RENEWABLE POWER GENERATION COSTS IN 2021

EXECUTIVE SUMMARY

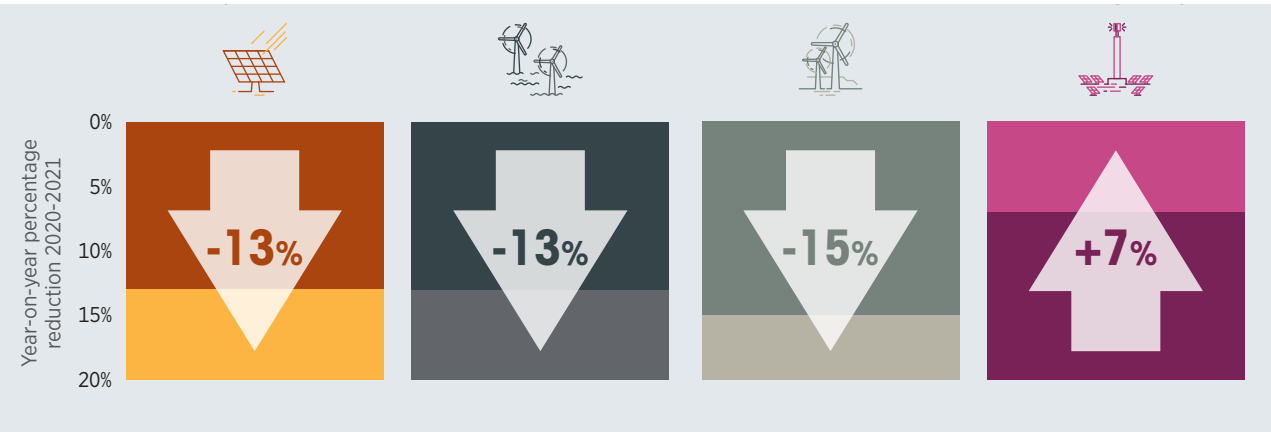
The competitiveness of renewables continued to improve in 2021. Data from the IRENA Renewable Cost Database and analysis of recent power sector trends affirm their essential role in the journey towards an affordable and technically feasible net zero future.

The global weighted average cost of newly commissioned solar photovoltaics (PV), onshore and offshore wind power projects in 2021 fell. This was despite rising commodity and renewable equipment prices in 2021 given there is a notable lag before these cost increases appear in project total installed costs; and significant improvements in performance in 2021 raised capacity factors, especially for onshore wind.

The global weighted average levelised cost of electricity (LCOE) of new utility-scale solar PV projects commissioned in 2021 fell by 13% year-on-year, from USD 0.055/kWh to USD 0.048/kWh. With only one concentrating solar power (CSP) plant commissioned in 2021, after two in 2020, deployment remains limited and year-to-year cost changes volatile. Noting this caveat, the average cost of electricity from the new CSP plant was around 7% higher than the average in 2020.

The global weighted average LCOE of new onshore wind projects added in 2021 fell by 15%, year-on-year, from USD 0.039/kilowatt hour (kWh) in 2020 to USD 0.033/kWh. China again dominated new onshore wind capacity additions in 2021 and also experienced, against the trend elsewhere, falling wind turbine prices. The cost of electricity for new onshore wind projects excluding China, fell by a more modest 12% year-on-year to USD 0.037/kWh. The offshore wind market, saw unprecedented expansion in 2021 (21 GW added), as China increased its new capacity additions and the global weighted average cost of electricity fell by 13% year-on-year, from USD 0.086/kWh to USD 0.075/kWh.

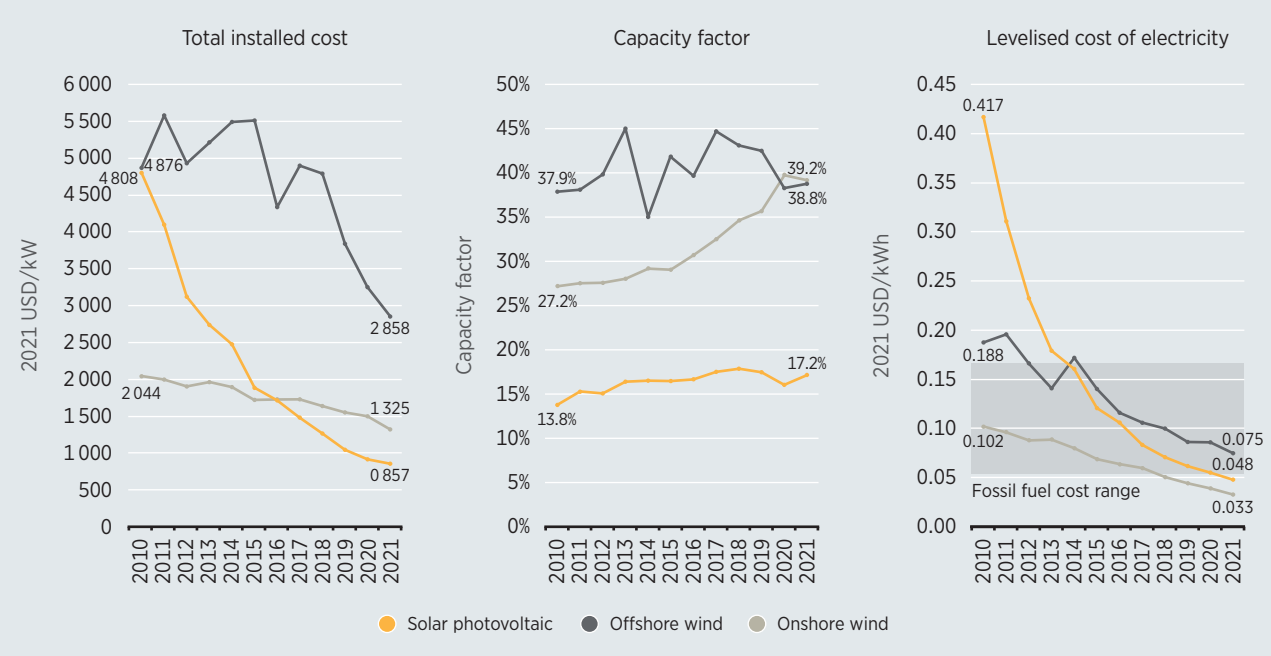
Figure ES.1 Change in global weighted levelised cost of electricity by technology, 2020-2021



Cost reductions were not universal however, the country weighted average total installed costs of utility-scale solar PV increased year-on-year in three of the top 25 markets, while for onshore wind this was true of seven of the top 25 markets in 2021.

The period 2010 to 2021 has witnessed a seismic shift in the balance of competitiveness between renewables and incumbent fossil fuel and nuclear options. The global weighted average LCOE of newly commissioned projects utility-scale solar PV projects declined by 88% between 2010 and 2021, that of onshore wind and CSP by 68%, and offshore wind by 60% (Figure ES.2).

Figure ES.2 Global weighted average total installed costs, capacity factors and LCOE of newly commissioned utility-scale solar PV, onshore and offshore wind, 2010-2021



In 2021, the global weighted average LCOE of new utility-scale solar PV and hydropower was 11% lower than the cheapest new fossil fuel-fired power generation option and that of onshore wind 39% lower. Geothermal and bioenergy globally remain, on average, more expensive than the cheapest fossil fuel-fired option, but provide secure supply and can be very competitive in non-OECD regions.

Rising commodity prices, especially materials prices such as steel, copper, polysilicon and aluminium; saw module and wind turbine prices rise from around Q4 2020. For instance, depending on materials prices and other supply chain pressures over the rest of this year, solar PV module prices might average a fifth more than they did in 2020. Yet, in 2021, the global weighted average cost of electricity from new solar PV and onshore wind fell. There are a number of potential reasons for this, including:

- Overall equipment cost increases were modest in late 2020 and into early 2021, when many projects commissioned in 2021 would have placed orders.

- Larger projects have greater purchasing power and longer lead times, and are increasingly dominating capacity additions outside Europe.

- Contingency allowances in many projects will have absorbed some or all of any increased costs.

- Technology improvements (*e.g.* more efficient PV modules and larger wind turbines) and improvements in manufacturing efficiency and scale continue.

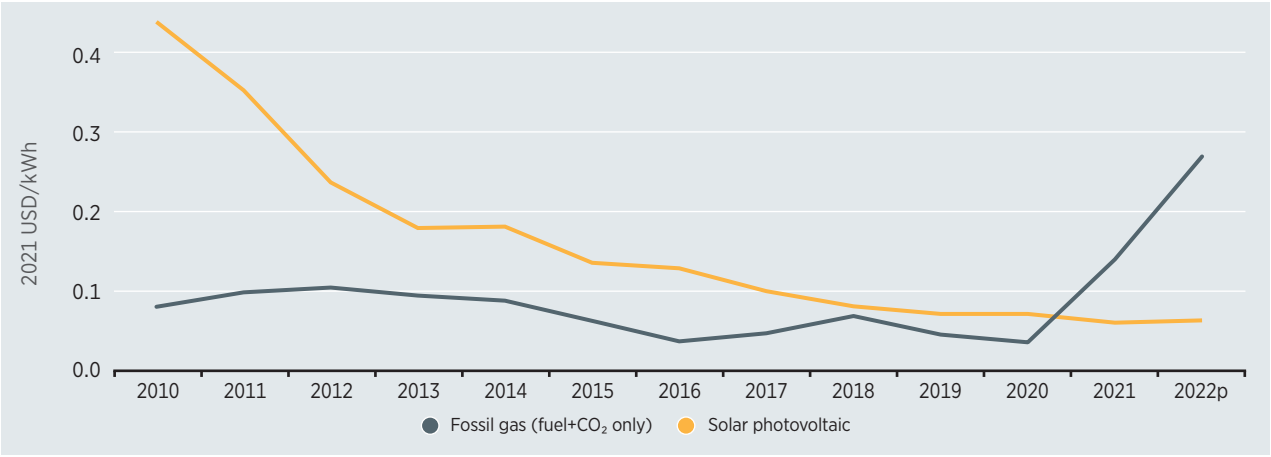
- China remains the dominant market for new solar and wind and has lower commodity prices, transport costs, while wind project developers squeezed turbine price reductions from manufacturers in 2021.

However, the data suggests that not all of the materials cost increases witnessed to date have been passed through into equipment prices, while manufacturer's margins have also been squeezed. If materials prices remain elevated in 2022, this suggests – when combined with the lag between materials costs increases and project costs – that price pressures in 2022 will be more pronounced than in 2021 and total installed costs are likely to rise this year in more markets.

The impact on the levelised cost of electricity for solar PV and onshore wind is, however, likely to be modest – in the order of 2-4% for utility-scale solar PV and 4-9% for onshore wind. Increasing profit margins to the more sustainable levels seen in 2017, might increase this figure for onshore wind to an 8% to 12% increase, but it is not clear if all these cost increases could be passed through in 2022 alone. More importantly, with the extremely high fossil fuel prices already experienced in 2022 likely to continue, the additional cost is outweighed many times over by the economic benefit of new renewable capacity.

Indeed, the extent of the benefits from renewables in 2022 will be unprecedented. Assuming average wholesale fossil gas prices in 2022 of USD 0.109/kWh in Europe, the average generated fuel-only cost (excludes carbon dioxide (CO_2) prices) of existing fossil gas generators will be in the order of USD 0.23/kWh, or 540% higher than in 2020. The European Union (EU) Emissions Trading Scheme (ETS) emission prices also raises fuel costs to USD 0.27/kWh in 2022, or 645% higher than in 2020, (Figure ES.3). To put this figure of USD 0.27/kWh in context; this is 4 to 6 times more expensive than the new solar and onshore wind capacity added in Europe in 2021 and it exceeds the average retail tariff (excluding taxes and levies) paid by households in 13 EU of the 27 countries in 2020 that covered transmission, distribution, wholesale electricity purchases, marketing and overheads.

Figure ES.3 The weighted average LCOE of utility scale solar PV compared to fuel and CO_2 cost only for fossil gas in Europe, 2010-2022



Note: 2022 values are possible outcomes for 2022 and not a forecast.

Countries investments in renewables are paying huge dividends in 2022. Globally, new renewable capacity added in 2021 could save USD 55 billion this year alone, given the fossil fuel price crisis. Looking at the benefit of the cumulative stock of renewables draws an even starker picture. In Europe, between January and May 2022, solar PV and wind generation alone have likely avoided in the order USD 50 billion in fossil fuel imports, predominantly fossil gas. The unprecedented extent of the fossil fuel price crisis in 2022 has overshadowed the fact, that without renewables, the situation for consumers, economies and the environment would be much worse.

Marginal fossil fuel electricity generating costs are so high in 2022, that a new onshore wind plant connected to the grid on 1 January 2022 and operating in the wholesale market might receive revenues in 2022 alone that are between around two (in Mexico) and thirteen times (in Brazil), the required annual return on capital required from the possible marginal avoided costs of fossil fuel generation for the full year. That countries have not prioritised accelerated renewable power generation capacity deployment in this year, but left the response largely to individuals and business, appears likely to have cost society billions of dollars this year and the next in direct energy costs. This is before accounting for the macroeconomic damage that accrues from the fossil fuel price crisis.

Table ES.1 Global weighted average total installed cost, capacity factor and levelised cost of electricity trends by technology, 2010 and 2021

	Total installed costs (2021 USD/kW)			Capacity factor (%)			Levelised cost of electricity (2021 USD/kWh)		
	2010	2021	Percent change	2010	2021	Percent change	2010	2021	Percent change
Bioenergy	2 714	2 353	-13%	72	68	-6%	0.078	0.067	-14%
Geothermal	2 714	3 991	47%	87	77	-11%	0.050	0.068	34%
Hydropower	1 315	2 135	62%	44	45	2%	0.039	0.048	24%
Solar PV	4 808	857	-82%	14	17	25%	0.417	0.048	-88%
CSP	9 422	9 091	-4%	30	80	167%	0.358	0.114	-68%
Onshore wind	2 042	1 325	-35%	27	39	44%	0.102	0.033	-68%
Offshore wind	4 876	2 858	-41%	38	39	3%	0.188	0.075	-60%