EASTERN AFRICA POWER POOL

Executive Strategy Workshop to map out priorities for IRENA's Africa Clean Energy Corridor initiative

Current and projected costs of generation

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Outline

- EAPP members-Electricity tariff
- Unit generation cost-Thermal options
- EAPP region-Unit generation cost of candidate hydro projects(Uganda, Tanzania, Sudan, Kenya)
- Screening curve for Non-Hydro options-Ethiopia
- Trends on Power exchanges

Typical Electricity Tariff($cents/Kwh)

Country	Residential	Commercial
Ethiopia	6.3	7.7
Kenya	23.1	16.1
Tanzania	17.2	14.0

- Current generation cost in EAPP member states ~5-20$/kwh

EAPP-Future thermal options

- Unit generation costs

Country	*Type*	*Capacity (MW)*	*Capital cost with IDC ($/kW)*	*Fixed cost c/kWh*	*Variable cost c/kWh*	*Total cost c/kWh*	*Fixed cost %*	*Variable cost %*
Egypt	STPP - NG	1300	1196	2.57	1.82	4.39	59%	41%
	CCGT - NG	1000	1021	2.04	1.43	3.47	59%	41%
	Nuclear	1000	4430	8.44	0.96	9.40	90%	10%
Ethiopia	Geothermal	75/100	3503	6.73	1.75	8.48	79%	21%
Kenya	Geothermal	140	4437	8.38	1.75	10.13	83%	17%
	STPP - coal (Richards Bay)	300	2919	5.92	5.05	10.97	54%	46%
Rwanda	Diesel/Methane	100	3613	6.69	2.05	8.74		
Sudan	STPP - Crude	250	2034	4.05	9.38	13.43	77%	23%
Tanzania	STPP - Coal	400	3482	6.77	2.65	9.42	30%	70%
	OCGT - NG	240	1001	2.03	5.10	7.13	72%	28%
Uganda	CCGT - Gasoil	185	1361	2.68	21.73	24.41	28%	72%
	STPP - HFO	60	2034	4.13	14.27	18.90	11%	89%

EAPP region-Unit cost of Candidate hydro projects-Uganda

Name	Generation		Investment Cost									Annual Costs (MUSD)				Unit Prices	
	Ins. Cap MW	Avrg. Energy GWh	Orig. cost MUSD	Price Year	Esc.In dec. 2009	Esc. Dec. 09 MUSD	Const Years	IDC %	Cost IDC in MUSD	Env. Mitigation in MUSD	Total Cost in MUSD	Amort	O& M	Insurance + Interim Repl.	Total	Energy Cost c/kWh	Invest Cost $/kW
Uganda																	
Karuma High	700	5512	2660	2009	100	2660	5		2660	133	2793	282	4	10	295	5.35	3990
Ayago	550	4336	2048	2009	100	2048	4		2048	102	2151	217	3	8	227	5.24	3910
Murchison High	750	5904	1580	2009	100	1580	5		1580	79	1658	167	4	6	177	3.00	2211
Isimba	100	788	346	2009	100	346	4		346	17	363	37	1	1	38	4.87	3631

Notes :

The capital cost of large hydro plants includes the cost of transmission required to connect the HPP to the system

Environmental Mitigation costs already include IDCs.

EAPP region-Unit cost of Candidate hydro projects-Tanza

Name	Generation		Investment Cost									Annual Costs (MUSD)				Unit Prices	
	Installed Cap. MW	Average Energy GWh	Original cost MUSD	Price Year	Esc. Index 2009	Escalated to Dec. 09 MUSD	Const. Years	IDC %	Total Cost with IDC MUSD	Env. Mitigation MUSD	Total Cost MUSD	Amortization	O & M	INS+INT REPL	Total	Energy unit cost c/kWh	Cost $/kW
TANZAN IA																	
Ruhudji	358	1928	494.74	2008	100.0	494.74	5	24.24	614.68	0.00	614.68	62.00	1.79	2.15	65.94	3.42	1717
Kinansi II	120	69	191.91	2008	100.0	191.91	3	15.68	222.01	0.00	222.01	22.39	0.60	0.78	23.77	34.45	1850
Masigira	118	664	208.67	2008	100.0	208.67	4	18.05	246.34	0.00	246.34	24.85	0.59	0.86	26.30	3.96	2088
Rumakali	222	1475	458.90	2008	100.0	458.90	5	24.24	570.15	0.00	570.15	57.50	1.11	2.00	60.61	4.11	2568
Mpanga	144	955	248.96	2008	100.0	248.96	4	18.05	293.91	0.00	293.91	29.64	0.72	1.03	31.39	3.29	2041
Stiegler Gorge 1	300	2230	872.68	2008	100.0	872.68	5	24.24	1084.24	0.00	1084.24	109.36	1.50	3.79	114.65	5.14	3614
Stiegler Gorge 2	600	1506	310.91	2008	100.0	310.91	5	24.24	386.28	0.00	386.28	38.96	3.00	1.35	43.31	2.88	644
Stiegler Gorge 3	300	1523	254.87	2008	100.0	254.87	5	24.24	316.66	0.00	316.66	31.94	1.50	1.11	34.55	2.27	1056
Igamba Falls (Stage 2)*	8	65	11.30	2004	127.2	14.37	3	15.68	16.63	0.00	16.63	1.68	0.04	0.06	1.78	2.73	2078
Igamba Falls 980 m	80	494	404.00	2004	127.2	513.85	4	18.05	606.62	0.00	606.62	61.18	0.40	2.12	63.71	12.90	7583
Ikondo	340	1842	640.88	2009	100.0	640.88	3	15.68	741.39	0.00	741.39	74.78	1.70	2.59	79.07	4.29	2181
Taveta	145	850	379.88	2009	100.0	379.88	3	15.68	439.46	0.00	439.46	44.32	0.73	1.54	46.59	5.48	3031
Songwe Bipugu	34	153	84.07	2004	127.2	106.93	3	15.68	123.70	0.00	123.70	12.48	0.17	0.43	13.08	8.55	3638
Songwe Sofre	157	736	255.05	2004	127.2	324.40	3	15.68	375.28	0.00	375.28	37.85	0.79	1.31	39.95	5.43	2390
Songwe Manolo	149	780	259.32	2004	127.2	329.83	3	15.68	381.56	0.00	381.56	38.48	0.75	1.34	40.56	5.20	2561
Kakono (High)	53	404	90.07	2008	100.0	90.07	3	15.68	104.20	0.00	104.20	10.51	0.27	0.36	11.14	2.76	1966
Kishanda	207	1087	181.00	2004	127.2	230.21	4	18.05	271.78	0.00	271.78	27.41	1.04	0.95	29.40	2.70	1313
Luiche	15	100	68.70	2004	127.2	87.38	3	15.68	101.08	0.00	101.08	10.20	0.08	0.35	10.63	10.63	6607
Rusumo Falls (Full)	62	444	227.44	2008	100.0	227.44	4	18.05	268.50	29.45	297.95	30.05	0.31	1.04	31.40	7.07	4845

EAPP region-Unit cost of Candidate hydro projects-Sudan

Name	Generation		Investment Cost									Annual Costs (MUSD)				Unit Prices	
	Installed Cap. MW	Average Energy GWh	Original cost MUSD	Price Year	Esc. Index 2009	Escalated to Dec. 09 MUSD	Const. Years	IDC %	Total Cost with IDC MUSD	Env. Mitigation MUSD	Total Cost MUSD	Amortization	O & M	INS+INT REPL	Total	Energy unit cost c/kWh	Cost $/kW
SUDAN																	
Sabaloka	90	670	596	2006	104.5	623.00	4	18.05	735.47	31.15	766.62	77.32	0.45	2.68	80.45	12.01	8518
Shereiq	315	1962	876	2006	104.5	915.68	5	24.24	1137.67	0.00	1137.67	114.74	1.58	3.98	120.30	6.13	3612
Kagbar	300	1413	763	2006	104.5	797.56	5	24.24	990.92	39.88	1030.80	103.97	1.50	3.61	109.07	7.72	3436
Dal 1 (low)	340	1968	1113	2007	101.4	1128.58	5	24.24	1402.18	0.00	1402.18	141.42	1.70	4.91	148.03	7.52	4124
Dagash	285	1503	800	2006	104.5	836.24	5	24.24	1038.97	41.81	1080.78	109.01	1.43	3.78	114.21	7.60	3792
Fula 1	720	4134	1319	2006	104.5	1378.75	5	24.24	1713.00	68.94	1781.94	179.72	3.60	6.24	189.56	4.59	2475
Shukoli	210	1443	420	2006	104.5	439.03	4	18.05	518.29	21.95	540.24	54.49	1.05	1.89	57.43	3.98	2573
Lakki	210	1443	429	2006	104.5	448.43	4	18.05	529.39	22.42	551.82	55.66	1.05	1.93	58.64	4.06	2628
Bedden	400	2748	880	2006	104.5	919.86	5	24.24	1142.87	45.99	1188.86	119.91	2.00	4.16	126.07	4.59	2972
Rumela	30	83	193	2006	104.5	201.74	3	15.68	233.38	10.09	243.47	24.56	0.15	0.85	25.56	30.79	8116

EAPP region-Unit cost of Candidate hydro projects-Kenya

Name	Generation		Investment Cost									Annual Costs (MUSD)				Unit Prices	
	Installed Cap. MW	Average Energy GWh	Original cost MUSD	Price Year	Esc. Index 2009	Escalated to Dec. 09 MUSD	Const. Years	IDC %	Total Cost with IDC MUSD	Env. Mitigation MUSD	Total Cost MUSD	Amortization	O & M	INS+INT REPL	Total	Energy unit cost c/kWh	Cost $/kW
KENYA																	
Mutonga	60	336	235.30	2008	100.0	235.30	3	15.68	272.20	0.00	272.20	27.45	0.30	0.95	28.71	8.54	4537
Low Grand Falls	140	707	460.90	2008	100.0	460.90	4	18.05	544.11	0.00	544.11	54.88	0.70	1.90	57.48	8.13	3887
Magwagwa	120	525	294.50	2004	127.2	374.57	4	18.05	442.20	0.00	442.20	44.60	0.60	1.55	46.75	8.90	3685
Karura	56	184	196.00	2009	100.0	196.00	3	15.68	226.74	0.00	226.74	22.87	0.28	0.79	23.94	13.01	4049

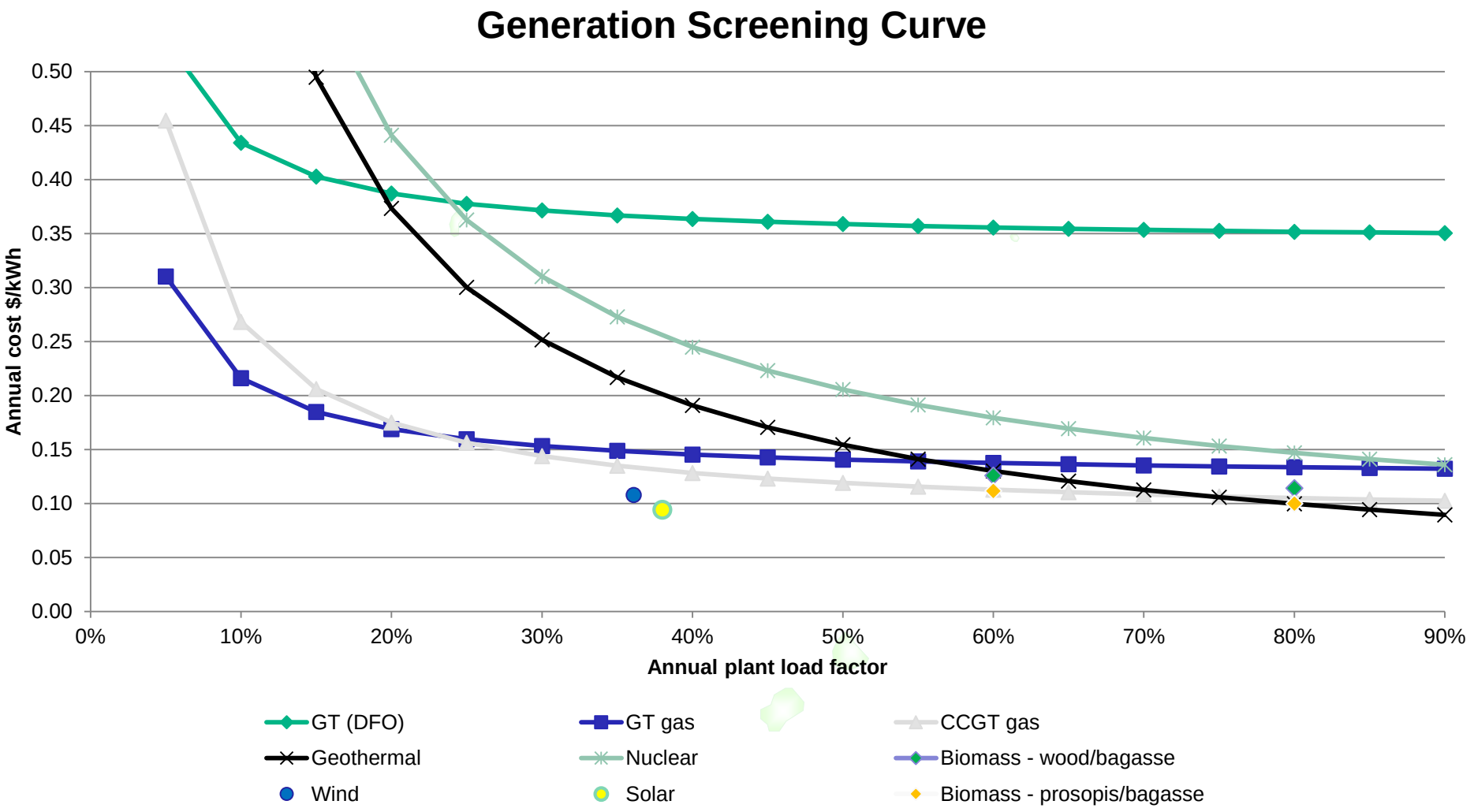
Typical future generation projects-Unit cost($cents/Kwh)

- Ethiopia- (3-5)
- Uganda- (3-5)
- Tanzania-(3-5)
- Sudan-(4-8)
- Kenya-----(8-10)

EAPP region-Unit cost of Candidate hydro projects..

- DRC and Ethiopia have even more attractive hydro sites.
- But there is interest in the development of Geothermal/Wind/Solar power(Energy mix)..
- Looking at hydro, the best projects in terms of unit cost are yet to come.
- Fossil-fuelled generation hardly compete with hydro in the EAPP region, but with geothermal/wind/solar based generation.
- Imports also affect the average generation cost in the individual systems with less hydro potential

Screening Curves for Non-Hydro Plant $/kWh



Power exchange trends...

- Significant power exchange already exists between Ethiopia, Sudan and Djibouti. PPA is already signed between Kenya and Ethiopia for a firm power transfer of 400MW.
- More generation projects to be commissioned in EAPP region from the short to the long term ,which leads to increased power exchange between members
- More PPAs and WAs are expected to be signed in the near future(ex.TZ/ET/KE)
- There seem to be no space for future major fossil-based generation in EAPP if countries remain committed to development of the vast RE potential in the region

THANK YOU

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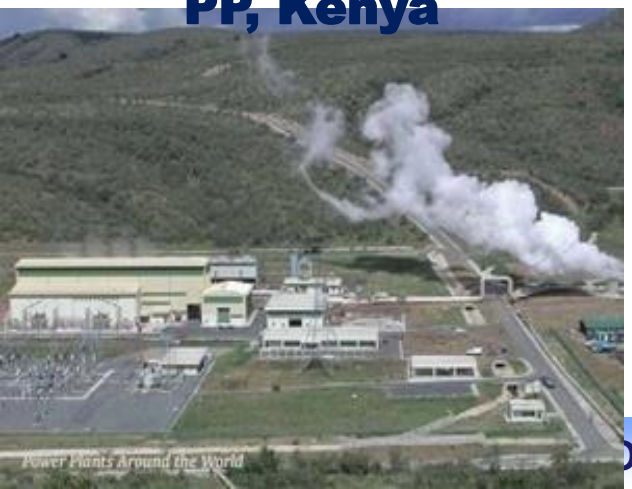
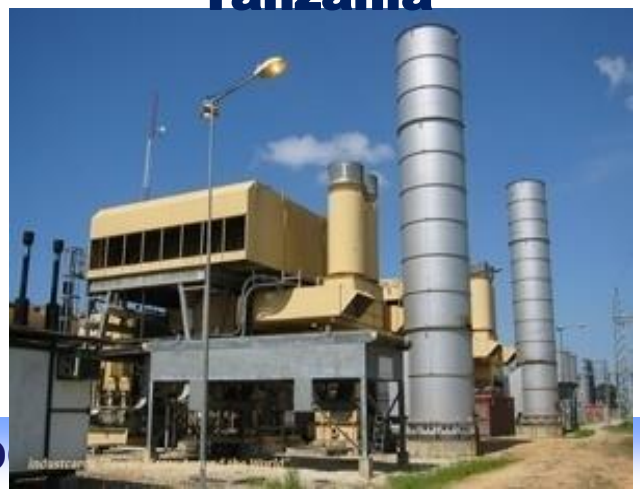
Zafarana Wind Farm, Egypt

Olkaria Geothermal PP, Kenya



Ubungo Gas PP, Tanzania



Merowe Hydro PP, Sudan