

FACT SHEETS ABOUT PHOTOVOLTAICS

European Technology & Innovation Platform PV

PV the cheapest electricity source almost everywhere

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The cost of solar photovoltaic (PV) systems has decreased dramatically over the past years. Market prices of PV modules have decreased by about 90% and system prices 80% during the past decade. PV has reached parity with retail and wholesale electricity in most countries. The concept of Levelised Cost of Electricity (LCOE) is used for making fair comparisons with electricity prices and the cost of other power generation technologies. In this factsheet, LCOE is defined to be the generation cost, i.e., including all the costs involved in supplying PV power at the point of connection to the grid. PV LCOE is based on PV system capital (CAPEX) and operational (OPEX) expenditures and includes the costs and profit margins of the whole value chain including financing, project development, manufacturing, installation, operation and maintenance.

PV system CAPEX can be divided into two parts: the modules and the Balance of System (BoS). For decades, module prices have very closely followed the so-called learning curve, which means that each time the global cumulative PV generation capacity doubles, the price of modules decreases by about 25%. However, during the last decade the learning rate (LR) has been 40%. It is expected that module prices will decrease according to the historical LR during the next decades, mainly

because of better manufacturing processes, less use of materials and continuously improving module efficiencies. Since a large part of BoS depends on the area of the modules, higher efficiency will also drive down the BoS significantly.

According to the base scenario by the European Technology and Innovation Platform for Photovoltaics (ETIP PV), the cumulative global PV capacity would increase from the end of year 2019 figure of 0.634 TWp to about 3 TWp by 2030 and to 20 TWp by 2050. Applying this volume growth, a 25% LR and an average 0.4%-point annual average efficiency improvement, PV LCOE would decrease from 2020 by about 35% by 2030 and by about 60% by 2050. Figures 1-4 show the PV LCOE at six European locations with four system sizes and different nominal Weighted Average Costs of Capital (WACC) rates. Annual inflation is set at 2% which means that e.g. 4% nominal WACC corresponds to 2% real WACC. PV system lifetime is 30 years and annual degradation 0.5% in all cases. OPEX for utility-scale from 2020 to 2050 decreases from 9 to 4 €/kWp/a, for rooftop solar it is 20% more. All prices are given in 2020 real euros. Other input parameters are given in Tables I and II.

Location	Rooftop		Ground	
	2020	2030	2020	2030
Helsinki	960	1010	1010	1070
London	980	1040	1040	1100
Munich	1130	1200	1200	1270
Toulouse	1270	1350	1350	1430
Rome	1490	1580	1580	1670
Malaga	1680	1790	1790	1890

Table I. Yield parameters (in kWh/kW_p/a)

If compared with the average variable retail electricity prices, even excluding the fixed fees which cannot be saved by own PV consumption, PV electricity is already cheaper in all six locations with all realistic WACC rates and consumer segments.

PV system type	2020	2025	2030	2040	2050
Residential 5 kW _p	1.05	0.86	0.73	0.57	0.47
Commercial 50 kW _p	0.69	0.56	0.47	0.36	0.29
Industrial 1 MW _p	0.52	0.41	0.35	0.26	0.21
Utility-scale 100 MW _p	0.43	0.34	0.29	0.22	0.17

Table II. CAPEX parameters (without VAT, in 2020 €/W_p)



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When comparing with the average wholesale (spot market) electricity prices in 2019, utility-scale PV was already competitive with over 7% nominal WACC in Germany and Finland and with over 10% WACC in other four countries. In Malaga, utility-scale PV LCOE with 7% nominal WACC is currently 22 €/MWh, decreasing to 14 €/MWh by 2030 and to 9 €/MWh by 2050. In several countries around the world, power purchase agreements (PPAs) below 15 €/MWh have been signed which proves that PV already is the cheapest electricity form when a moderate interest rate truly reflects its inherent low technological and environmental risk.

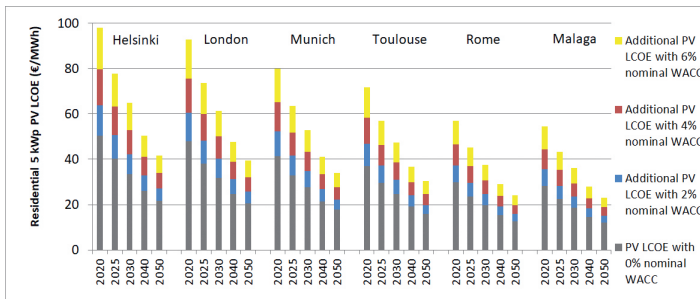


Figure 1. PV LCOE (in 2020 €) at six European locations with different nominal WACCs for 5 kWp residential rooftop PV. VAT (2020 rate: FIN 24%, UK 20%, GER 19%, FRA 20%, ITA 10%, ESP 21%) has been added to the residential PV CAPEX.

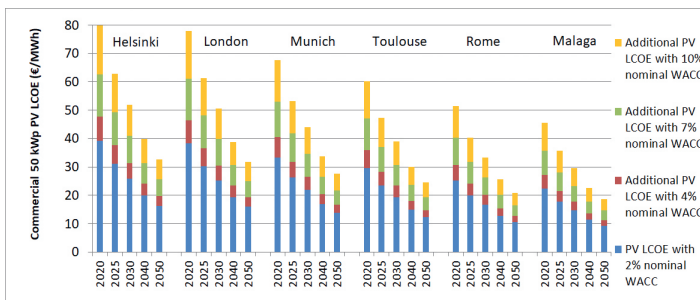


Figure 2. PV LCOE (in 2020 €) at six European locations with different nominal WACCs for 50 kWp commercial rooftop PV.

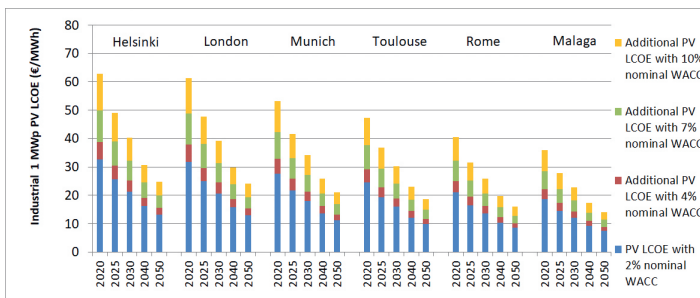


Figure 3. PV LCOE (in 2020 €) at six European locations with different nominal WACCs for 1 MWp industrial PV.

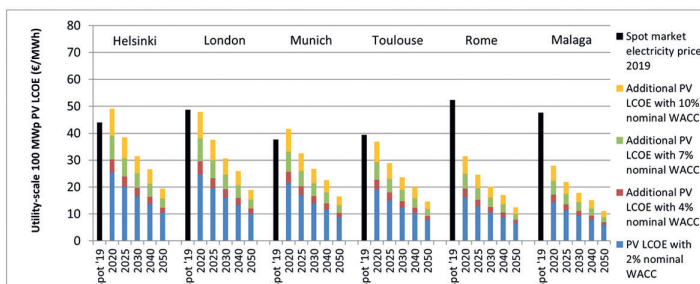


Figure 4. PV LCOE (in 2020 €) six European locations with different nominal WACCs for 100 MWp utility-scale PV compared with average spot market electricity price in 2019 (black column).

