall commence from the 1st day of the month of January immediately after the commercial operation date.

Note 2: The applicable escalation rate for each subsequent year shall be the rate announced for that particular year.

Note 3: To compensate for the higher tariffs in tier 1, developers will be required to deliver in tier 2, an average amount of energy at least equal to that delivered in tier 1. This obligation will be stipulated in the agreement, with corresponding penalties for non-delivery in tier 2.

Note 4: Biomass (Dendro) means sustainably grown firewood.

Option 2: Flat Tariff

Technology	All inclusive rate (LKR/kWh) for years 1-20
Mini hydro	14.56
Wind	23.07
Biomass (Dendro)	18.56
Agricultural & Industrial Waste	13.88
Municipal Waste	15.31
Waste Heat Recovery	9.55

Note 1: The flat tariff will not be escalated for any reason over the entire 20-year period.

Note 2: Extensions after the 20th year will be at the same rate as for an option 1 project.

The selection between options 1 and 2 would be at the discretion of the developer, at the time of signing the SPPA.

Sri Lanka Sustainable Energy Authority
3G 17 BMICH
Buddhaloka Mawatha
Colombo 00700.
e-mail : info@energy.gov.lk
web : www.energy.gov.lk

2009 April 24

