

Electricity pricing

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Electricity pricing (sometimes referred to as **electricity tariff** or the **price of electricity**) varies widely from country to country, and may vary significantly from locality to locality within a particular country. There are many reasons that account for these differences in price. The price of power generation depends largely on the type and market price of the fuel used, government subsidies, government and industry regulation, and even local weather patterns.

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Basis of electricity rates

Electricity prices vary between countries and can even vary within a single region or distribution network of the same country. In standard regulated monopoly markets, electricity rates typically vary for residential, commercial, and industrial customers. Prices for any single class of electricity customer can also vary by time-of-day or by the capacity or nature of the supply circuit (e.g., 5 kW, 12 kW, 18 kW, 24 kW are typical in some of the large developed countries); for industrial customers, single-phase vs. 3-phase, etc. If a specific market allows real-time dynamic pricing, a more recent option in limited markets to date typically following the introduction of electronic metering, prices can even vary between times of low and high electricity network demand.

The actual electricity rate (cost per unit of electricity) that a customer pays can often be heavily dependent on customer charges, particularly for small customers (e.g. residential users).^[1]

The cost also differs by the source of the electricity. In the U.S. in 2002, the typical cost of electricity from different sources is around: Coal: 1-4 cents; Gas: 2.3-5.0 cents; Oil: 6-8 cents; Wind: 5-7 cents; Nuclear: 6-7 cents; Solar: 12.2 cents.^[2] However, electricity costs vary greatly. Renewable sources reach grid parity in parts of the world where conventional power plants based on fossil fuel are costly enough (e.g. transportation costs of diesel to isolated communities). The varying costs involved in producing electricity lead to great variance in average electricity rates for residents of different states in the U.S.^[3]

Country/Territory	US cents/kWh	US cents/megajoule	Date	Source
American Samoa	38.3 to 40.4	10.64 to 11.22		[10]
Argentina	3.1 ^[a] (subsidized)	0.86 (Buenos Aires)	2006	[7][11]
Argentina (Concordia)	19.13 ^[a]	5.31	Jun 14, 2013	
Australia	varies by state anywhere from 15-26 per kWh mans a service fee of \$0.70 AUD a day	6.11 to 11.06	Dec 21, 2016	[12][13][14]
Bahrain	0.79 to 4.23 (0.79 for first 3000 kWh; 2.38 for 3001-5000 kWh and 4.23 for every additional kWh. Exchange rate used from BHD to USD is 0.378)		Aug 19, 2015	[15]
Bangladesh	2.95 to 9.24		Mar 13, 2014	[16]
Belarus	13.8 to 69.8		Jun 21, 2016	[17]
Belgium	29.08	8.08	Nov 1, 2011	[18][19]
Bhutan	1.88 to 4.40	0.52 to 1.22	Mar 23, 2012	[20][21]
Bulgaria	13.38 day (between 7:00-23:00 DST); 9.13 night	2.54 to 3.72	Oct 29, 2014	[22][23][24]
Brazil	12.00 to 25.00 varying by state and Electricity Service Provider		Jul 7, 2016	[25]
Cambodia	15.63 to 21.00 in Phnom Penh	4.34 to 5.83	Feb 28, 2014	[26][27]
Canada, Ontario	14.6		2015	[28]
Canada, Ontario, Toronto	6.52 to 11.69 depending on time of day plus transmission, delivery, and other charges of about 3.75 per kWh	1.81 to 3.25	Feb 9, 2014	[29]
Canada, Quebec	5.41 for the first 30 kWh/day then 7.78 + 40.64/day for subscription fee		2012	[30]
China	0.04 USD - 0.45 USD		2014	[31]
Chile	23.11		Jan 1, 2011	[32][33]
Colombia (Bogota)	18.05		Jun 1, 2013	[34][35]
Cook Islands	34.6 to 50.2			[10]
Croatia	17.55		Jul 1, 2008	[36]
Denmark	33		May 1, 2015	[18][19]
United Arab Emirates	6.26 to 10.35 (plus 1.63 fuel surcharge)			[37][38]
Egypt	Priced into sections at a kWh/Month, subsidized ^[a] 0.98 @ 0-50 kWh/M 1.89 @ 51-100 kWh/M 2.08 @ 0-200 kWh/M		Jul 17, 2014	[39] [40]

Country/Territory	US cents/kWh	US cents/megajoule	Date	Source
	3.12 @ 201-350 kWh/M 4.42 @ 351-650 kWh/M 7.8 @ 651-1000 kWh/M 9.62 @ 1000+ kWh/M			
Ethiopia	6.7 to 7.7 ^[a]		Dec 31, 2012	^[41]
Fiji	12 to 14.2			^[10]
Finland	20.65		Nov 1, 2011	^{[18][19]}
France	19.39		Nov 1, 2011	^{[18][19]}
Germany	32.04		Feb 1, 2015	^[42]
Romania	18.40		Jun 26, 2013	^[43]
Guyana	26.80		Apr 1, 2012	^[44]
Switzerland	25.00		Jan 6, 2014	^[45]
Hungary	23.44		Nov 1, 2011	^{[18][19]}
Hong Kong	12.04 to 24.05		Jan 1, 2013	^{[46][47]}
India	0.1 to 18 (Average 7)		March 1, 2014	^[48]
Indonesia	11		Jul 21, 2015	^[49]
Iceland	5.54		Nov 8, 2015	^[50]
Iran	2 to 19		Jul 1, 2011	
Iraq	Residential pricing per kWh used, subsidized ^[a] 2.5 @ 0-500 kWh/M 4.17 @ 501-1000 kWh/M 7.5 @ 1001-1500 kWh/M 11.67 @ 1501-2000 kWh/M 14.17 @ 2001-3000 kWh/M 16.67 @ 3001-4000 kWh/M 18.75 @ > 4001 kWh/M		Apr 8, 2015	^[51]
Ireland	28.36		Nov 1, 2011	^{[18][19]}
Israel	16 ^[a]		Jun 1, 2013	^[52]
Italy	28.39		Nov 1, 2011	^{[18][19]}
Jamaica	44.7		Dec 4, 2013	^{[53][53]}
Japan	20 to 24		Dec 31, 2009	^{[54][55]}
Jordan	5 ^[a] to 33		Jan 30, 2012	^[56]
Kazakhstan	4.8 to 8.2		Dec 13, 2016	
Kiribati	32.7			^[57]
South Korea			Jan 14, 2013	^[58]

Country/Territory	US cents/kWh	US cents/megajoule	Date	Source
	Priced into a sliding scale at a kWh/Month, residential service (low-voltage) ^[a] 5.1 @ 0-100 kWh/M 10.5 @ 101-200 kWh/M 15.7 @ 201-300 kWh/M 23.5 @ 301-400 kWh/M 34.9 @ 401-500 kWh/M 59.3 @ 501- kWh/M			
Kuwait	0.3 to 3		Jan 1, 2016	^[59]
Laos	11.95 for >150kWh, 4.86 for 26-150 kWh, 4.08 for 0-25 kWh		Feb 28, 2014	^[60] ^[61]
Latvia	18.25		Jun 1, 2012	^[62] ^[62]
Lithuania	12		July 1, 2016	^[63]
Macedonia	7 to 10 industrial-14		Aug 1, 2013	^[64]
Malaysia	Domestic Consumer pricing per kWh used, subsidized 4.95 @ 1 to 200 kWh 7.59 @ 201 to 300 kWh 11.73 @ 301 to 600 kWh 12.41 @ 601 to 900 kWh 12.98 @ 901 kWh onwards (Exchange Rate of 4.4 MYR to 1 USD on Nov 24, 2016)		Jan 1, 2014	^[65]
Marshall Islands	32.6 to 41.6			^[66]
Mexico	19.28 ^[b]		Aug 22, 2012	^[67] ^[68]
Moldova	11.11		Apr 1, 2011	^[69]
Myanmar	3.6		Feb 28, 2014	
Nepal	7.2 to 11.2		Jul 16, 2012	^[70]
Netherlands	28.89		Nov 1, 2011	^[18] ^[19]
New Caledonia	26.2 to 62.7			^[10]
New Zealand	19.15		Apr 19, 2012	
Nicaragua	Priced into a sliding scale at a kWh/Month, ^[a] Residential T-0 10 @ 0-25 kWh/M 21 @ 26-50 kWh/M 22 @ 51-100 kWh/M		Sep 1, 2014	^[71]

Country/Territory	US cents/kWh	US cents/megajoule	Date	Source
	29 @ 101-150 kWh/M 27 @ 151-500 kWh/M 43 @ 501-1000 kWh/M 48 @ 1000+ kWh/M			
Niue	44.3			[57]
Nigeria	2.58 to 16.55		Jul 2, 2013	[72]
Norway	15.9		Jul 25, 2013	
Pakistan	General Supply Tariff - Residential 2 < 50 kWh/M 5.79 @ 1-100 kWh/M 8.11 @ 101-200 kWh/M 10.21 @ 201-300 kWh/M 16 @ 301-700 kWh/M 18 >700 kWh/M		14 Jul 2015	[73]
Palau	22.83			[57]
Papua New Guinea	19.6 to 38.8			[10]
Paraguay	8		2011	[74]
Peru	10.44		2007	[75][76]
Philippines	18.22		October 7, 2015	[77]
Portugal	25.25		Nov 1, 2011	[18][19]
Russia	2.4 to 14		Nov 1, 2011	[18][19]
Rwanda	22 to 23.6		2016	[78]
Saudi Arabia	1 to 7 (from the first 2,000 kWh/month to more than 10,000 kWh/month)		Sep 9, 2015	[79]
Serbia	3.93 to 13.48, average ~6,1 ^[d]		Feb 28, 2013	[80]
Singapore	25.28		Sep 30, 2014	[81]
Spain	15		May 1, 2015	[82]
Sri Lanka	Priced into sections at a kWh/Month, subsidized ^[a] 1.84 @ 0-30 kWh/M 3.57 @ 31-60 kWh/M 5.78 @ 0-60 kWh/M 7.36 @ 61-90 kWh/M 20.43 @ 91-120 kWh/M 23.55 @ 121-181 kWh/M 33.12 @ 180+ kWh/M		Sep 16, 2014	[83]
Solomon Islands	88 to 99			[84]

Country/Territory	US cents/kWh	US cents/megajoule	Date	Source
South Africa	13		Sep 29, 2015	^[85] ^[86]
Surinam	3.90 to 4.84		Nov 20, 2013	^[87]
Sweden	8.33		Feb 3, 2015	^[18]
Tahiti	25 to 33.1			^[10]
Taiwan	7 to 17		Jun 1, 2012	^[88]
Thailand	6 to 13		July 1, 2013	^[89]
Tonga	47		Jun 1, 2011	^[10]
Trinidad and Tobago	4		July 8, 2015	^[90]
Turkey	11.20 residential (Low voltage) 11.29 business (Low voltage) 8.78 industry (Medium voltage)		Jul 1, 2016	^[91]
Turks and Caicos Islands	35.39		March 16, 2016	^[92]
Tuvalu	36.55			^[57]
Uganda	4.44 (First 15 kWh in a month for domestic consumers) 19.26 (Above 15 kWh in a month for domestic consumers)		Aug 9, 2016	^[93]
Ukraine	2.6 to 10.8		2014	^[94] ^[95]
United Kingdom	22		May 1, 2015	^[18] ^[96]
United States	8 to 17 ; 37 ^[c] 43 ^[c]		Sep 1, 2012	^[97] ^[98]
United States Virgin Islands	48.9 to 51.9		Oct 1, 2014	^[99]
United Arab Emirates-Al Ain	0 to 8.23 (i.e. AED 0 to AED 0.305)		2017	^[100]
Uruguay	17.07 to 26.48		Feb 11, 2014	^[101]
Uzbekistan	4.95		2011	^[102]
Vanuatu	60			^[10]
Venezuela	3.1 at Official exchange rate (13.50 Bs/US\$) or 0.48 cents at unofficial exchange rate (1.095 Bs/US\$)			^[103]
Vietnam	6.20 to 10.01		2011	^[104]
Western Samoa	30.5 to 34.7			^[10]

^a Denotes countries with government subsidized electricity tariffs.^[105]^[106]^[107]

^b Mexico has subsidized electricity tariffs according consumption limits, more than 500kWh consumed bimonthly meet no subsidies. This tariff corresponds to the most expensive. Only 1% of Mexico's population pays this tariff.
[108]

^c Hawaii.

^d Prices don't include VAT (20%)

^e San Diego, California high-tier

The U.S. Energy Information Administration (EIA) also publishes an incomplete list (<http://www.eia.gov/emeu/international/elecprih.html>) of international energy prices, while the International Energy Agency (IEA) provides a thorough, quarterly review for purchase. (http://www.iea.org/publications/free_new_Desc.asp?PUBS_ID=2385)

Forecasting

Electricity price forecasting is simply the process of using mathematical models to predict what electricity prices will be in the future.

Forecasting methodology

The simplest model for day ahead forecasting is to ask each generation source to bid on blocks of generation and choose the cheapest bids. If not enough bids are submitted, the price is increased. If too many bids are submitted the price can reach zero or become negative. The offer price includes the generation cost as well as the transmission cost along with any profit. Power can also be sold or purchased from adjoining power pools.^{[109][110][111]}

Wind power and solar power, being non-dispatchable, is normally taken before any other bids, and at a pre-determined rate for each supplier. Any excess is sold to another grid operator, or stored, using pumped-storage hydroelectricity, or in the worst case, curtailed.^[112] The HVDC Cross-Channel line between England and France is bidirectional, but is normally used to capacity to purchase power from France. Allocation is done by bidding.^[113]

Driving factors

In addition to the basic production cost of electricity, electricity prices are set by supply and demand.^[114] Everything from salmon migration to forest fires can affect current and future power prices. However, when forecasting those prices there are some fundamental drivers that are the most likely to be considered.

Power quality

In the modern world, transmission, production and consuming electrical power associated with excessive Total Harmonic Distortions (THD) and not unity Power Factor (PF) would be costly for owners. Cost of PF and THD impact is difficult to estimate, but it causes heat and vibration, malfunctioning, and even meltdowns. Usually the electric company monitors the situation at the transmission level, and it is difficult to predict or model at the consuming level. A spectrum of Compensation devices^[115] mitigate at some level any bad outcomes, but true improvements would be achieved only with real-time Correction devices (old style switching type^[116] modern low-speed DSP driven^[117] and near real-time^[118]). Most modern devices reduce a wide range of problems, while maintaining short ROI and significant reduction of ground currents. Another reason to mitigate the problems is to

reduce cost for the operation and generation of the electrical energy, which is commonly done by Electric Power Distribution companies in conjunction with generation companies. Power Quality out of unity would cause serious erroneous responses from many kinds of analog and digital equipment, where the response could be unpredictable.

Phase balancing

Currently most common distribution network and generation of electrical power is done with 3 phase structures, with special attention paid to the phase balancing and resulting reduction of ground current. It is true for industrial or commercial networks where most power is used in 3 phase machines, but light commercial and residential users would not have real-time capabilities to do phase balancing. Often this issue leads to unexpected equipment behavior or malfunctions and in extreme cases fires. For example, sensitive professional analogue or digital recording equipment always needs to be connected to well balanced and grounded power networks. To determine and mitigate the cost of the unbalanced electricity network, electric companies in most cases charge by demand or as separate category for heavy unbalanced loads. There are a few simple techniques available for balancing,^[119] but in the dynamic world of demanding loads, it would be difficult to do it without fast computing and real-time modeling.

Weather driven demand

Studies show that generally demand for electricity is driven largely by temperature. Heating demand in the winter and cooling demand (air conditioners) in the summer are what primarily drive the seasonal peaks in most regions. Heating degree days and cooling degree days help measure energy consumption by referencing the outdoor temperature above and below 65 degrees Fahrenheit, a commonly accepted baseline.^[120]

Hydropower availability

Snowpack, streamflows, seasonality, salmon, etc. all affect the amount of water that can flow through a dam at any given time. Forecasting these variables allows one to predict the available potential energy for a dam for a given period.^[121] Some regions such as the Pacific Northwest get a large percentage of their generation from hydro-electric dams.

Power plant and transmission outages

Whether planned or unplanned, outages affect the total amount of power that is available to the grid.

Fuel prices

The fuel used to generate electricity at a power plant is the primary cost incurred by electrical generation companies. Particularly, coal, as a fuel for base load power plants and more important, to a degree, natural gas for peaking power plants affect power prices.^[122] This will change as more renewable energy is used, when the capital cost will be the primary cost, as renewable energy (other than biomass and biofuel) has no fuel cost.

Economic health

During times of economic hardship, many factories will cut back their production due to a reduction of consumer demand and therefore reduce production-related electrical demand.^[123]

See also

- Cost of electricity by source
- Energy economics
- Feed-in tariff
- Stranded costs
- Levelised energy cost
- Electricity market
- Electricity liberalization
- Demand response
- Spark spread

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