CURRENT AND PROSPECTIVE COSTS OF ELECTRICITY GENERATION

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(1) Overview

This work provides a comprehensive survey of current and future cost estimates in the electricity sector, covering renewable and conventional generation. Among the various cost estimates available, we focus on the production costs, including capital costs, fixed and variable operation & maintenance costs (O&M), and variable costs; in addition, we provide estimates on plant availability, technical lifetime, and operational flexibility.

The objective of this document is to provide a unified dataset that can be used for model comparisons. DIW Berlin and TU Berlin are currently involved in various studies on future energy system development. The standardization of the cost assumptions should provide a comprehensive common dataset, and thus add value to modeling exercises and comparisons.

(2) Methods

In making the use of data transparent, the document aligns with the "Ethical code for appropriate scientific behavior for economists" set out by the Verein fuer Socialpolitik (VfS 2012) for German speaking economists, requiring, amongst other things, that research be transparent and tractable, and that data, source code, and results be made publicly available; it is also in line with the American Economic Association Disclosure Policy (AEA 2012).

The following tables summarize the most important findings and estimates on generation technologies. Based on an assessment of available data, we propose the following set of costs for the use in models. Note that nuclear investment cost includes decommissioning and waste disposal; CCTS operation and maintenance costs include the cost of carbon transportation and storage.

	Investment cost in 2010 EUR/kW	**2010**	**2020**	**2030**	**2040**	**2050**
WIND	Onshore	1300	1240	1182	1127	1075
	Offshore	3000	2742	2506	2290	2093
SOLAR	PV	1800	1474	1207	989	810
	CSP	3500	2841	2307	1872	1520
BIO	Biomass	2500	2350	2209	2076	1951
GEO	Geothermal	4200	3775	3392	3049	2740
HYDRO	Pump storage or reservoir**	2000	2000	2000	2000	2000
	Run-of-river	3000	3000	3000	3000	3000
MARINE	Wave and Tidal	5000	4246	3605	3062	2600
NUCLEAR	Nuclear – Generation 3	6000	5833	5671	5513	5360
COAL	Coal – IGCC w/o CCTS	1800	1729	1660	1595	1531
	Coal – IGCC w CCTS	3200*	2992	2798	2616	2447
	Coal – PC w/o CCTS (Advanced/SuperC)	1300	1224	1153	1086	1023
	Coal – PC w CCTS (Advanced/SuperC)	2700*	2500	2314	2143	1984
	Coal – PC w/o CCTS (Subcritical)	1200	1130	1065	1003	944
	Coal - PC w CCTS (Subcritical)	2600*	2407	2229	2063	1910
	Lignite – Advanced (BoA) w/o CCTS	1700	1601	1508	1420	1338
	Lignite – Advanced (BoA) w CCTS	3100*	2870	2657	2460	2278
GAS	Gas CC w/o CCTS	800	764	729	696	664
	Gas CC w CCTS	1400*	1306	1219	1138	1062
	Gas Combustion Turbine w/o CCTS	400	400	400	400	400
	Gas Combustion Turbine w CCTS	1000*	933	871	813	758
	Gas Steam Turbine w/o CCTS	400	400	400	400	400
OIL	Oil Combustion Turbine w/o CCTS	400	400	400	400	400
	Oil Steam Turbine w/o CCTS	400	400	400	400	400

* CCTS costs are reported for 2010 although the technology is not available for commercial applications
** Pump storage is usually more expensive than reservoir storage. Investment cost also depends on storage size

(3) Results

All-in-costs (Levelized Cost of Electricity, LCoE) and their composition as a function of dependence of full load hours are illustrated below. A 9% discount rate is assumed with 2010 fuel prices (IEA 2011b) and a CO_2 price of 20 EUR/t. EEX prices help to identify the range at which power plants would be profitable. Even at high use factors, power plants hardly generate profits from "energy-only markets" under 2010 EEX prices. Gas CCGT plants demonstrate the best cost performance at typical use rates. Nuclear power is not competitive in any case, with all-in-costs of around 100 EUR/MWh at 8000 full load hours; this does not yet include insurance costs.

Screening curves plot energy cost expressed in terms of money per installed capacity unit. The graph illustrates that gas-fired plants are the cheapest technology at low full load hours. As full load hours increase, coal-fired technologies expose lower per-unit cost compared to gas-fired plants. Onshore wind turbines are the cheapest option from around 1000 full load hours onwards, a use rate easily attained in central European locations. CCTS and nuclear power do not prove competitive at any instance, except in a scenario of high CO_2 prices combined with high use rates.

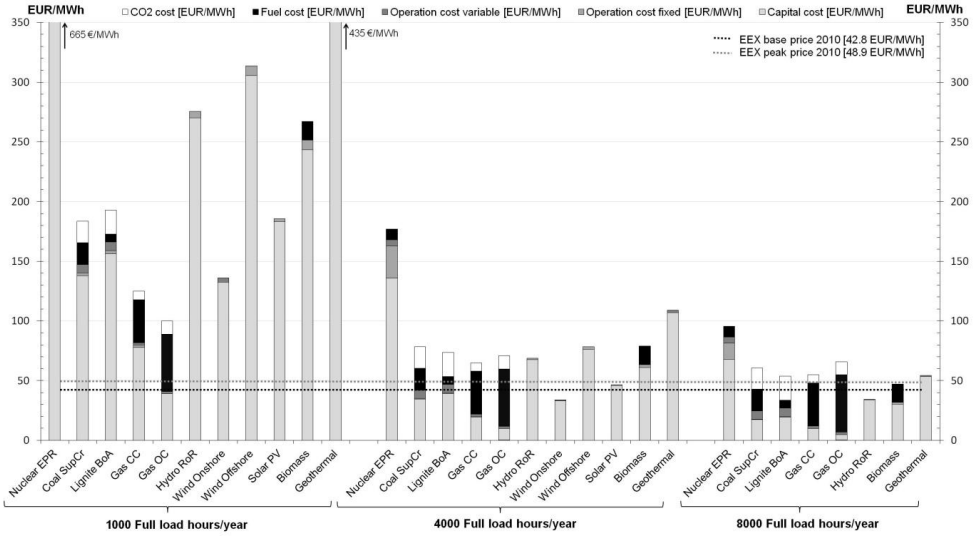

Fig. 1: Levelized Cost of Electricity

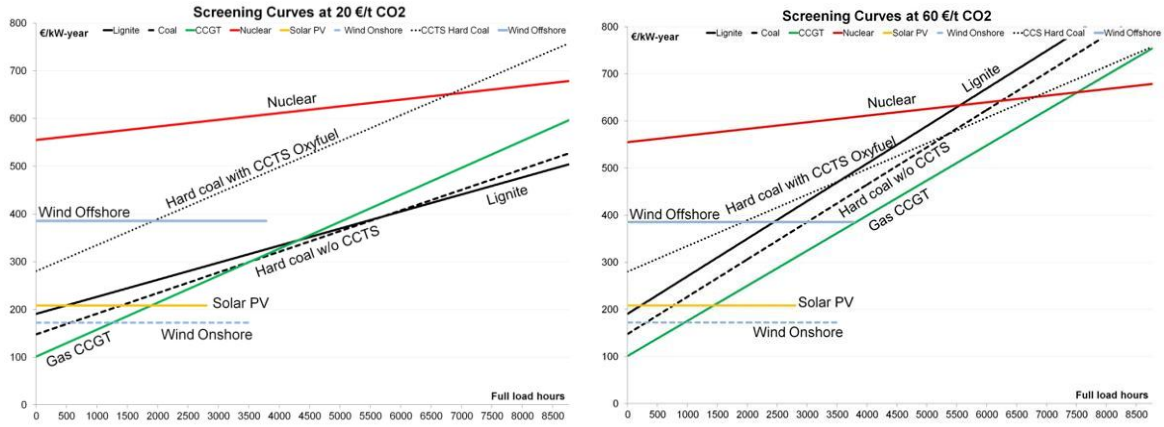

Fig. 1: Screening curve

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