



RENEWABLE POWER GENERATION COSTS IN 2020

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FOREWORD

Renewables are becoming more and more competitive in the energy landscape. The data from the IRENA Renewable Cost Database shows cost declines continued in 2020, with the cost of electricity from utility-scale solar photovoltaics (PV) falling 7% year-on-year, offshore wind fell by 9%, onshore wind by 13% and that of concentrating solar power (CSP) by 16%.

The decade 2010 to 2020 saw dramatic improvement in the competitiveness of solar and wind power technologies. Between 2010 and 2020, the cost of electricity from utility-scale solar photovoltaics (PV) fell 85%, followed by concentrating solar power (CSP; 68%), onshore wind (56%) and offshore wind (48%). The last decade has seen CSP, offshore wind and utility-scale solar PV all join onshore wind in the cost range for new capacity fired by fossil fuels, when calculated without the benefit of financial support. Indeed, the trend is not only one of renewables competing with fossil fuels, but significantly undercutting them.

This is not just the case where new generating capacity is required. The analysis in this report shines a spotlight on how even existing coal plants are increasingly vulnerable to being undercut by new renewables. Indeed, our analysis suggests that up to 800 gigawatts (GW) of existing coal-fired capacity could be economically replaced by new renewables capacity, saving the electricity system up to USD 32 billion per year and reducing carbon-dioxide (CO₂) emissions by up to 3 gigatonnes (Gt) CO₂. This would provide 20% of the emissions reduction needed by 2030 for the 1.5°C climate pathway outlined in IRENA's *World Energy Transitions Outlook*. There is no room for these coal assets to be part of the energy future, retrofitting with carbon capture and storage would only increase costs. While the flexibility to integrate very high shares of renewables will come from other, cheaper sources, with IRENA having identified 30 options that can be combined into comprehensive solutions in the report *Innovation landscape for a renewable powered future*.

IRENA has, for over a decade, highlighted the essential role renewable power generation will play in the energy transition, as the opportunities for cost reduction were time and again, demonstrated, and then, in many cases, exceeded as smart policy and the razor-sharp focus of industry combined to unlock better performance and lower costs. The insights from IRENA's data bear witness to the fruits of IRENA's pluriannual programme of work and its focus on providing our Member States with the facts they need to support the energy transition at home. With falling renewable power generation costs, updates to Nationally Determined Contributions (NDC) need to consider the opportunities that have emerged in recent years. Countries can be more ambitious, and IRENA is ready to support them in that process.

This report also reinforces one of the key messages of our *World Energy Transitions Outlook 2021*, that very low-cost renewables can not only form the backbone of a decarbonised electricity system, but support a radically different future energy system where renewable hydrogen – derived from very low-cost renewable electricity – and modern biomass provide the last key to unlocking an affordable pathway to a 1.5°C future for us all. Now is the time to seize that opportunity.




Francesco La Camera

Director-General

International Renewable
Energy Agency

CONTENTS

	Figures, Tables and Boxes	5
	Abbreviations	10
	Highlights	11
	EXECUTIVE SUMMARY	12
	Renewable power generation costs in 2020	12
	Renewable power generation cost trends, 2010-2020: A decade of falling costs	14
	Renewable power generation is becoming the default economic choice for new capacity. . . .	16
	Low-cost renewable power is stranding existing coal-fired power plants.	18
	Solar and wind power technologies have remarkable learning rates	19
	LATEST COST TRENDS	20
	Introduction	21
	Solar and wind power cost trends in 2020	24
	Cost trends 2010-2020: A decade of decline	26
	Auction and Power Purchase Agreement price trends	34
	Learning curves for solar and wind power technologies	37
	Low-cost renewable hydrogen today: Is it possible?	46
	ONSHORE WIND	50
	Highlights	51
	Introduction	52
	Onshore wind total installed costs	55
	Capacity factors	57
	Operation and maintenance costs	60
	Levelised cost of electricity	62
	SOLAR PHOTOVOLTAICS	66
	Highlights	67
	Recent market trends	68
	Total installed costs	68
	Capacity factors	78
	Operation and maintenance costs	81
	Levelised cost of electricity	82
	OFFSHORE WIND	90
	Highlights	91
	Introduction	92
	Total installed costs	95
	Capacity factors	98
	Operation and maintenance costs	100

05	CONCENTRATING SOLAR POWER	104
	Highlights	105
	Total installed costs	107
	Capacity factors	110
	Operations and maintenance costs	112
	Levelised cost of electricity	113
06	HYDROPOWER	118
	Highlights	119
	Total installed costs	120
	Capacity factors	127
	Operation and maintenance costs	128
	Levelised cost of electricity	130
07	GEOHERMAL	132
	Highlights	133
	Introduction	134
	Total installed costs	136
	Capacity factors	137
	Levelised cost of electricity	138
08	BIOENERGY	140
	Highlights	141
	Bioenergy for power	142
	Biomass feedstocks	142
	Total installed costs	143
	Capacity factors and efficiency	146
	Operation and maintenance costs	147
	Levelised cost of electricity	148
09	RENEWABLE HEAT COSTS	152
	Solar thermal for district heating in Denmark	154
	Large-scale solar thermal in Austria, Germany and Mexico	155
	Economies of scale	156
■	REFERENCES	159
■	ANNEX I Cost metric methodology	164
	Changing financing conditions for renewables and the weighted average cost of capital . . .	168
■	ANNEX II The IRENA Renewable Cost Database	176
■	ANNEX III Regional Groupings	178

FIGURES

Figure ES.1 Global weighted-average LCOE from newly commissioned, utility-scale solar and wind power technologies, 2019-2020.	13
Figure ES.2 Global LCOEs from newly commissioned, utility-scale renewable power generation technologies, 2010-2020.	15
Figure ES.3 The global weighted-average LCOE and PPA/auction prices for solar PV, onshore wind, offshore wind and CSP, 2010-2023.	17
Figure 1.1 Global LCOE from newly commissioned utility-scale solar and wind power technologies, 2019-2020.	25
Figure 1.2 Global LCOEs from newly commissioned, utility-scale renewable power generation technologies, 2010-2020.	27
Figure 1.3 Annual and cumulative total new renewable power generation capacity added at a lower cost than the cheapest fossil fuel-fired option, 2010-2020.	29
Figure 1.4 Global weighted-average total installed costs by technology, 2010-2020.	31
Figure 1.5 Global weighted-average utility-scale capacity factor by technology, 2010-2020.	32
Figure 1.6 Global weighted-average utility-scale LCOE by technology, 2010-2020.	33
Figure 1.7 The project and global weighted-average LCOE and PPA/auction prices for solar PV, onshore wind, offshore wind and CSP, 2010-2023.	35
Figure 1.8 The global weighted-average total installed cost learning curve trends for solar PV, CSP, onshore and offshore wind, 2010-2020.	38
Figure 1.9 The global weighted-average LCOE learning curve trends for solar PV, CSP, onshore and offshore wind, 2010-2021/23.	39
Figure 1.10 Operating costs only of existing coal-fired power plants in Bulgaria, Germany, India and the United States by installed capacity and capacity factor in 2020.	42
Figure B1.1 Benchmark real WACC estimates for utility-scale solar PV projects in the G20, 2021.	45
Figure 1.11 Scenarios for LCOH ₂ from utility-scale solar PV and onshore wind under different input assumptions in Saudi Arabia.	47
Figure 2.1 Global weighted-average total installed costs, capacity factors and LCOE for onshore wind, 2010-2020.	51
Figure 2.2 Weighted-average onshore wind rotor diameter and nameplate capacity evolution, 2010-2020.	53
Figure 2.3 Wind turbine price indices and price trends, 1997-2021.	54
Figure 2.4 Total installed costs of onshore wind projects and global weighted-average, 1983-2020.	55
Figure 2.5 Onshore wind weighted-average total installed costs in 15 countries, 1984-2020.	56
Figure 2.6 Historical onshore wind average capacity factors and wind speed for projects commissioned in 2020.	58
Figure 2.7 Historical onshore wind weighted-average capacity factors in 15 countries, 1984-2020.	59
Figure 2.8 Full-service (initial and renewal) O&M pricing indexes and weighted-average O&M costs in Denmark, Germany, Ireland, Japan, Norway, Sweden and the United States, 2008-2020.	61
Figure 2.9 LCOE of onshore wind projects and global weighted average, 1983-2020.	63
Figure 2.10 The weighted-average LCOE of commissioned onshore wind projects in 15 countries, 1984-2020.	64
Figure 3.1 Global weighted-average total installed costs, capacity factors and LCOE for PV, 2010-2020.	67

Figure 3.2	Average monthly solar PV module prices by technology and manufacturing country sold in Europe, 2010 to 2020 (top) and average yearly module prices by market in 2013 and 2020 (bottom)	69
Figure 3.3	Total installed PV system cost and weighted averages for utility-scale systems, 2010-2020	72
Figure 3.4	Utility-scale solar PV total installed cost trends in selected countries, 2010-2020	73
Figure 3.5	Detailed breakdown of utility-scale solar PV total installed costs by country, 2020	74
Figure 3.6	Detailed breakdown of utility-scale solar PV total installed costs in selected European countries and Chile, 2020	76
Figure 3.7	Global average inverter load ratio trend, 2010-2020	79
Figure B3.1	Behind-the-meter residential lithium-ion battery system prices in Germany, Australia, France, Italy and the United Kingdom, 2014-2020	80
Figure 3.8	Global utility-scale solar PV project levelised cost of electricity and range, 2010-2020	82
Figure B3.2	Drivers of the decline of LCOE of utility-scale solar PV (2010-2020)	83
Figure 3.9	Utility-scale solar PV weighted average cost of electricity in selected countries, 2010-2020	84
Figure B3.3	Scenarios for utility-scale solar PV LCOE under different input assumptions in Saudi Arabia	88
Figure 4.1	Global weighted-average and range of total installed costs, capacity factors and LCOE for offshore wind, 2010-2020	91
Figure 4.2	Average distance from shore and water depth for offshore wind, 2000-2020	93
Figure 4.3	Project turbine size and global weighted-average turbine size and wind farm capacity for offshore wind, 2000-2020	94
Figure 4.4	Project and weighted-average total installed costs for offshore wind, 2000-2020	95
Figure 4.5	Representative offshore wind farm total installed cost breakdowns by country/region, 2013, 2016, 2017 and 2019	98
Figure 4.6	Project and weighted-average capacity factors for offshore wind, 2000-2020	99
Figure 4.7	Offshore wind project and global weighted-average LCOEs and auction/PPA prices, 2000-2024	102
Figure 5.1	Global weighted-average total installed costs, capacity factors and LCOE for CSP, 2010-2020	105
Figure 5.2	CSP total installed costs by project size, collector type and amount of storage, 2010-2020	109
Figure 5.3	Capacity factor trends for CSP plants by direct normal irradiance and storage duration, 2010-2020	111
Figure 5.4	The LCOE for CSP projects by technology and storage duration, 2010-2020	113
Figure 5.5	Decomposition of the reduction in LCOE for CSP projects by source, 2010-2020	115
Figure B5.1	Results of recent auction and PPA results for utility scale solar PV and CSP	116
Figure 6.1	Global weighted-average total installed costs, capacity factors and LCOE for hydropower, 2010-2020	119
Figure 6.2	Total installed costs by project and global weighted average for hydropower, 2010-2020	122
Figure 6.3	Total installed costs for small and large hydropower projects and the global weighted-average, 2010-2020	123
Figure 6.4	Distribution of total installed costs of large and small hydropower projects by capacity, 2010-2015 and 2016-2020	124

<p>Figure 6.5 Total installed cost by project and capacity weighted averages for large hydropower projects by country/region, 2010-2020 126</p> <p>Figure 6.6 Total installed costs by project and capacity weighted averages for small hydropower projects by country/region, 2010-2020 126</p> <p>Figure 6.7 Large hydropower project LCOE and capacity weighted averages by country/region, 2010-2020 131</p> <p>Figure 6.8 Small hydropower project LCOE and capacity weighted averages by country/region, 2010-2020 131</p> <p>Figure 7.1 Global weighted-average total installed costs, capacity factors and LCOE for geothermal, 2010-2020 133</p> <p>Figure 7.2 Geothermal power total installed costs by project, technology and capacity, 2007-2021 137</p> <p>Figure 7.3 Capacity factors of geothermal power plants by technology and project size, 2007-2021 138</p> <p>Figure 7.4 LCOE of geothermal power projects by technology and project size, 2007-2021 139</p> <p>Figure 8.1 Global weighted-average total installed costs, capacity factors and LCOE for bioenergy, 2010-2020 141</p> <p>Figure 8.2 Total installed costs of bioenergy power generation projects by selected feedstocks and country/region, 2010-2020 145</p> <p>Figure 8.3 Total installed costs of bioenergy power generation projects for different capacity ranges by country/region, 2010-2020 145</p> <p>Figure 8.4 Project capacity factors and weighted averages of selected feedstocks for bioenergy power generation projects by country and region, 2010-2020 146</p>	<p>Figure 8.5 LCOE by project and weighted averages of bioenergy power generation projects by feedstock and country/region, 2010-2020 149</p> <p>Figure 8.6 LCOE and capacity factor by project of selected feedstocks for bioenergy power generation projects, 2010-2020 150</p> <p>Figure 9.1 Total installed costs and LCOHEAT for solar thermal district heating plants in Denmark, 2010-2019 155</p> <p>Figure 9.2 Total installed costs and LCOHEAT for commercial and industrial-scale solar thermal plants in Austria, Germany and Mexico, 2010-2020 156</p> <p>Figure 9.3 Total installed costs for district heating projects by installed capacity in Europe, 2010-2020 157</p> <p>Figure A2.1 Distribution of projects by technology and country in IRENA's Renewable Cost Database and Auction and PPA Database 176</p>
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TABLES

Table H1	Total installed cost, capacity factor and levelised cost of electricity trends by technology, 2010 and 2020 11
Table ES1	Capacity of uneconomic existing coal-fired power plants and annual savings in coal-fired generation, electricity costs and CO ₂ emissions, 2021 18
Table ES2	Learning rates for solar PV, CSP, onshore and offshore wind, 2010-2020 and 2010 to 2021/3 19
Table 1.1	Capacity of uneconomic existing coal-fired power plants and annual savings in coal-fired generation, electricity costs and CO ₂ emissions, 2021 43

Table 2.1	Total Installed cost ranges and weighted averages for onshore wind projects by country/region, 2010 and 2020	57	Table 6.3	Hydropower weighted-average capacity factors and ranges for large hydropower projects by country/region, 2010-2020	128
Table 2.2	Country-specific average capacity factors for new onshore wind, 2010 and 2020	60	Table 6.4	Hydropower weighted-average capacity factors and ranges for small hydropower projects by country/region, 2010-2020	128
Table 2.3	Regional weighted-average LCOE and ranges for onshore wind in 2010 and 2020	65	Table 6.5	Hydropower project O&M costs by category from a sample of 25 projects	129
Table 3.1	Residential and commercial sector solar PV total installed cost by country or state, 2010-2020	77	Table 8.1	Project weighted-average capacity factors of bioenergy-fired power generation projects, 2010-2020	147
Table 3.2	Global weighted-average capacity factors for utility-scale PV systems by year of commissioning, 2010-2020	78	Table A1.1	Standardised assumptions for LCOE calculations	167
Table 3.3	Residential and commercial sector solar PV levelised cost of electricity by country or state, 2010-2019	86	Table A1.2	O&M cost assumptions for the LCOE calculation of PV projects	173
Table 4.1	Regional and country weighted-average total installed costs and ranges for offshore wind, 2010 and 2020	97	Table A1.3	BoS cost breakdown categories for solar PV	174
Table 4.2	Weighted-average capacity factors for offshore wind projects in six countries, 2010 and 2020	100			
Table 4.3	Regional and country weighted-average LCOE of offshore wind, 2010 and 2020	102			
Table 5.1	Representative CSP total installed costs by component, 2020	108			
Table 5.2	All-in (insurance included) O&M cost estimates for CSP plants in selected markets, 2019-2020	112			
Table 6.1	Total installed cost breakdown by component and capacity-weighted averages for 25 hydropower projects in China, India and Sri Lanka, 2010-2016	122			
Table 6.2	Total installed costs for hydropower by weighted-average and by capacity range, 2000-2020	124			

BOXES

Box 1.1	Deriving country- and technology-specific WACC values	44
Box 3.1	Battery storage cost trends in stationary applications	80
Box 3.2	Decomposing the decline in utility-scale LCOE from 2010 to 2020	83
Box 3.3	Electricity from solar PV in the Middle East at USD 0.01/kWh?	87
Box 5.1	CSP and battery storage: Duration and costs matter	116

ABBREVIATIONS

BoS	Balance of System	LCOE	Levelised cost of electricity
CAPEX	Capital expenditure	LCOH₂	Levelised cost of hydrogen
CCUS	carbon capture, utilisation and storage	LCOHEAT	Levelised cost of heat
CIF	Climate Investment Fund	Mtoe	million tonnes of oil equivalent
CO₂	carbon dioxide	MW	megawatt
CSP	concentrated solar power	MWh	megawatt-hour
EU	European Union	NDC	Nationally Determined Contributions
EUR	euro	NREL	National Renewable Energy Laboratory (US)
FIT	feed-in tariff	O&M	Operation and Maintenance
GW	gigawatt	OECD	OECD Organisation of Economic Co-operation and Development
HTF	Heat Transfer Fluid	OEM	Original Equipment Manufacturer
ILR	Inverter Load Ratio	PPA	Power Purchase Agreement
IPP	independent power producer	PTC	Parabolic trough Collectors
IRENA	International Renewable Energy Agency	TWh	Terawatt-hour
ITC	Investment Tax Credit	WACC	Weighted Average Cost of Capital
kW	kilowatt		
kWh	kilowatt-hour		

HIGHLIGHTS

- The trend in cost declines continued for solar and wind power in 2020, despite the impact of the global pandemic and the disruptions caused by the spread of COVID-19 virus. In 2020, the global weighted-average levelised cost of electricity (LCOE) from new capacity additions of onshore wind declined by 13%, compared to 2019. Over the same period, the LCOE of concentrating solar power (CSP) fell by 16%, that of offshore wind fell by 9% and that of utility-scale solar photovoltaics (PV) by 7%.
- Renewable power generation costs have fallen sharply over the past decade, driven by steadily improving technologies, economies of scale, competitive supply chains and improving developer experience. Costs for electricity from utility-scale solar PV fell 85% between 2010 and 2020.
- The cost of electricity from solar and wind power has fallen, to very low levels. Since 2010, globally, a cumulative total of 644 GW of renewable power generation capacity has been added with estimated costs that have been lower than the cheapest fossil fuel-fired option in each respective year. In emerging economies, the 534 GW added at costs lower than fossil fuels, will reduce electricity generation costs by up to USD 32 billion this year.
- New solar and wind projects are increasingly undercutting even the cheapest and least sustainable of existing coal-fired power plants. IRENA analysis suggests 800 GW of existing coal-fired capacity has operating costs higher than new utility-scale solar PV and onshore wind, including USD 0.005/kWh for integration costs. Replacing these coal-fired plants would cut annual system costs by USD 32 billion per year and reduce annual CO₂ emissions by around 3 Gigatonnes of CO₂.
- This comprehensive cost study draws on cost and auction price data from projects around the world and highlights the latest trends for each of the main renewable power technologies.

Table H1 Total installed cost, capacity factor and levelised cost of electricity trends by technology, 2010 and 2020

	Total installed costs			Capacity factor			Levelised cost of electricity		
	(2020 USD/kW)			(%)			(2020 USD/kWh)		
	2010	2020	Percent change	2010	2020	Percent change	2010	2020	Percent change
Bioenergy	2 619	2 543	-3%	72	70	-2%	0.076	0.076	0%
Geothermal	2 620	4 468	71%	87	83	-5%	0.049	0.071	45%
Hydropower	1 269	1 870	47%	44	46	4%	0.038	0.044	18%
Solar PV	4 731	883	-81%	14	16	17%	0.381	0.057	-85%
CSP	9 095	4 581	-50%	30	42	40%	0.340	0.108	-68%
Onshore wind	1 971	1 355	-31%	27	36	31%	0.089	0.039	-56%
Offshore wind	4 706	3 185	-32%	38	40	6%	0.162	0.084	-48%