## TABLE R8. Renewable Power, Targets for Specific Amount of Installed Capacity or Generation as of End-2019

Note: Text in **bold** indicates new/revised in 2019 and text in *italics* indicates policies adopted at the state/provincial level.

| Country | Technology | Target |
|---|---|---|
| Algeria | Electricity | 4.5 GW by 2020; 22 GW by 2030 |
| | Bio-power from waste-to-energy | 360 MW by 2020; 1 GW by 2030 |
| | Geothermal power | 5 MW by 2020; 15 MW by 2030 |
| | Solar PV | 3 GW by 2020; 13.5 GW by 2030 |
| | CSP | 2 GW by 2030 |
| | Wind power | 1 GW by 2020; 5 GW by 2030 |
| Antigua and Barbuda | Electricity | 5 MW by 2030 |
| Armenia | Hydropower (small-scale) | 377 MW by 2020; 397 MW by 2025 |
| | Geothermal power | 50 MW by 2020; 100 MW by 2025 |
| | Solar PV | 40 MW by 2020; 80 MW by 2025 |
| | Wind power | 50 MW by 2020; 100 MW by 2025 |
| Austria | Bio-power from solid biomass and biogas | 200 MW added 2010-2020 |
| | Hydropower | 1 GW added 2010-2020 |
| | Solar PV | 1.2 GW added 2010-2020 |
| | Wind power | 2 GW added 2010-2020 |
| Australia | Electricity | 33,000 GWh by 2020 |
| Azerbaijan | Electricity | 1 GW by 2020 |
| Bahrain | Electricity | 255 MW by 2020; 710 MW by 2030 |
| | Bio-power | 5 MW by 2025; 10 MW by 2035 |
| | Solar power (PV and CSP) | 200 MW by 2025; 400 MW by 2035 |
| | Wind power | 50 MW by 2025; 300 MW by 2035 |
| Bangladesh | Bio-power | 7 MW by 2021 |
| | Biogas power | 7 MW by 2021 |
| | Waste-to-energy | 40 MW by 2021 |
| | Hydropower | 4 MW by 2021 |
| | Solar power | 1,676 MW by 2021 |
| | Wind power | 1,370 MW by 2021 |
| Belarus | Electricity | 2.6 billion kWh through 2035 |
| Belgium | | no national target |
| *Flanders* | *Solar PV* | *Increase production 30% by 2020* |
| *Wallonia* | *Electricity* | *8 TWh per year by 2020* |
| Bhutan | Electricity | 20 MW by 2025 |
| | Bio-power from solid biomass | 5 MW by 2025 |
| | Solar PV | 5 MW by 2025 |
| | Wind power | 5 MW by 2025 |
| Bolivia | Electricity | 160 MW capacity added 2015-2025 |
| Bosnia and Herzegovina | Hydropower | 120 MW by 2030 |
| | Solar PV | 4 MW by 2030 |
| | Wind power | 175 MW by 2030 |
| Burundi | Bio-power from solid biomass | 4 MW (no date) |
| | Hydropower | 212 MW (no date) |
| | Solar PV | 40 MW (no date) |
| | Wind power | 10 MW (no date) |
| Canada | | no national target |
| *Ontario* | *Electricity* | *20 GW by 2025 supplied by a mix of technologies, including:* |
| | *Hydropower* | *9.3 GW by 2025* |

TABLE R8. Renewable Power, Targets for Specific Amount of Installed Capacity or Generation, 2019 (continued)

Note: Text in **bold** indicates new/revised in 2019 and text in *italics* indicates policies adopted at the state/provincial level.

| Country | Technology | Target |
|---|---|---|
| Canada (continued) | | |
| *Ontario* | *Solar PV* | *40 MW by 2025* |
| | *Wind power* | *5 GW by 2025* |
| *Prince Edward Island* | *Wind power* | *30 MW increase by 2030 (base year 2011)* |
| China | Electricity | 680 GW non-fossil generation capacity by 2020 |
| | Bio-power | 15 GW by 2020 |
| | Hydropower | 340 GW by 2020 |
| | Solar power | 110 GW by 2020; 5 GW solar thermal power by 2020 |
| | Wind power | 210 GW by 2020 (including 5 GW grid-connected offshore wind) |
| Chinese Taipei | Electricity | 10.9 GW by 2020; 27.4 GW by 2025 |
| | Geothermal power | 150 MW by 2020; 200 MW by 2025 |
| | Solar PV | 6.5 GW by 2020; 20 GW by 2025 |
| | Wind power (onshore) | 814 MW by 2020; 1.2 GW by 2025 |
| | Wind power (offshore) | 520 MW by 2020; 3-5.7 GW by 2025 |
| Croatia | Hydropower | 1,655 MW by 2020 |
| Cuba | Electricity | 2.1 GW biomass, wind, solar and hydropower capacity by 2030 |
| Djibouti | Electricity | 1 GW by 2035 |
| | Geothermal power | 500 MW by 2035 |
| | Solar power (PV and CSP) | 200 MW by 2035 |
| | Wind power | 300 MW by 2035 |
| Egypt | Hydropower | 2.8 GW by 2020 |
| | Solar PV | 17.3 GW by 2035 |
| | CSP | 1.1 GW by 2020; 11 GW by 2035 |
| | Wind power | 7.2 GW by 2022; 21 GW by 2035 |
| Ethiopia | Bio-power from bagasse | 103.5 MW (no date) |
| | Hydropower | 22 GW by 2030 |
| | Wind power | 7 GW by 2030 |
| Finland | Bio-power | 13.2 GW by 2020 |
| | Hydropower | 14.6 GW by 2020 |
| | Wind power | 884 MW by 2020 |
| France | Hydropower | 0.1 to 2 GW by 2023 |
| | Ocean power | 380 MW by 2020 |
| | Solar power | 18.2-20.2 GW by 2023; [8 GW by 2020]; 45 GW by 2030 |
| | Wind power (offshore) | 1 GW per year; 2.4 GW by 2023; 4.7 to 5.2 GW by 2028 |
| | Wind power (onshore) | 21.8 to 26 GW by 2023 |
| Germany | Bio-power | 100 MW added per year |
| | Solar PV | **2.5 GW added per year; 98 GW by 2030** |
| | Wind power (onshore) | 2.8 GW tendered per year through 2019; 2.9 GW per year after 2019 |
| | Wind power (offshore) | **20 GW added by 2030** |
| | Wind power (total) | **67 to 71 GW by 2030** |
| Greece | Solar PV | 2.2 GW by 2030 |
| Grenada | Geothermal power | 15 MW (no date) |
| | Solar power | 10 MW (no date) |
| | Wind power | 2 MW (no date) |

TABLE R8. Renewable Power, Targets for Specific Amount of Installed Capacity or Generation, 2019 (continued)

Note: Text in **bold** indicates new/revised in 2019 and text in *italics* indicates policies adopted at the state/provincial level.

| Country | Technology | Target |
|---|---|---|
| India | Electricity | **175 GW by 2022; 450 GW by 2030** |
| | Bio-power | 10 GW by 2022 |
| | Hydropower (small-scale)[a] | 5 GW by 2022 |
| | Solar PV | 20 million solar lighting systems added 2010-2022 |
| | Solar PV and CSP | 100 GW by 2022 |
| | Wind power | 60 GW by 2022 |
| *Andhra Pradesh* | *Electricity* | *18 GW capacity added by 2020-21* |
| *Delhi* | *Solar PV* | *5,000 MW added 2015-2020* |
| | *Solar power* | *1 GW by 2020; 2 GW by 2025* |
| *Rajasthan* | *Hybrid (solar PV and wind)* | ***3.5 GW by 2024-2025*** |
| | *Wind* | ***2 GW by 2024-2025*** |
| | *Solar power*[b] | ***25 GW by 2020***<br>***30 GW by 2024-2025*** |
| *Jharkhand* | *Solar PV* | *2,650 MW installed by 2019-2020* |
| Indonesia | Geothermal power | 12.6 GW by 2025 |
| | Hydropower | 2 GW by 2025, including 0.43 GW micro-hydro |
| | Pumped storage[c] | 3 GW by 2025 |
| | Solar power | 5 GW by 2020 [156.8 MW solar PV by 2025] |
| | Wind power | 100 MW by 2025 |
| Iraq | Solar PV | 2.24 GW by 2020 |
| Iran | Solar power and wind power | 5 GW by 2020 |
| Italy | Bio-power | 19,780 GWh per year generation from 2.8 GW capacity by 2020 |
| | Geothermal power | 6,759 GWh per year generation from 920 MW capacity by 2020 |
| | Hydropower | 42,000 GWh per year generation from 17.8 GW capacity by 2020 |
| | Solar PV | 50 GW by 2030 |
| | Wind power (onshore) | 18,000 GWh per year generation and 12 GW capacity by 2020 |
| | Wind power (offshore) | 2,000 GWh per year generation and 680 MW capacity by 2020 |
| Japan | Ocean power (wave and tidal) | 1.5 GW by 2030 |
| Jordan | Electricity | 1.8 GW by 2020; 3.22 GW by 2025 |
| | Bio-power | 50 MW by 2025 |
| | Solar PV | 1 GW by 2020; 2.5 GW by 2025 |
| | Wind power | 1.2 GW by 2020 |
| Kazakhstan | Bio-power | 15.05 MW at three stations by 2020 |
| | Hydropower | 539 MW at 41 stations by 2020 |
| | Solar power | 713.5 MW at 28 plants by 2020 |
| | Wind power | 1,787 MW at 34 stations by 2020 |
| Kenya | Geothermal power | 5 GW by 2030 |
| Korea, Republic of | Electricity | 13,016 GWh per year; 21,977 GWh per year (4.7%) by 2020; 39,517 GWh per year (7.7%) by 2030 supplied by a mix of technologies, including: |
| | Bio-power from solid biomass | 2,628 GWh per year by 2030 |
| | Bio-power from biogas | 161 GWh per year by 2030 |
| | Bio-power from landfill gas | 1,340 GWh per year by 2030 |
| | Geothermal power | 2,046 GWh per year by 2030 |
| | Hydropower (large-scale) | 3,860 GWh per year by 2030 |
| | Hydropower (small-scale) | 1,926 GWh per year by 2030 |
| | Ocean power | 6,159 GWh per year by 2030 |
| | Solar PV | 2,046 GWh per year by 2030 |
| | CSP | 1,971 GWh per year by 2030 |
| | Wind power | 16,619 GWh per year by 2030 |
| | Wind power (offshore) | 2.5 GW by 2019 |

TABLE R8. Renewable Power, Targets for Specific Amount of Installed Capacity or Generation, 2019 (continued)

Note: Text in **bold** indicates new/revised in 2019 and text in *italics* indicates policies adopted at the state/provincial level.

| Country | Technology | Target |
|---|---|---|
| Kosovo[d] | Hydropower | 140 MW by 2020 |
| Kuwait | Solar PV | 3.5 GW by 2030 |
| | CSP | 1.1 GW by 2030 |
| | Wind power | 3.1 GW by 2030 |
| Lebanon | Wind power | 400-500 MW by 2020 |
| Lesotho | Electricity | 260 MW by 2030 |
| Libya | Solar PV | 300 MW by 2020; 800 MW by 2025, 3.35 GW by 2030 |
| | CSP | 150 MW by 2020; 400 MW by 2025; 400 MW by 2030 |
| | Wind power | 600 MW by 2020; 1 GW by 2025 |
| Macedonia, North | Bio-power from solid biomass | 50 GWh by 2020 |
| | Bio-power from biogas | 20 GWh by 2020 |
| | Hydropower (small-scale) | 216 GWh by 2020 |
| | Solar PV | 14 GWh by 2020 |
| | Wind power | 300 GWh by 2020 |
| Malaysia | Electricity | 2.1 GW (excluding large-scale hydro), 11.2 TWh per year, or 10% of national supply (no date given); 11% by 2020; 14% by 2030; 36% by 2050 |
| | Solar power | 1 GW capacity added by 2020 |
| Mauritania | Electricity | 60 MW by 2020 |
| Morocco | Electricity | 6GW by 2020; 11 GW by 2030 |
| | Hydropower | 2 GW by 2020 |
| | Solar PV and CSP | 2 GW by 2020; 4.56 GW by 2030 |
| | Wind power | 2 GW by 2020; 4.2 GW by 2030 |
| Mozambique | Bio-digesters for biogas | 1,000 systems installed (no date) |
| | Hydropower, solar PV, wind power | 2 GW each (no date) |
| | Solar PV | 82,000 solar home systems installed (no date) |
| | Wind turbines for water pumping | 3,000 stations installed (no date) |
| | Renewable energy-based productive systems | 5,000 systems installed (no date) |
| Myanmar | Renewable power | 27% of installed power capacity by 2030 |
| Nigeria | Bio-power | 400 MW by 2025 |
| | Hydropower (small-scale) | 2 GW by 2025[e] |
| | Solar PV (large-scale, >1 MW) | 500 MW by 2025 |
| | CSP | 5 MW by 2025 |
| | Wind power | 40 MW by 2025 |
| Norway | Electricity | 26.4 TWh common electricity certificate market with Sweden by 2020 |
| Palestine, State of | Bio-power | 21 MW by 2020 |
| | Solar PV | 45 MW by 2020 |
| | CSP | 20 MW by 2020 |
| | Wind power | 44 MW by 2020 |
| Philippines | Electricity | Triple the 2010 capacity by 2030 |
| | Bio-power | 277 MW added 2010-2030 |
| | Geothermal power | 1.5 GW added 2010-2030 |
| | Hydropower | 5,398 MW added 2010-2030 |
| | Ocean power | 75 MW added 2010-2030 |
| | Solar PV | 284 MW added 2010-2030 |
| | Wind power | 2.3 GW added 2010-2030 |
| Poland | Wind power (offshore) | 10 GW by 2040 |

TABLE R8. Renewable Power, Targets for Specific Amount of Installed Capacity or Generation, 2019 (continued)

Note: Text in **bold** indicates new/revised in 2019 and text in *italics* indicates policies adopted at the state/provincial level.

| Country | Technology | Target |
|---|---|---|
| Portugal | Electricity | 14.7 GW by 2020; 27.9 GW by 2030 |
| | Hydropower | 7 GW by 2020; 8.7 GW by 2030 |
| | Wind power | 5.4 GW by 2020; 9.3 GW by 2030 |
| | Solar | 1.9 GW by 2020; 9 GW by 2030 |
| | Other (biopower, geothermal and wave) | 0.5 GW by 2020; 0.6 GW by 2030 |
| Qatar | Electricity | 500 MW by 2030 |
| | Bio-power | 50 MW by 2030 |
| | Solar power | 400 MW by 2030 |
| | Wind power | 50 MW by 2030 |
| Russian Federation[f] | Electricity | 5.5 GW by 2024 |
| | Hydropower (small-scale) | 425.4 MW by 2024 |
| | Solar PV | 1.8 GW by 2024 |
| | Wind power | 3.4 GW by 2024 |
| *Altai Republic* | *Solar PV* | *150 MW by 2021* |
| Saudi Arabia | Electricity | 27.3 GW by 2023; 58.7 GW by 2030 |
| | Geothermal, bio-power (waste-to-energy)[g], wind power | 13 GW combined by 2040 |
| | Solar PV | 20 GW by 2023; 40 GW by 2030 |
| | CSP | 300 MW by 2023; 2.7 MW by 2030 |
| | Wind | 7 GW by 2023; 16 GW by 2030 |
| Serbia | Wind power | 1.4 GW (no date) |
| Sierra Leone | Electricity | 1 GW (no date) |
| Singapore | Solar PV | 350 MW by 2020 |
| Solomon Islands | Geothermal power | 20 to 40 MW (no date) |
| | Hydropower | 3.77 MW (no date) |
| | Solar power | 3.2 MW (no date) |
| South Africa | Electricity | 17.8 GW by 2030; 42% of new capacity installed 2010-2030 |
| Spain | Solar | 77 GW by 2030 |
| Sudan | Electricity | 16 GW by 2031 |
| | Bio-power from solid biomass | 54 MW by 2031 |
| | Bio-power from biogas | 68 MW by 2031 |
| | Hydropower | 54 MW by 2031 |
| | Solar PV | 750 MW by 2031 |
| | CSP | 50 MW by 2031 |
| | Wind power | 680 MW by 2031 |
| Sweden | Electricity | 25 TWh more renewable electricity annually by 2020 (base year 2002) |
| | Electricity | 26.4 TWh common electricity certificate market with Norway by 2020 |
| Switzerland | Electricity | 12 TWh per year by 2035; 24.2 TWh per year by 2050 |
| | Hydropower | 43 TWh per year by 2035 |
| Syria | Bio-power | 140 MW by 2020; 260 MW by 2025; 400 MW by 2030 |
| | Solar PV | 380 MW by 2020; 1.1 GW by 2025; 1.8 GW by 2030 |
| | CSP | 50 MW by 2025; 1.3 GW by 2030 |
| | Wind power | 1 GW by 2020; 1.5 GW by 2025; 2 GW by 2030 |
| Tajikistan | Hydropower (small-scale) | 100 MW by 2020 |
| Thailand | Bio-power from solid biomass | 4.8 GW by 2021 |
| | Bio-power from biogas | 600 MW by 2021 |
| | Bio-power from organic MSW[g] | 400 MW by 2021 |
| | Geothermal power | 1 MW by 2021 |

TABLE R8. Renewable Power, Targets for Specific Amount of Installed Capacity or Generation, 2019 (continued)

Note: Text in **bold** indicates new/revised in 2019 and text in *italics* indicates policies adopted at the state/provincial level.

| Country | Technology | Target |
|---|---|---|
| Thailand (continued) | Hydropower | 6.1 GW by 2021 |
| | Ocean power (wave and tidal) | 2 MW by 2021 |
| | Solar PV | 3 GW by 2021; 6 GW by 2036 |
| | Wind power | 1.8 GW by 2021 |
| Trinidad and Tobago | Wind power | 100 MW (no date) |
| Tunisia | Electricity | 4.7 GW by 2030 |
| | Bio-power from solid biomass | 300 MW by 2030 |
| | Solar power | 10 GW by 2030 |
| | Wind power | 16 GW by 2030 |
| Turkey | Bio-power from solid biomass | 1 GW by 2023 |
| | Geothermal power | 1 GW by 2023 |
| | Hydropower | 34 GW by 2023 |
| | Solar PV | 5 GW by 2023 |
| | Wind power | 20 GW by 2023 |
| United Kingdom | Wind power (offshore) | 39 GW by 2030, one-third of electricity by 2030 |
| United States | | no national target |
| *Iowa* | *Electricity* | *105 MW generating capacity for IOUs*[h] |
| *Massachusetts* | *Wind power (offshore)* | *1.6 GW by 2027; additional 1.6 GW by 2035* |
| | *Wind power (total)* | *2,000 MW by 2020* |
| | *Solar power* | *1600 MW by 2020* |
| *New York* | *Energy storage* | *1.5 GW of energy storage by 2025 and 3 GW by 2030* |
| *Texas* | *Electricity* | *5,880 MW* |
| Uzbekistan | Solar PV | 157.7 MW installed by 2019; 382.5 by 2020; 601.9 by 2021; 1.24 GW by 2025 |
| | Wind power | 102 MW installed by 2021; 302 MW installed by 2025 |
| Venezuela | Electricity | 613 MW new capacity installed 2013-2019, including: |
| | Wind power | 500 MW new capacity installed 2013-2019 |
| Vietnam | Hydropower | 21.6 GW by 2020; 24.6 GW by 2025; 27.8 GW by 2030 |
| | Solar power | 850 MW by 2020; 4 GW by 2025; 12 GW by 2030 |
| | Wind power | 800 MW by 2020; 2 GW by 2025; 6 GW by 2030 |
| Yemen | Electricity | 714.25 MW by 2025 |
| | Bio-power | 6 MW by 2025 |
| | Geothermal power | 200 MW by 2025 |
| | Solar PV | 8.25MW by 2025 |
| | CSP | 100 MW by 2025 |
| | Wind power | 400 MW by 2025 |

[a] India does not classify hydropower installations larger than 25 MW as renewable energy sources. Therefore, national targets and data for India do not include hydropower facilities >25 MW.

[b] Utility or grid-scale solar parks are to account for 24 GW, distributed generation for 4 GW, solar rooftops for 1 GW and solar pumps for the remaining 1 GW.

[c] Pumped storage plants are not energy sources but a means of energy storage. As such, they involve conversion losses and are powered by renewable or non-renewable electricity. Pumped storage is included here because it can play an important role as balancing power, particularly for variable renewable resources.

[d] Kosovo is not a member of the United Nations.

[e] Nigeria's target excludes hydropower plants >30 MW.

[f] The Russian Federation's targets exclude hydropower plants >25 MW.

[g] It is not always possible to determine whether municipal solid waste (MSW) data include non-organic waste (plastics, metal, etc.) or only the organic biomass share.

[h] Investor-owned utilities (IOUs) are those operating under private control rather than government or co-operative operation.

Source: See the REN21 GSR 2020 data pack online at www.ren21.net/GSR.

TABLE R9. Renewable Heating and Cooling Policies, as of End-2019

Note: Text in **bold** indicates new/revised in 2019.

| Country | Financial Support Policies | | | | | | Bans/Mandates | |
|---|---|---|---|---|---|---|---|---|
| | Investment subsidy/grants | Rebates | Tax credits | Tax deductions and exemptions | Loans | Feed-in tariff | Targeted fossil fuel bans in buildings/ industry | Renewable heat mandates |
| Argentina | | | I/C | I/C | I/C | | | ● |
| Armenia[c] | I/C | | | | R/C | | | |
| Australia | R/C | | | | | | | ● |
| Austria | C | | | I | R | | ● | |
| Belgium | | | | C | | | | |
| Brazil | | | | | | | | ● |
| Bulgaria | R/I/P | | | | | | | |
| Canada | I/C | | C | C | | | | |
| Chile | R | | | C | | | | |
| China | I | | | | | | | ● |
| Costa Rica | | | | I | | | | |
| Croatia | | | | | | I | | |
| Cyprus | R/C | | | | | | | |
| Czech Republic | R/C | | | I | | | | |
| Denmark | | | | I | I | I | ● | |
| Egypt | | | | I | | | | |
| Estonia | R | | | | | | | |
| Finland | I/C | | | | | | | |
| France | R/I/C/P | | R | **R/C** | **R** | | | ● |
| Georgia[c] | | | | | R/C | | | |
| Germany | R/C/P | | | | I/C | | | ● |
| Greece | R/I | | | R/I/C | | I | | ● |
| Hungary | R/C/P | | | | | | | |
| India | R/I/C/P | I | | | | | | ●[a] |
| Ireland | R/I/C/P | | | C | | I/C/P | | ● |
| Israel | | | | | | | | ● |
| Italy | R | R/C/P | R/I/C | | | | | ●[a] |
| Japan | I | | | | | | | |
| Jordan | R | | | | | | | ● |
| Korea, Republic of | R | | | | | | | ● |
| Latvia | | | | C | | | | |
| Lebanon | | | | | R/I/C | | | |
| Lithuania | R | | | I | **R** | I | | |
| Luxembourg | R/C/P | | | | | | | |
| Macedonia, North | R | | | | | | | |
| Malawi | | | | | | | | ● |
| Malta | | R | | | | | | |
| Mexico | R | | | | | | | |
| Morocco | I | | | | | | | |
| Namibia | | | | | | | | ● |

TABLE R9. Renewable Heating and Cooling Policies, as of End-2019 (continued)

Note: Text in **bold** indicates new/revised in 2019.

| Country | Financial Support Policies | | | | | | Bans/Mandates | |
|---|---|---|---|---|---|---|---|---|
| | Investment subsidy/grants | Rebates | Tax credits | Tax deductions and exemptions | Loans | Feed-in tariff | Targeted fossil fuel bans in buildings/ industry | Renewable heat mandates |
| Netherlands | | | **I/C** | | | R/I/C/P | | |
| New Zealand | I | | | | | | | |
| Norway | C/P | R | | | | | ● | ● |
| Philippines | I | | | | | | | |
| Poland | R | | | | R/C/P | | ● | |
| Portugal | R/I/C | | | | | | | ● |
| Romania | R/I/C[b]/P | | | | | | | |
| Slovak Republic | I | | | | | | | |
| Slovenia | R | | | | R | | | |
| South Africa | R/I/C | | | | | | | ● |
| Spain | I/C | | | I | R/C | | | ● |
| Sweden | | | | R/C | | | | |
| Switzerland | R | | | | | | | ●[a] |
| Thailand | I/C | | | | | | | |
| Tunisia | R/C | | | | | | | |
| Turkey | I | | | | | I | | |
| Ukraine | | | | | R | | | |
| United Arab Emirates | | | | | | | | ● |
| United Kingdom | R/I/C/P | | | | | R/C/P | ● | |
| United States | R/I/C/P | | R | | | | | ● |
| Uruguay | R | | | | | | | ● |

**R** Residential
**I** Industrial
**C** Commercial
**P** Public facilities

[a] City level

[b] Agricultural renewable heat installation subsidies financed by the European Agricultural Fund for Rural Development (EAFRD).

[c] Incentives provided by the European Bank for Reconstruction and Development under the Caucuses Energy Efficiency Program II.

Source: See the REN21 GSR 2020 data pack online at www.ren21.net/GSR.

TABLE R10. Renewable Transport Mandates at the National/State/Provincial Levels, as of End-2019

Note: Text in **bold** indicates new/revised in 2019, brackets '[]' indicate previous mandates where new mandates were enacted, and text in *italics* indicates mandates adopted at the state/provincial level.

| Country | Existing Biodiesel Blend Mandate (% Biodiesel) | Existing Ethanol Blend Mandate (% Ethanol) | Unspecified/ Overall Blend Mandate | Biofuel Mandate by Future Year | Advanced Biofuel Mandate by Future Year | Other Renewable Transport Mandates | Other Transport Mandates by Future Year (not necessarily linked to renewables) |
|---|---|---|---|---|---|---|---|
| **EU** | | | | | 0.2% by 2022, 1% by 2025; 3.5% by 2030 | | 13 million zero- or low-emission vehicles by 2025 |
| Angola | | 10% | | | | | |
| Argentina | 10% | 12% | | | | | |
| Australia | | | | | | | |
| *New South Wales* | *2%* | *7%* | | | | | |
| *Queensland* | *1%* | *3%* | | | | | |
| Austria | 6.3% | 3.4% | 5.75% | 8.75% by 2020 | 0.5% of total transport energy from 2020 | | |
| Belgium | 6% [4%] | 8.5% [4%] | | | 0.1% total transport energy by 2020 | | |
| Brazil | **11% [10%]** | 27% | | **15% biodiesel by 2022 and 30% by 2030; 10% biokerosene in aviation fuel by 2030** | | | |
| Bulgaria | 6% | 8% | | | 1% of total transport fuel | | |
| Cabo Verde | | | | | | | 35% EVs by 2025; 70% by 2030; 100% by 2035 |
| Canada | 2% | 5% | | | | | Ban on sale of new petrol or diesel vehicles by 2040; 10% ZEV sales by 2025, 30% by 2030; 825,000 ZEVs by 2025, 2.7 million by 2030, 14 million by 2040 |
| *Alberta* | *2%* | *5%* | | | | | |
| *British Columbia* | *4%* | *5%* | | | | | *Ban on most gasoline and diesel cars after 2040* |
| *Manitoba* | *2%* | *9%* | | | | | |
| *Ontario* | *4%* | *5%* | | *10% ethanol in gasoline by 2020* | | | |
| *Quebec* | | | | ***10% ethanol and 2% biodiesel by 2021; 15% ethanol and 4% biodiesel by 2025*** | | | |
| *Saskatchewan* | *2%* | *8%* | | | | | |
| Chile | | | | | | | 40% EVs in vehicle stock by 2050 |
| China[a] | | 10% | | | | | 20% of total car sales to be hybrid and electric vehicles by 2025; 2 million annual EV sales by 2020 |
| *Hainan Province* | | | | | | | ***ICE ban (sales) by 2030*** |
| Chinese Taipei | 1% | | | | | | Ban on sales of ICE vehicles by 2040; zero-emission two-wheelers by 2035 |

TABLE R10. Renewable Transport Mandates at the National/State/Provincial Levels, as of End-2019 (continued)

Note: Text in **bold** indicates new/revised in 2019, brackets '[]' indicate previous mandates where new mandates were enacted, and text in *italics* indicates mandates adopted at the state/provincial level.

| Country | Existing Biodiesel Blend Mandate (% Biodiesel) | Existing Ethanol Blend Mandate (% Ethanol) | Unspecified/ Overall Blend Mandate | Biofuel Mandate by Future Year | Advanced Biofuel Mandate by Future Year | Other Renewable Transport Mandates | Other Transport Mandates by Future Year (not necessarily linked to renewables) |
|---|---|---|---|---|---|---|---|
| Colombia | 10% | 10% [8%] | | | | | 10% ZEVs by 2025; 600,000 EVs by 2030 |
| Costa Rica | 20% | 7% | | | | | 25% of vehicles, 70% of buses and taxis to be zero emission by 2035; 100% of vehicle sales, 60% of vehicles and 100% of buses to be zero emission by 2050 |
| Croatia | 5.75% | 0.97% | 6.92% | | 0.1% second-generation biofuels[b] | | |
| Czech Republic | 6% | 4.1% | | | 0.5% of transport energy in 2020 | | |
| Denmark | | | 5.75% | | 0.9% of transport energy from 2020 | | Ban on sale of new petrol or diesel vehicles by 2030 |
| Ecuador | 5% | 10% | | | | | |
| Estonia | 3.1% | | | 10% by 2020 | At least 0.5% in diesel fuel from 2019 | | |
| Ethiopia | | 10% | | | | | |
| Finland | | | 15% | 30% by 2029; **30% in aviation by 2030** | 0.5% in total transport by 2020; 10% by 2030 | | 250,000 BEVs/PHEVs by 2030 |
| France | | 7.5% | **7.9% biofuels in motor fuel** | **8.2% in motor fuel by 2020** | 2.3% of diesel and 3.4% of petrol from advanced biofuels by 2023 | | Sales of all diesel and petrol cars and vans banned by 2040 |
| Germany | | | | | Minimum 0.05% market share from 2020 for companies that supplied more than 20 PJ of fuel in the previous year; increase to 0.5% by 2025. | | 100,000 public EV charging stations by 2020; 7-10 million BEVs/FCEVs by 2030 |
| Greece | | | 7% | | | | |
| Guatemala | | 5% | | | | | |
| Hungary | 4.9% | 4.9% | | | | | |
| Iceland | | | | | | | No new registrations of diesel and gasoline cars by 2030 |
| India | 20% | 10% | | | | | Ban on sale of new petrol or diesel vehicles by 2030; EVs to be 15% of all sales by 2025 and 30% by 2030 |
| *Delhi* | | | | | | | ***20% of all vehicle parking in residential and commercial parking complexes to be EV ready; all leased or hired cars used for government commuting to transition to electric by the end of 2020*** |

TABLE R10. Renewable Transport Mandates at the National/State/Provincial Levels, as of End-2019 (continued)

Note: Text in **bold** indicates new/revised in 2019, brackets '[]' indicate previous mandates where new mandates were enacted, and text in *italics* indicates mandates adopted at the state/provincial level.

| Country | Existing Biodiesel Blend Mandate (% Biodiesel) | Existing Ethanol Blend Mandate (% Ethanol) | Unspecified/ Overall Blend Mandate | Biofuel Mandate by Future Year | Advanced Biofuel Mandate by Future Year | Other Renewable Transport Mandates | Other Transport Mandates by Future Year (not necessarily linked to renewables) |
|---|---|---|---|---|---|---|---|
| Indonesia | **30% [20%]** | 3% | | 30% biodiesel from 2025; 20% ethanol from 2025; 5% biofuel in aviation fuel by 2025. **Increase the portion of diesel blended with crude palm oil (CPO) from the current 20% (B20) to 30% (B30) starting January next year and to 50% (B50) by the end of 2020.**[e] | | B20 blending mandate expanded from road transport to rail-roads and power plants | 2200 EVs by 2025 |
| Ireland | 10% | | | 11% from 2020; **10% in petrol and 12% in diesel by 2030** | 0.25% of transport energy in 2020 | | **950,000 EVs by 2030** |
| Israel | | | | | 6.7% cap on conventional biofuels by 2022 | | 100% EV or natural gas vehicle sales by 2030; 177,000 EVs by 2025, 1.4 million by 2030 |
| Italy | | | 7% | | 0.9% by 2020; 1.85% by 2022 | | 6 million EVs by 2030 (including 1.6 million BEVs) |
| Jamaica | | 10% | | | | | |
| Japan | | | | | | | Ban on sales of ICE vehicles by 2050 |
| Korea, Republic of | 3% | | | | | | 30% of all new car sales in the country to be electric by 2020; 1,000 hydrogen buses by 2022 (from natural gas) |
| Lithuania | | | | | 0.5% by 2020 | | |
| Malawi | | 10% | | | | | |
| Malaysia | 10% | 10% | | **20% from 2020** | | | 100,000 EVs by 2030 |
| Malta | | | | | 0.5% by 2020 | | |
| Mexico[c] | | 10% [5.8%] | | | | | 5% ZEV sales by 2030, 50% by 2040 |
| Mozambique | | 15% | | 20% ethanol from 2021 | | | |
| Nepal | | | | | | | Increase EV share to 20% by 2020 (2010 base year) |
| Netherlands | | | 16.4% [8.5%] | 16.4% from 2020 | 1% by 2020 | | 100% sales of hydrogen and electric cars by 2030 |
| New Zealand | 7% | | Max. 3% methanol blend | | | | 64,000 EVs by 2021 |
| Norway | 4% | | | 20% ethanol by 2020 | 0.5% in aviation by 2020 and 30% by 2030 | | Ban on sale of new petrol or diesel vehicles by 2025 |

TABLE R10. Renewable Transport Mandates at the National/State/Provincial Levels, as of End-2019 (continued)

Note: Text in **bold** indicates new/revised in 2019, brackets '[]' indicate previous mandates where new mandates were enacted, and text in *italics* indicates mandates adopted at the state/provincial level.

| Country | Existing Biodiesel Blend Mandate (% Biodiesel) | Existing Ethanol Blend Mandate (% Ethanol) | Unspecified/ Overall Blend Mandate | Biofuel Mandate by Future Year | Advanced Biofuel Mandate by Future Year | Other Renewable Transport Mandates | Other Transport Mandates by Future Year (not necessarily linked to renewables) |
|---|---|---|---|---|---|---|---|
| Pakistan | | | | | | | 30% EV sales by 2030 |
| Panama | | 10% | | | | 30% of new vehicle purchases for public fleets to be flex-fuel (no date) | |
| Paraguay | 1% | 25% | | | | | |
| Peru | 2% | 8% | | | | | |
| Philippines | 2% | 10% | | | | | |
| Poland | | | 7.5% | 8.5% by 2020 | 0.1% by 2020 | | 1 million EVs by 2025 |
| Portugal | | | 9% | | | | |
| Romania | 6.5% | 8% | | 10% by 2020 | | | |
| Slovak Republic | | | 5.8% | | 0.5% in 2020-2024; 0.75% in 2025-2030 | | |
| Slovenia | | | 7.5% | 100% biodiesel for heavy-duty trucks by 2030 | 0.5% in 2020 | | Ban on sale of new petrol or diesel vehicles by 2030; 12% of vans and trucks to be electric by 2030 |
| South Africa | 5% | 2% | | | | | |
| Spain | | | 6% | | 0.1% from 2020 | | |
| *Balearic Islands* | | | | | | | ***Ban on sale of new petrol or diesel vehicles by 2035*** |
| Sri Lanka | | | | | | | Ban on sale of new petrol or diesel vehicles by 2040 |
| Sudan | | 5% | | | | | |
| Sweden | | | | | | | **Ban on sale of cars with petrol or diesel engines after 2030;** all buses and government vehicles to be electric by 2030 |
| Thailand | 7% | 5% | | 4.1 billion litres of ethanol and 5.1 billion litres of biodiesel by 2036 | 25 million litres per day by 2022 | | 1.2 million EVs by 2036 |
| Turkey | | 2% | | | | | |
| Ukraine | | 7% | | | | | |

TABLE R10. Renewable Transport Mandates at the National/State/Provincial Levels, as of End-2019 (continued)

Note: Text in **bold** indicates new/revised in 2019, brackets '[]' indicate previous mandates where new mandates were enacted, and text in *italics* indicates mandates adopted at the state/provincial level.

| Country | Existing Biodiesel Blend Mandate (% Biodiesel) | Existing Ethanol Blend Mandate (% Ethanol) | Unspecified/ Overall Blend Mandate | Biofuel Mandate by Future Year | Advanced Biofuel Mandate by Future Year | Other Renewable Transport Mandates | Other Transport Mandates by Future Year (not necessarily linked to renewables) |
|---|---|---|---|---|---|---|---|
| United Kingdom | | | 7.25% | **9.75% from 2020** | 3.1% by 2032 | | 50% to 70% of new car sales and 40% of van sales to be ultra-low emission by 2030, and 25% of the government fleet to be ultra-low emission by 2022; **ban on sale of new petrol, diesel or hybrid cars by 2035 [2040]** |
| *Scotland* | | | | | | | *Ban on sales of all diesel and petrol cars and vans by 2032; USD 1.7 million to promote e-bikes* |
| United States | | | | Energy Independence and Security Act of 2007 mandatory target: 113.5 billion litres by 2020, 125 billion litres by 2021, 136.2 billion litres by 2022.[d] | 18.6 billion litres in 2019; 19.3 billion litres by 2020 | Renewable Fuel Standard (RFS) 2019 standards: 75.4 billion litres total renewable fuels, including 1.6 billion litres cellulosic biofuel, 9.2 billion litres biomass-based diesel and a cap of 56.7 billion litres for conventional biofuels.[d] | |
| *California* | | | | | | | *5 million ZEVs on the road by 2030; 250,000 vehicle charging stations by 2025, 200 hydrogen refuelling stations by 2025; all-electric buses by 2040* |
| *California, Colorado, Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island and Vermont* | | | | | | | *California Air Resources Board (CARB) programme target of 3.3 million ZEVs (PHEV, BEV, FCEV) by 2025, also adopted by 10 other states* |
| *Hawaii, Missouri and Montana* | | *10%* | | | | | |
| *Louisiana* | *2%* | *2%* | | | | | |
| *Massachusetts* | *5%* | | | | | | |
| *Minnesota* | *10%* | *20% [10%]* | | | | | |
| *New Mexico* | *5%* | | | | | | |

TABLE R10. Renewable Transport Mandates at the National/State/Provincial Levels, as of End-2019 (continued)

Note: Text in **bold** indicates new/revised in 2019, brackets '[]' indicate previous mandates where new mandates were enacted, and text in *italics* indicates mandates adopted at the state/provincial level.

| Country | Existing Biodiesel Blend Mandate (% Biodiesel) | Existing Ethanol Blend Mandate (% Ethanol) | Unspecified/ Overall Blend Mandate | Biofuel Mandate by Future Year | Advanced Biofuel Mandate by Future Year | Other Renewable Transport Mandates | Other Transport Mandates by Future Year (not necessarily linked to renewables) |
|---|---|---|---|---|---|---|---|
| *Oregon* | *5%* | *10%* | | | | | |
| *Pennsylvania* | | | | | | *E10 one year after 1.3 billion litres produced; B5 one year after 379 million litres produced, B10 one year after 757 million litres produced, and B20 one year after 1.5 billion litres produced*[d] | |
| *Washington* | *2%* | *2%* | | | | *B5 180 days after in-state feedstock and oil-seed crushing capacity can meet 3% requirement* | |
| Uruguay | 5% | 5% | | | | | |
| Vietnam | | 5% | | | | | |
| Zimbabwe | | 20% [15%] | | | | | |

[a] China's E10 mandate was extended to cover 15 regions.

[b] Blending mandate of 0.1% for second-generation biofuels, which may increase in 2019 depending on available supplies.

[c] Mexico's E10 maximum blend was subsequently halted in response to several court cases challenging the increase.

[d] Original target(s) set in gallons and converted to litres for consistency.

[e] Not yet enforced.

Note: ZEV = zero emission vehicle; EV = electric vehicle; ICE = internal combustion engine

Source: See the REN21 GSR 2020 data pack online at www.ren21.net/GSR.

## TABLE R11. Feed-in Electricity Policies, Cumulative Number of Countries/States/Provinces and 2019 Revisions

Note: Text in **bold** indicates new/revised in 2019, and text with a ~~strikethrough~~ indicates discontinuation and text in *italics* indicates policies adopted at the state/provincial level.

| Year | Cumulative[a] # | Countries/States/Provinces Added That Year |
|---|---|---|
| 1978 | 1 | ~~United States~~[b] |
| 1988 | 2 | ~~Portugal~~ |
| 1990 | 3 | **Germany** |
| 1991 | 4 | Switzerland |
| 1992 | 5 | Italy[c] |
| 1993 | 7 | Denmark; India |
| 1994 | 10 | **Luxembourg**; ~~Spain~~; Greece |
| 1997 | 11 | Sri Lanka |
| 1998 | 12 | ~~Sweden~~ |
| 1999 | 14 | ~~Norway; Slovenia~~ |
| 2000 | 14 | [none identified] |
| 2001 | 17 | Armenia; France; Latvia |
| 2002 | 23 | Algeria; Austria; ~~Brazil~~; Czech Republic; Indonesia; Lithuania |
| 2003 | 29 | Cyprus; Estonia; Hungary; Slovak Republic; ~~Republic of Korea~~; *Maharashtra (India)* |
| 2004 | 34 | Israel; Nicaragua; *Prince Edward Island (Canada); Andhra Pradesh and Madhya Pradesh (India)* |
| 2005 | 41 | **China[d]**; Ecuador; Ireland; Turkey; *Karnataka, Uttar Pradesh and Uttarakhand (India)* |
| 2006 | 46 | Argentina; Pakistan; Thailand; ~~*Ontario (Canada)*~~; *Kerala (India)* |
| 2007 | 55 | Albania; Bulgaria; Croatia; ~~Dominican Republic~~; Finland; North Macedonia; Moldova; Mongolia; *South Australia (Australia)* |
| 2008 | 70 | Iran; Kenya[e]; Liechtenstein; Philippines; San Marino; Tanzania; **Queensland (Australia)**; *Chhattisgarh, Gujarat, Haryana, Punjab, Rajasthan, Tamil Nadu and West Bengal (India); California (United States)* |
| 2009 | 81 | Japan; Serbia; ~~South Africa~~; **Ukraine**; *Australian Capital Territory, New South Wales and Victoria (Australia);* **Chinese Taipei**; *Hawaii, Oregon and Vermont (United States)* |
| 2010 | 87 | Belarus; Bosnia and Herzegovina; Malaysia; Malta; ~~Mauritius~~; **~~United Kingdom~~** |
| 2011 | 95 | Ghana; **Montenegro**; Netherlands; Syria; Vietnam; *Nova Scotia (Canada)[f]; Rhode Island (United States);* Angola[g] |
| 2012 | 101 | Jordan; Nigeria; State of Palestine; Rwanda; Uganda; Malawi[h] |
| 2013 | 103 | Kazakhstan; Pakistan |
| 2014 | 107 | Egypt; Vanuatu; *Virgin Islands (United States);* Mozambique[i] |
| 2015 | 107 | [none identified] |
| 2016 | 108 | Czech Republic (reinstated); Chile |
| 2017 | 111 | Zambia; Vietnam; *Massachusetts (United States)* |
| 2018 | 113 | Senegal; **Bermuda (UK)** |
| 2019 | 113 | [none identified] |
| Unknown year | 126 | Andorra; Honduras; Maldives; Panama; Peru; Poland; Russian Federation; Tajikistan; *Bihar, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Odisha (India)* |
| **Total Removed** | **13** | |
| **Total Existing** | **113** | |

| 2019 FIT Policy Adjustments | |
|---|---|
| *Australia – Queensland* | *Solar FIT reduced* |
| Bermuda | FIT increased for solar PV power generators |
| China | New solar FIT policy |
| Chinese Taipei | FIT reduced for offshore wind projects |
| Germany | Cap removed on solar FIT programme |
| Luxembourg | FIT increased for solar PV power generators |
| Montenegro | FIT surcharge abolished |
| Ukraine | FIT for new wind and solar power projects commissioned after 2020 to be reduced. FIT for biomass and biogas to remain at current level until 2030. |
| United Kingdom | FITs for solar energy replaced with new Small Export Guarantee obligating electricity suppliers to offer a tariff (came into force 1 January 2020) |

[a] "Cumulative number" refers to number of jurisdictions that had enacted feed-in policies as of the given year.

[b] The US PURPA policy (1978) is an early version of the FIT, which has since evolved.

[c] The FIT for solar PV in Italy ended in 2013.

[d] The FIT for CSP in China ended in 2016.

[e] Kenya planned to replace its FIT system with an energy auction tariff.

[f] Nova Scotia's community FIT (COMFIT) was removed in 2015, the same year that the province's Developmental Tidal Feed-in Tariff Program was introduced.

[g] Angola's policy was adopted but had not yet been enacted as of end-2019.

[h] The FIT was in use but had not yet been not formally approved by the Ministry and Malawi Energy Regulatory Authority.

[i] Although the decree was available, injection of power into the grid could not yet happen pending the approval of regulation.

Source: See the REN21 GSR 2020 data pack online at www.ren21.net/GSR.

TABLE R12. Renewable Power Tenders Held at the National/State/Provincial Levels, 2019

| Country | Technology | Description |
|---|---|---|
| Australia | Solar PV, energy storage | 250 MW solar PV and 20 MW / 40 MWh battery energy storage system announced |
| Belgium | Wind power (offshore) | At least 1.7 GW after 2020 announced |
| Brazil | Mix of technologies (including bio-power, hydropower, solar PV, wind power) | 401.6 MW awarded |
| | Technology-neutral among renewable and non-renewable technologies | 1.04 GW wind power awarded<br>530 MW solar PV awarded<br>445 MW hydropower<br>229.62 MW biomass awarded<br>734.13 MW natural gas awarded |
| Burkina Faso | Solar PV | 30 MW announced |
| Cabo Verde | Solar PV | 5 MW announced |
| | Wind power | 10 MW announced |
| Cambodia | Solar PV | 60 MW awarded |
| China | Solar PV | 22.78 GW of ground-mounted and distributed generation awarded |
| Colombia | Solar power and wind power | 1,374 MW awarded |
| Denmark | Solar PV | 83 MW awarded |
| | Solar power and wind power (hybrid) | 93 MW solar-wind hybrid facilities awarded (including 34.1 MW solar PV capacity) |
| Ethiopia | Solar PV | 250 MW awarded |
| | Solar PV | 750 MW announced |
| | Solar PV | Design, supply and commissioning of solar mini-grid projects in 25 rural towns and villages announced |
| France | Wind power (offshore) | 600 MW awarded |
| | Solar PV (ground-mounted) | 855 MW awarded |
| | Solar PV (ground-mounted) | 858 MW awarded |
| Gambia | Solar PV and storage | Utility-scale solar PV park with 150 MW battery storage announced |
| Ghana | Solar PV | 12 MWp announced |
| Germany | Solar PV | 153 MW awarded |
| | Solar PV | 501 MW awarded |
| | Wind power (onshore) | 500 MW awarded |
| Greece | Solar power and wind power (joint auction) | 437.78 MW awarded |
| | Solar PV | 143 MW awarded |
| | Solar power | 105.09 MW awarded |
| | Wind power | 179.5 MW awarded |
| | Wind power | 224 MW awarded |
| Guinea Bissau | Solar PV | 22 MWp ground-mounted solar power plant and 30 kV transmission line announced |
| India | Solar PV | 30 GW announced |
| | Transmission line supply and reactor package installation | Installation of reactor packages and supply of transmission lines announced |
| | Solar PV (floating) | 70 MW announced |
| | Wind power (offshore) | Undisclosed capacity announced |
| Iraq | Solar PV | 755 MW offered |
| Ireland | Technology-neutral among renewable technologies | 13,500 GWh announced |
| | Energy storage | 110 MW awarded |
| Italy | Solar power, wind power | 4.8 GW announced (650 MW combined solar and wind, 600 MW rooftop PV) |

TABLE R12. Renewable Power Tenders Held at the National/State/Provincial Levels, 2019 (continued)

| Country | Technology | Description |
|---|---|---|
| Japan | Solar power | 195.8 MW awarded |
| Lithuania | Technology-neutral among renewable technologies | 300 GWh allocated |
| Mali | Solar PV + storage | 1.3 MW with 1.5 MW/2 MWh storage announced |
| | Solar PV-diesel hybrid | Four 80 kWp mini-grids announced |
| Malaysia | Solar power | 491 MW large-scale solar projects awarded |
| Mauritius | Energy storage | 14 MW for a pre-existing solar plant announced |
| Mexico | Geothermal power | Additional drilling at the Los Azufres geothermal field announced |
| Netherlands | Wind power | 760 MW awarded |
| Nigeria | Solar PV + storage | 15 MW ground-mounted solar with 5 MW battery system offered |
| Poland | Wind power (onshore) | 2.5 GW awarded |
| Portugal | Solar power | 1.3 GW awarded |
| | Energy storage | 50-100 MW announced |
| | Solar PV (floating) | 50 MW offered |
| Russian Federation | Wind power | 78 MW awarded |
| Seychelles | Solar PV (floating) | 4 MW awarded |
| Togo | Solar PV | Tender announced for the development, operation and maintenance of solar PV based mini-grids in 317 localities |
| Tonga | Solar PV | 6 MW awarded |
| Tunisia | Solar power | 500 MW offered |
| Turkey | Wind power | 1 GW awarded |
| United Arab Emirates | Solar power | 900 MW awarded |
| United Kingdom | Wind power (offshore) | 5.47 GW awarded |
| | Wind power (onshore) | 330 MW awarded |
| Vietnam | Solar PV (floating) | 400 MW announced in pilot auctions |
| Zambia | Hydropower (small-scale) | 100 MW announced |
| | Solar PV | 120 MW awarded |
| | Solar PV | 100 MW announced |
| Zimbabwe | Solar PV, energy storage | 19.65 MWp announced |

**State/Provincial Renewable Energy Auctions Held in 2019**

| Country | State | Technology | Description |
|---|---|---|---|
| **India** | Chhattisgarh | Solar power | Supply and installation of 5,000 small solar irrigation pumps and 700 solar trees awarded |
| | Kerala | Solar power | Construction and supply of three solar-powered boats offered |
| | Maharashtra | Bio-power | 50 MW of power from bagasse-based co-generation announced |
| | Rajasthan | Solar PV | 750 kW of grid-connected solar PV announced for electric vehicle charging stations at selected highways/cities |

Note: This table provides an overview of identified renewable energy tenders in 2019 and may not constitute a comprehensive picture of all capacity offered through tenders during the year.

Source: See the REN21 GSR 2020 data pack online at www.ren21.net/GSR.

TABLE R13. Biofuels Global Production, Top 15 Countries and EU-28, 2019

| Country | Ethanol | Biodiesel (FAME) | Biodiesel (HVO) | Change Relative to 2018 |
|---|---|---|---|---|
| | Billion litres | | | |
| United States | 59.7 | 4.0 | 2.5 | -1.7 |
| Brazil | 35.3 | 5.9 | 0.0 | 2.9 |
| Indonesia | 0.0 | 7.9 | 0.0 | 3.9 |
| China | 4.0 | 0.6 | 0.0 | 0.7 |
| Germany | 0.8 | 3.8 | 0.0 | 0.0 |
| France | 0.9 | 2.8 | 0.2 | -0.3 |
| Argentina | 1.1 | 2.5 | 0.0 | -0.2 |
| Thailand | 1.6 | 1.7 | 0.0 | 0.3 |
| Spain | 0.5 | 2.0 | 0.0 | 0.1 |
| Netherlands | 0.4 | 1.0 | 1.1 | 0.1 |
| Canada | 2.0 | 0.3 | 0.0 | 0.3 |
| India | 2.1 | 0.2 | 0.0 | 0.5 |
| Malaysia | 0.0 | 1.6 | 0.0 | 0.7 |
| Poland | 0.2 | 1.0 | 0.0 | 0.1 |
| Italy | 0.0 | 0.8 | 0.2 | 0.2 |
| **EU-28** | **4.7** | **12.4** | **2.9** | **-0.1** |
| **World Total** | **113.7** | **40.9** | **6.5** | **7.8** |

Note: Production levels are rounded to the nearest 0.1 billion litres. Rounding is to account for uncertainties in available data. Countries are ranked according to total biofuel production in 2019. FAME = fatty acid methyl esters; HVO = hydrotreated vegetable oil.

Source: See endnote 13 for this section.

TABLE R14. Geothermal Power Global Capacity and Additions, Top 10 Countries, 2019.

| Country | Added 2019 | Total End-2019 |
|---|---|---|
| | MW | GW |
| **Top Countries by Additions** | | |
| Turkey | 232 | 1.5 |
| Indonesia | 182 | 2.1 |
| Kenya | 160 | 0.8 |
| Costa Rica | 55 | 0.3 |
| Japan | 54 | 0.6 |
| Mexico | 27 | 0.9 |
| United States | 15 | 2.5 |
| Germany | 6 | 0.05 |
| **Top Countries by Total Capacity** | | |
| United States | 15 | 2.5 |
| Indonesia | 182 | 2.1 |
| Philippines | – | 1.9 |
| Turkey | 232 | 1.5 |
| New Zealand | – | 1.0 |
| Mexico | 27 | 0.9 |
| Italy | – | 0.8 |
| Iceland | – | 0.8 |
| Kenya | 160 | 0.8 |
| Japan | 54 | 0.6 |
| **World Total** | **728** | **13.9** |

Note: Capacity additions are rounded to the nearest 1 MW, and totals are rounded to the nearest 0.1 GW, with the exception of Germany, which is rounded to the nearest 0.01 GW. Rounding is to account for uncertainties and inconsistencies in available data. Table reflects known new capacity and capacity increases at existing facilities but does not indicate known capacity decommissioning or derating of existing facilities, although those may be reflected (at least partially) in total capacity values. For more information and statistics, see Geothermal section in Market and Industry chapter and related endnotes.

Source: See endnote 14 for this section.

TABLE R15. Hydropower Global Capacity and Additions, Top 10 Countries, 2019

| Country | Added 2019 | Total End-2019 |
|---|---|---|
| | GW | |
| **Top Countries by Additions** | | |
| Brazil | 4.9 | 109 |
| China | 3.9 | 326 |
| Lao PDR | 1.9 | 7.2 |
| Bhutan | 0.7 | 2.3 |
| Tajikistan | 0.6 | 6.4 |
| Russian Federation | 0.5 | 48 |
| Angola | 0.3 | 3.4 |
| Uganda | 0.3 | 1.0 |
| Ethiopia | 0.3 | 4.1 |
| Turkey | 0.2 | 29 |
| **Top Countries by Total Capacity** | | |
| China | 3.9 | 326 |
| Brazil | 4.9 | 109 |
| Canada | – | 81 |
| United States | ~0 | 80 |
| Russian Federation | 0.5 | 48 |
| India | 0.2 | 45 |
| Norway | 0.1 | 31 |
| Turkey | 0.2 | 29 |
| Japan | – | 22 |
| France | ~0 | 20 |
| **World Total** | **16** | **1,150** |

Note: Capacity additions are rounded to the nearest 0.1 GW, and totals are rounded to the nearest 1 GW except when totals are less than 10 GW. Rounding is to account for uncertainties and inconsistencies in available data. Capacity amounts of less than 50 MW are designated by "~0". For more information and statistics, see Hydropower section in Market and Industry chapter and related endnotes.

Source: See endnote 15 for this section.

TABLE R16. Solar PV Global Capacity and Additions, Top 10 Countries, 2019

| | Total End-2018 | Added 2019 | Total End-2019 |
|---|---|---|---|
| | GW | | |
| **Top Countries by Additions** | | | |
| China | 175.4 | 30.1 | 204.7 |
| United States | 62.7 | 13.3 | 76 |
| India | 32.9 | 9.9 | 42.8 |
| Japan | 56 | 7 | 63 |
| Vietnam | 0.1 | 4.8 | 4.9 |
| Spain | 5.2 | 4.8 | 9.9 |
| Germany | 45.2 | 3.8 | 49 |
| Australia | 11 | 3.7 | 14.7 |
| Ukraine | 1.3 | 3.5 | 4.8 |
| Republic of Korea | 8.1 | 3.1 | 11.2 |
| **Top Countries by Total Capacity** | | | |
| China | 175.4 | 30.1 | 204 |
| United States | 62.7 | 13.3 | 76 |
| Japan | 56 | 7 | 63 |
| Germany | 45.2 | 3.8 | 49 |
| India | 32.9 | 9.9 | 42.8 |
| Italy | 20.1 | 0.7 | 20.8 |
| Australia | 11 | 3.7 | 14.7 |
| United Kingdom | 13.1 | 0.3 | 13.4 |
| Republic of Korea | 8.1 | 3.1 | 11.2 |
| Spain | 5.2 | 4.8 | 9.9 |
| **World Total** | **512** | **115** | **627** |

Note: Country data are rounded to the nearest 0.1 GW, and world totals are rounded to the nearest 1 GW. Rounding is to account for uncertainties and inconsistencies in available data; where totals do not add up, the difference is due to rounding. Data are provided in direct current (DC); data for India, Japan and the United States were converted from official data reported in alternating current (AC) into DC by sources listed for this table. Data are from a variety of sources, some of which differ significantly because of variations in accounting or methodology. For more information, see Solar PV section in Market and Industry chapter and related endnotes.

Source: See endnote 16 for this section.

TABLE R17. Concentrating Solar Thermal Power (CSP) Global Capacity and Additions, 2019

| Country | Total End-2018 | Added 2019 | Total End-2019 |
|---|---|---|---|
| | | MW | |
| Spain | 2,304 | – | 2,304 |
| United States | 1,738 | – | 1,738 |
| Morocco | 516 | – | 516 |
| South Africa | 400 | 100 | 500 |
| China | 220 | 200 | 420 |
| Israel | – | 240 | 240 |
| India | 225 | – | 225 |
| United Arab Emirates | 100 | – | 100 |
| Saudi Arabia | 50 | – | 50 |
| Kuwait | – | 50 | 50 |
| Algeria | 20 | – | 20 |
| Egypt | 20 | – | 20 |
| Iran | 17 | – | 17 |
| France | – | 9 | 9 |
| **World Total** | **5,610** | **600** | **6,210** |

Note: Table includes all countries with operating commercial CSP capacity at end-2019. Pilot and demonstration facilities and facilities with capacities of 5 MW or less are excluded from the table. Additional countries that had small (5 MW or less) pilot or demonstration plants in operation by year's end include Australia (4.1 MW), Denmark (4 MW), Canada (1.1 MW), France (0.25 MW), Germany (1.5 MW), Italy (6 MW), Oman (7 MW), Thailand (5 MW) and Turkey (5 MW). National data are rounded to the nearest MW, and world totals are rounded to the nearest 5 MW. Rounding is to account for uncertainties and inconsistencies in available data; where totals do not add up, the difference is due to rounding. Capacity data reflect net capacity; where it is not possible to verify if reported capacity reflects net or gross capacity, capacity is assumed to be net. For more information, see CSP section in Market and Industry chapter and related endnotes.

Source: See endnote 17 for this section.

TABLE R18. Solar Water Heating Collectors and Total Capacity End-2018 and Newly Installed Capacity 2019, Top 20 Countries

| | Total End-2018 | | | Gross Additions 2019 | | |
|---|---|---|---|---|---|---|
| | $GW_{th}$ | | | $MW_{th}$ | | |
| **Country** | **Glazed** | **Unglazed** | **Total** | **Glazed** | **Unglazed** | **Total** |
| China | 337.6 | – | 337.6 | 22,750 | – | 22,750 |
| Turkey | 17.6 | – | 17.6 | 1,320 | – | 1,320 |
| India | 9.5 | – | 9.5 | 1,270 | – | 1,270 |
| Brazil | 7.1 | 4.2 | 11.3 | 461 | 464 | 925 |
| United States | 2.2 | 15.7 | 17.9 | 112 | 487 | 600 |
| Australia | 2.6 | 3.9 | 6.5 | 122 | 266 | 388 |
| Germany | 13.5 | 0.4 | 13.9 | 358 | – | 358 |
| Mexico | 2.0 | 1.0 | 3.0 | 203 | 83 | 286 |
| Greece | 3.3 | – | 3.3 | 253 | – | 253 |
| Israel | 3.3 | – | 3.4 | 252 | – | 252 |
| Poland | 1.8 | – | 1.8 | 184 | – | 184 |
| Spain | 2.9 | 0.1 | 3.0 | 143 | 2 | 145 |
| Denmark | 1.2 | – | 1.2 | 137 | – | 137 |
| South Africa | 0.7 | 0.9 | 1.5 | 70 | 42 | 112 |
| Italy | 3.3 | – | 3.3 | 106 | – | 106 |
| Austria | 3.3 | 0.2 | 3.6 | 63 | – | 64 |
| Cyprus | 0.6 | 1.5 | 2.1 | 49 | – | 49 |
| Tunisia | 0.7 | – | 0.7 | 44 | – | 44 |
| Palestine, State of | 1.3 | – | 1.3 | 32 | – | 32 |
| Switzerland | 1.1 | 0.1 | 1.2 | 28 | 3 | 32 |
| **Total Top 20 Countries** | 415.4 | 28.1 | 443.5 | 27,957 | 1,348 | 29,305 |
| **World Total** | **452** | **30** | **482** | **29,840** | **1,455** | **31,295** |

Note: Countries are ranked according to newly installed glazed collector capacity in 2019. Data are for glazed and unglazed water collectors excluding air collectors, which added at least 1.1 $GW_{th}$ to the year-end world total for 2018, and excluding concentrating collectors, which achieved 364 $MW_{th}$ at the end of 2018. End-2018 data for individual countries and Total 20 Top Countries are rounded to the nearest 0.1 $GW_{th}$; end-2018 World Total data are rounded to the nearest $GW_{th}$; additions for individual countries and Total 20 Top Countries are rounded to the nearest 1 $MW_{th}$. Where totals do not add up, the difference is due to rounding. By accepted convention, 1 million square metres = 0.7 $GW_{th}$. The year 2018 is the most recent one for which firm global data on total capacity in operation were available. However, 479 $GW_{th}$ of solar thermal capacity (water and non-concentrating collectors only) was estimated to be in operation worldwide by end-2019. For details and source information on 2019 additions, see Solar Thermal section in Market and Industry chapter and related endnotes.

Source: See endnote 18 for this section.

TABLE R19. Wind Power Global Capacity and Additions, Top 10 Countries, 2019

| Country | Total End-2018 | Added 2019 | Total End-2019 |
|---|---|---|---|
| | GW | | |
| **Top Countries by Additions** | | | |
| China[a] | 184.2/209.5 | 25.7/26.8 | 210/236.3 |
| United States | 96.5 | 9.1 | 105.6 |
| United Kingdom | 21.1 | 2.4 | 23.5 |
| India | 35.1 | 2.4 | 37.5 |
| Spain | 23.5 | 2.3 | 25.8 |
| Germany | 59.3 | 2.1 | 61.4 |
| Sweden | 7.4 | 1.6 | 9.0 |
| France | 15.3 | 1.3 | 16.6 |
| Mexico | 4.9 | 1.3 | 6.2 |
| Argentina | 0.7 | 0.9 | 1.6 |
| **Top Countries by Total Capacity** | | | |
| China[a] | 184.2/209.5 | 25.7/26.8 | 210/236.3 |
| United States | 96.5 | 9.1 | 105.6 |
| Germany | 59.3 | 2.1 | 61.4 |
| India | 35.1 | 2.4 | 37.5 |
| Spain | 23.5 | 2.3 | 25.8 |
| United Kingdom | 21.1 | 2.4 | 23.5 |
| France | 15.3 | 1.3 | 16.6 |
| Brazil | 14.7 | 0.7 | 15.5 |
| Canada | 12.8 | 0.6 | 13.4 |
| Italy | 10.1 | 0.5 | 10.5 |
| **World Total** | **591** | **60** | **651** |

[a] For China, data to the left of the "/" are the amounts officially classified as connected to the grid and operational (receiving FIT premium) by year's end; data to the right are total installed capacity, most, if not all, of which was connected to substations by year's end. The world totals include the higher numbers for China. See Wind Power section in Market and Industry chapter and related endnotes for more details.

Note: Country data are rounded to the nearest 0.1 GW; world data are rounded to the nearest GW. Rounding is to account for uncertainties and inconsistencies in available data; where totals do not add up, the difference is due to rounding or to repowering/removal of existing projects. Several countries repowered or decommissioned existing capacity during the year, which is reflected in the table to the extent possible. Data are from a variety of sources, some of which differ significantly because of variations in accounting or methodology. For more information, see Wind Power section in Market and Industry chapter and related endnotes.

Source: See endnote 19 for this section.

TABLE R20. Electricity Access by Region and Country, Status in 2018 and Targets

| World/Region/Country | Population with Electricity Access in 2018 | Population Without Electricity Access in 2018 | Target |
|---|---|---|---|
| | Share of population with access | Millions | Share of population with electricity access |
| **World[a]** | **89%** | **861** | |
| **All Developing Countries** | **86%** | **861** | |
| **Africa** | **54%** | **601** | |
| **North Africa** | **>99%** | **<1** | |
| **Sub-Saharan Africa** | **45%** | **600** | |
| **Developing Asia** | **94%** | **226** | |
| **Central and South America** | **97%** | **16** | |
| **Middle East** | **93%** | **18** | |
| **Africa** | | | |
| Angola | 45% | 17 | → 100% by 2030 |
| Benin | 35% | 8 | → 95% by 2025 (urban)<br>→ 65% by 2025 (rural) |
| Botswana | 59% | <1 | → 100% by 2030 |
| Burkina Faso | 20% | 16 | → 100 by 2025 |
| Burundi | 11% | 10 | → 25% by 2025 |
| Cameroon | 70% | 7 | |
| Central African Republic | <5% | 5 | → 50% by 2030 |
| Chad | 9% | 14 | |
| Congo, Democratic Republic of the | 9% | 77 | → 60% by 2025 |
| Congo, Republic of | 69% | 2 | |
| Côte d'Ivoire | 63% | 9 | → 100% by 2025 |
| Djibouti | 42% | <1 | → 100% by 2035 |
| Egypt | >95% | <1 | |
| Equatorial Guinea | 83% | <1 | |
| Eritrea | 49% | 3 | |
| Eswatini | 87% | <1 | → 75% by 2018<br>→ 85% by 2020<br>→ 100% by 2025 |
| Ethiopia | 45% | 59 | → 100% by 2030 |
| Gabon | 92% | <1 | |
| Gambia | 47% | 1 | → 100% by 2030 |
| Ghana | 84% | 5 | → 100% by 2020 |
| Guinea | 17% | 10 | → 100% by 2030 |
| Guinea-Bissau | 10% | 2 | → 80% by 2030 |
| Kenya | 75% | 13 | → 100% by 2022 |
| Lesotho | 36% | <1 | → 40% by 2020 |
| Liberia | 11% | 4 | → 100% by 2030 |
| Madagascar | 25% | 20 | |
| Malawi | 15% | 16 | → 30% by 2020 |
| Mali | 40% | 12 | → 87% by 2030 |
| Mauritania | 30% | 3 | |
| Morocco | >95% | <1 | |
| Mozambique | 29% | 22 | → 100% by 2025 |

TABLE R20. Electricity Access by Region and Country, Status in 2018 and Targets (continued)

| World/Region/Country | Population with Electricity Access in 2018 | Population Without Electricity Access in 2018 | Target |
|---|---|---|---|
| | Share of population with access | Millions | Share of population with electricity access |
| **Africa** (continued) | | | |
| Namibia | 56% | 1.1 | |
| Niger | 12% | 19 | → 65% by 2030 |
| Nigeria | 60% | 78 | → 75% by 2020<br>→ 90% by 2030 |
| Rwanda | 49% | 6 | → 100% by 2030 |
| Senegal | 69% | 5 | → 100% by 2025 |
| Sierra Leone | 25% | 6 | → 100% by 2025 |
| Somalia | 18% | 13 | |
| South Africa | 95% | 3 | → 100% by 2019 |
| South Sudan | <5% | 12 | |
| Sudan | 47% | 22 | |
| Tanzania | 37% | 37 | → 75% by 2030 |
| Togo | 43% | 5 | → 82% by 2030 |
| Uganda | 23% | 34 | → 98% by 2030 |
| Zambia | 37% | 11 | → 66% by 2030 |
| Zimbabwe | 34% | 11 | → 66% by 2030<br>→ 90% by 2030 (urban)<br>→ 51% by 2030 (rural) |
| **Developing Asia** | | | |
| Bangladesh | 85% | 25 | → 100% by 2021 |
| Brunei Darussalam | >95% | <1 | |
| Cambodia | 72% | 5 | → 70% by 2030 (rural) |
| India | 95% | 74 | → 100% by 2019 |
| Indonesia | 98% | 5 | |
| Korea, Democratic People's Republic | 27% | 19 | → 90% by 2017 |
| Lao PDR | 95% | <1 | |
| Mongolia | 91% | <1 | |
| Myanmar | 43% | 31 | → 87% by 2030 |
| Nepal | 94% | 2 | |
| Pakistan | 77% | 46 | |
| Philippines | >95% | 5 | |
| Vietnam | >95% | <1 | |
| **Central and South America** | | | |
| Argentina | >95% | <1 | |
| Bolivia | 92% | <1 | → 100% by 2025 (rural) |
| Brazil | >95% | <1 | |
| Colombia | >95% | 2 | → 97.45% by 2017 |
| Costa Rica | >95% | <1 | |
| Cuba | >95% | <1 | |
| Dominican Republic | >95% | <1 | |
| Ecuador | >95% | <1 | → 98.9% by 2022 (urban)<br>→ 96.3% by 2022 (rural) |
| El Salvador | >95% | <1 | |

TABLE R20. Electricity Access by Region and Country, Status in 2018 and Targets (continued)

| World/Region/Country | Population with Electricity Access in 2018 | Population Without Electricity Access in 2018 | Target |
|---|---|---|---|
| | Share of population with access | Millions | Share of population with electricity access |
| **Central and South America** (continued) | | | |
| Guatemala | 93% | 1 | |
| Haiti | 39% | 7 | → 50% by 2020 |
| Honduras | 79% | 2 | |
| Jamaica | >95% | <1 | |
| Nicaragua | >95% | <1 | |
| Panama | 93% | <1 | |
| Paraguay | >95% | <1 | |
| Peru | >95% | 1 | |
| Trinidad and Tobago | >95% | <1 | |
| Uruguay | >95% | <1 | |
| Venezuela | >95% | <1 | |
| **Middle East** | | | |
| Bahrain | >95% | <1 | |
| Iran | >95% | <1 | |
| Iraq | >95% | <1 | |
| Jordan | >95% | <1 | |
| Kuwait | >95% | <1 | |
| Lebanon | >95% | <1 | |
| Oman | >95% | <1 | |
| Saudi Arabia | >95% | <1 | |
| Syria | >95% | 1 | |
| Qatar | >95% | <1 | |
| United Arab Emirates | >95% | <1 | |
| Yemen | 47% | 15 | |
| **Oceania** | | | |
| Federated States of Micronesia[b] | 80% | <1 | → 90% by 2020 (rural) |

Disclaimer: The tracking of data related to energy access and DREA systems is a challenging process. Discrepancies or inconsistencies with past reporting may be due to improvements in data collection.

[a] Includes countries in the OECD and economies in transition.

[b] For the Federated States of Micronesia, rural electrification rate is defined by electrification of all islands outside of the four that host the state capital (which is considered urban).

Source: See endnote 20 for this section.

TABLE R21. Clean Cooking Access by Region and Country, Status in 2018 and Targets

| World/Region/Country | Population with Access to Clean Cooking in 2018 | Population Without Access to Clean Cooking in 2018 | Target |
|---|---|---|---|
| | Share of population | Millions | Share of population with access to clean cooking |
| **World[a]** | **65%** | **2,651** | |
| **All Developing Countries** | **56%** | **2,651** | |
| **Africa** | **29%** | **910** | |
| **Sub-Saharan Africa** | **17%** | **905** | |
| **North Africa** | **98%** | **1.1** | |
| **Developing Asia** | **57%** | **1,674** | |
| **Central and South America** | **89%** | **57** | |
| **Middle East** | **96%** | **10** | |
| **Africa** | | | |
| Algeria | 92% | 4 | |
| Angola | 50% | 15 | → 100% by 2030 |
| Benin | 5% | 11 | |
| Botswana | 66% | <1 | |
| Burkina Faso | 14% | 17 | → 100% by 2030 (urban)<br>→ 65% by 2030 (rural) |
| Burundi | <5% | 11 | |
| Cabo Verde | 83% | <1 | → 100% by 2020 |
| Cameroon | 25% | 19 | |
| Central African Republic | <5% | 5 | |
| Chad | 7% | 14 | |
| Comoros | 12% | <1 | |
| Congo, Democratic Republic of the | <5% | 81 | |
| Congo, Republic of | 26% | 4 | |
| Côte d'Ivoire | 30% | 18 | |
| Djibouti | 13% | <1 | |
| Egypt | >95% | <1 | |
| Equatorial Guinea | 37% | <1 | |
| Eritrea | 18% | 4 | |
| Eswatini | 52% | <1 | → 100% by 2030 |
| Ethiopia | 7% | 100 | → 100% by 2025 |
| Gabon | 80% | <1 | |
| Gambia | 11% | 2 | → 100% by 2030 |
| Ghana | 25% | 22 | → 100% by 2030 |
| Guinea | <5% | 13 | → 50% by 2025 |
| Guinea-Bissau | 5% | 2 | → 75% by 2030 |
| Kenya | 15% | 43 | → 100% by 2022 |
| Lesotho | 37% | 1 | |
| Liberia | <5% | 5 | → 100% by 2030 |
| Libya | >95% | <1 | |
| Madagascar | <5% | 26 | |
| Malawi | <5% | 18 | |
| Mali | <5% | 19 | → 100% by 2030 |
| Mauritania | 48% | 2 | |

TABLE R21. Clean Cooking Access by Region and Country, Status in 2018 and Targets (continued)

| World/Region/Country | Population with Access to Clean Cooking in 2018 | Population Without Access to Clean Cooking in 2018 | Target |
|---|---|---|---|
| | Share of population | Millions | Share of population with access to clean cooking |
| **Africa** | | | |
| Mauritius | 93% | <1 | |
| Morocco | >95% | <1 | |
| Mozambique | 6% | 29 | |
| Namibia | 43% | 2 | |
| Niger | <5% | 21 | → 100% by 2030 (urban)<br>→ 60% by 2030 (rural) |
| Nigeria | 9% | 178 | |
| Rwanda | <5% | 12 | → 100% by 2030 |
| São Tomé and Príncipe | 16% | <1 | |
| Senegal | 30% | 12 | |
| Seychelles | 91% | <1 | |
| Sierra Leone | <5% | 8 | |
| Somalia | 6% | 14 | |
| South Africa | 87% | 8 | |
| South Sudan | <5% | 12 | |
| Sudan | 46% | 23 | |
| Tanzania | 6% | 56 | → 75% by 2030 |
| Togo | 8% | 7 | → 80% by 2030 |
| Tunisia | >95% | <1 | |
| Uganda | 6% | 42 | → 99% by 2030 |
| Zambia | 17% | 15 | |
| Zimbabwe | 31% | 12 | |
| **Developing Asia** | | | |
| Bangladesh | 19% | 135 | |
| Brunei Darussalam | >95% | <1 | |
| Cambodia | 20% | 13 | |
| China | 72% | 399 | |
| India | 49% | 688 | |
| Indonesia | 68% | 85 | |
| Korea, Democratic People's Republic | 12% | 23 | |
| Lao PDR | 6% | 7 | |
| Malaysia | >95% | <1 | |
| Mongolia | 46% | 2 | |
| Myanmar | 21% | 43 | |
| Nepal | 30% | 21 | |
| Pakistan | 46% | 108 | |
| Philippines | 44% | 59 | |
| Singapore | >95% | <1 | |
| Sri Lanka | 28% | 16 | |
| Thailand | 76% | 17 | |
| Vietnam | 73% | 26 | |

TABLE R21. Clean Cooking Access by Region and Country, Status in 2018 and Targets (continued)

| World/Region/Country | Population with Access to Clean Cooking in 2018 | Population Without Access to Clean Cooking in 2018 | Target |
|---|---|---|---|
| | Share of population | Millions | Share of population with access to clean cooking |
| **Central and South America** | | | |
| Argentina | >95% | <1 | |
| Bolivia | 82% | 2 | |
| Brazil | >95% | 9 | |
| Chile[b] | 92% | 1.5 | |
| Colombia | 93% | 4 | |
| Costa Rica | 94% | <1 | |
| Cuba | 80% | 2 | |
| Dominican Republic | 91% | <1 | |
| Ecuador | >95% | <1 | |
| El Salvador | 88% | <1 | |
| Guatemala | 46% | 9 | |
| Haiti | 6% | 10 | |
| Honduras | 55% | 4 | |
| Jamaica | 92% | <1 | |
| Mexico[a] | 85% | 19 | |
| Nicaragua | 55% | 3 | |
| Panama | 90% | <1 | |
| Paraguay | 69% | 2 | |
| Peru | 78% | 7 | |
| Trinidad and Tobago | >95% | <1 | |
| Uruguay | >95% | <1 | |
| Venezuela | >95% | <1 | |
| **Middle East** | | | |
| Bahrain | >95% | <1 | |
| Iran | >95% | <1 | |
| Iraq | >95% | <1 | |
| Jordan | >95% | <1 | |
| Kuwait | >95% | <1 | |
| Lebanon | >95% | <1 | |
| Oman | >95% | <1 | |
| Saudi Arabia | >95% | <1 | |
| Qatar | >95% | <1 | |
| United Arab Emirates | >95% | <1 | |
| Yemen | 66% | 10 | |

Disclaimer: The tracking of data related to energy access and DREA systems is a challenging process. Discrepancies or inconsistencies with past reporting may be due to improvements in data collection.

[a] Includes countries in the OECD and economies in transition.

[b] Based on 2016 data

Source: See endnote 21 for this section.

TABLE R22. Global Trends in Renewable Energy Investment, 2009–2019

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Billion USD | | | | | | | | | | |
| **New Investment by Stage** | | | | | | | | | | | |
| **Technology Research and Start-up** | | | | | | | | | | | |
| Government R&D | 5.4 | 4.9 | 4.8 | 4.7 | 5.2 | 4.5 | 4.4 | 5.1 | 5.1 | 5.5 | 5.7 |
| Corporate R&D | 3.3 | 3.8 | 4.3 | 4.1 | 4.0 | 4.3 | 4.1 | 4.3 | 6.9 | 7.8 | 7.7 |
| Venture capital | 1.6 | 2.6 | 2.6 | 2.4 | 0.8 | 1.0 | 1.4 | 0.8 | 0.8 | 0.2 | 1.2 |
| **Scale-up** | | | | | | | | | | | |
| Public markets | 11.7 | 10.6 | 9.9 | 3.8 | 9.8 | 14.9 | 12.0 | 6.2 | 5.6 | 6.0 | 6.6 |
| Private equity expansion capital | 3.0 | 5.3 | 2.4 | 1.6 | 1.3 | 1.7 | 1.8 | 1.7 | 0.7 | 2.2 | 1.8 |
| **Projects** | | | | | | | | | | | |
| Asset finance | 111.8 | 152.2 | 189.6 | 170.1 | 171.5 | 228.4 | 267.7 | 247.5 | 272.6 | 242.0 | 230.1 |
| (re-invested equity) | -3.7 | -1.8 | -2.1 | -2.9 | -1.2 | -3.5 | -6.7 | -4.1 | -2.9 | -5.8 | -3.4 |
| Small-scale distributed capacity | 34.7 | 60.9 | 75.1 | 69.9 | 40.2 | 36.7 | 32.6 | 32.5 | 42.5 | 38.2 | 52.1 |
| **Total New Investment** | **167.8** | **238.5** | **286.6** | **253.7** | **231.7** | **288.1** | **317.3** | **293.9** | **331.4** | **296.0** | **301.7** |
| **Merger & Acquisition Transactions** | | | | | | | | | | | |
| | 61.5 | 57.3 | 75.0 | 65.7 | 67.0 | 88.8 | 108.1 | 133.9 | 146.2 | 151.5 | 100.7 |
| **Total Transactions** | **229.3** | **295.8** | **361.6** | **319.3** | **298.7** | **376.9** | **425.4** | **427.8** | **477.7** | **447.5** | **402.4** |
| **New Investment by Technology** | | | | | | | | | | | |
| Wind power | 72.5 | 97.8 | 83.3 | 78.3 | 83.3 | 111.1 | 119.7 | 123.5 | 133.4 | 132.7 | 142.7 |
| Solar power | 63.6 | 102.0 | 160.1 | 144.0 | 120.4 | 147.8 | 176.6 | 145.9 | 180.8 | 143.5 | 141.0 |
| Biomass and waste-to-energy | 13.4 | 17.3 | 20.9 | 15.4 | 14.6 | 13.1 | 10.4 | 15.2 | 7.4 | 11.5 | 11.2 |
| Biofuels | 9.4 | 10.1 | 10.5 | 7.7 | 5.1 | 5.5 | 3.6 | 2.1 | 3.3 | 3.3 | 3.0 |
| Hydropower <50 MW | 6.0 | 8.2 | 7.7 | 6.3 | 5.7 | 7.4 | 4.2 | 4.3 | 4.0 | 2.3 | 2.5 |
| Geothermal | 2.5 | 2.8 | 3.8 | 1.7 | 2.4 | 2.9 | 2.5 | 2.7 | 2.4 | 2.5 | 1.2 |
| Ocean power | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 | 0.4 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| **Total New Investment** | **167.8** | **238.5** | **286.6** | **253.7** | **231.7** | **288.1** | **317.3** | **293.9** | **331.4** | **296.0** | **301.7** |

Note: Excludes large hydropower projects of more than 50 MW.

Source: See endnote 22 for this section.

# ENERGY UNITS AND CONVERSION FACTORS

## METRIC PREFIXES

| | | | |
|---|---|---|---|
| kilo | (k) | = | $10^3$ |
| mega | (M) | = | $10^6$ |
| giga | (G) | = | $10^9$ |
| tera | (T) | = | $10^{12}$ |
| peta | (P) | = | $10^{15}$ |
| exa | (E) | = | $10^{18}$ |

## VOLUME

| | | |
|---|---|---|
| 1 $m^3$ | = | 1,000 litres (l) |
| 1 US gallon | = | 3.785412 l |
| 1 Imperial gallon | = | 4.546090 l |

**Example:** 1 TJ = 1,000 GJ = 1,000,000 MJ = 1,000,000,000 kJ = 1,000,000,000,000 J

## ENERGY UNIT CONVERSION

| Multiply by: | GJ | Toe | MBtu | MWh |
|---|---|---|---|---|
| **GJ** | 1 | 0.024 | 0.948 | 0.278 |
| **Toe** | 41.868 | 1 | 39.683 | 11.630 |
| **MBtu** | 1.055 | 0.025 | 1 | 0.293 |
| **MWh** | 3.600 | 0.086 | 3.412 | 1 |

Toe = tonnes (metric) of oil equivalent

1 Mtoe = 41.9 PJ

**Example:** 1 MWh x 3.600 = 3.6 GJ

## BIOFUELS CONVERSION

Ethanol: 21.4 MJ/l

Biodiesel (FAME): 32.7 MJ/l

Biodiesel (HVO): 34.4 MJ/l

Petrol: 36 MJ/l

Diesel: 41 MJ/l

## SOLAR THERMAL HEAT SYSTEMS

1 million $m^2$ = 0.7 $GW_{th}$

Used where solar thermal heat data have been converted from square metres ($m^2$) into gigawatts thermal ($GW_{th}$), by accepted convention.

**Note on Biofuels:**

1) These values can vary with fuel and temperature.
2) Around 1.7 litres of ethanol is energy equivalent to 1 litre of petrol, and around 1.2 litres of biodiesel (FAME) is energy equivalent to 1 litre of diesel.
3) Energy values from http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Tonnes_of_oil_equivalent_(toe) except HVO, which is from *Neste Renewable Diesel Handbook*, p. 15, https://www.neste.com/sites/default/files/attachments/neste_renewable_diesel_handbook.pdf.

# DATA COLLECTION AND VALIDATION

REN21 has developed a unique renewable energy reporting culture, allowing it to become recognised as a neutral data and knowledge broker that provides credible and widely accepted information. **Transparency is at the heart** of the REN21 data and reporting culture, and the following text explains some of the GSR's key processes for data collection and validation.

## DATA COLLECTION

Production of REN21's GSR is a continuous process occurring on an annual basis. The data collection process begins following the launch of the previous year's report with an Expression of Interest form to mobilise REN21's GSR contributors. During this time, the GSR team also prepares the questionnaires that will be filled in by contributors. The questionnaires are updated each year with emerging and relevant topics as identified by the REN21 Secretariat.

**REN21 collects data in seven main ways:**

1. **Country questionnaire.** In the country questionnaire, contributors from around the world submit data on renewable energy in their respective countries or countries of interest. This covers information about market trends, policy developments and local perspectives. Each data point is provided with a source and verified independently by the GSR team. Data collection with the country questionnaire typically begins in October.
2. **DREA questionnaire.** The Distributed Renewables for Energy Access (DREA) questionnaire collects data related to energy access from contributors around the world and focuses on developing and emerging countries. This covers information about the status of electrification and clean cooking in a certain country or region, as well as policies and programmes for energy access and markets for distributed renewables.
3. **Technology questionnaire.** The technology questionnaire functions similarly to the country questionnaire, but the input focuses specifically on annual developments for certain renewable energy technologies. As in the country questionnaire, all submitted data are validated with reliable, primary sources.
4. **Peer review.** To further collect data and project examples and to ensure that significant developments have not been overlooked, GSR contributors and reviewers participate in an open peer review process that takes place twice during each report cycle. The first round typically occurs in January and includes Round 1 chapters such as Policy Landscape, while the second round is held typically in March/April and includes Round 2 chapters such as Global Overview and Market and Industry Trends. Peer review is open to all interested experts.
5. **Expert interviews.** REN21's global community consists of a wide range of professionals who provide their expert input on renewable energy trends in the target year through interviews and personal communication with the REN21 GSR team and chapter authors. The vast majority of the information is backed up by primary sources.
6. **Desk research.** To fill in remaining gaps in the GSR and to pursue new topics, the REN21 GSR team and chapter authors conduct extensive desk research. Topics of research vary widely between GSR years and depend on emerging topics, important trends and annual availability of formal or informal data in the target sector.
7. **Data sharing agreements.** REN21 holds several data sharing agreements with some of the largest and most reliable data providers/aggregators in the energy sector. These formal data are used exclusively in some cases or, in others, form the foundation of calculations and estimations presented in the GSR.

## DATA VALIDATION

REN21 ensures the accuracy and reliability of its reports by conducting data validation and fact-checking as a continuous process. Beginning during the first submission of the country questionnaires, data are continually verified up through the design period and until the final report is published. **All data provided by contributors, whether written or verbal, are validated by primary sources, which are published alongside the full report.**

# METHODOLOGICAL NOTES

This 2020 report is the 15th edition of the *Renewables Global Status Report* (GSR), which has been produced annually since 2005 (with the exception of 2008). Readers are directed to the previous GSR editions for historical details.

Most 2019 data[i] for national and global capacity, output, growth and investment provided in this report are preliminary. Where necessary, information and data that are conflicting, partial or older are reconciled by using reasoned expert judgment. Endnotes provide additional details, including references, supporting information and assumptions where relevant.

Each edition draws from thousands of published and unpublished references, including: official government sources; reports from international organisations and industry associations; input from the GSR community via hundreds of questionnaires submitted by country, regional and technology contributors as well as feedback from several rounds of formal and informal reviews; additional personal communications with scores of international experts; and a variety of electronic newsletters, news media and other sources.

Much of the data found in the GSR is built from the ground up by the authors with the aid of these resources. This often involves extrapolation of older data, based on recent changes in key countries within a sector or based on recent growth rates and global trends. Other data, often very specific and narrow in scope, come more-or-less prepared from third parties. The GSR attempts to synthesise these data points into a collective whole for the focus year.

The GSR endeavours to provide the best data available in each successive edition; as such, data should not be compared with previous versions of this report to ascertain year-by-year changes.

## NOTE ON ESTABLISHING RENEWABLE ENERGY SHARES OF TOTAL FINAL ENERGY CONSUMPTION (TFEC)

### Assumptions Related to Renewable Electricity Shares of TFEC

When estimating electricity consumption from renewable sources, the GSR must make certain assumptions about how much of the estimated gross output from renewable electricity generating resources actually reaches energy consumers, as part of total final energy consumption.

The International Energy Agency's (IEA) *World Energy Statistics and Balances* reports electricity output by individual technology. However, it does not report electricity consumption by technology – only total consumption of electricity.

The difference between gross output and final consumption is determined by:

- The energy industry's own-use, including electricity used for internal operations at power plants. This includes the power consumption of various internal loads, such as fans, pumps and pollution controls at thermal plants, and other uses such as electricity use in coal mining and fossil fuel refining.
- Transmission and distribution losses that occur as electricity finds its way to consumers.

**Industry's own-use.** The common method is to assume that the proportion of consumption by technology is equal to the proportion of output by technology. This is problematic because logic dictates that industry's own-use cannot be proportionally the same for every generating technology. Further, industry's own-use must be somewhat lower for some renewable generating technologies (particularly non-thermal renewables such as hydropower, solar PV and wind power) than is the case for fossil fuel and nuclear power technologies. Such thermal power plants consume significant amounts of electricity to meet their own internal energy requirements (see above).

Therefore, the GSR has opted to apply differentiated "industry own-use" by generating technology. This differentiation is based on explicit technology-specific own-use (such as pumping at hydropower facilities) as well as on the apportioning of various categories of own-use by technology as deemed appropriate. For example, industry own-use of electricity at coal mines and oil refineries is attributed to fossil fuel generation.

Differentiated own-uses by technology, combined with global average losses, are as follows: solar PV, ocean energy and wind power (8.2%); hydropower (10.1%); concentrating solar thermal power (CSP) (14.2%); and bio-power (15.2%). For comparison, the undifferentiated (universal) combined losses and industry own-use would be 16.7% of gross generation. Estimated technology-specific industry own-use of electricity from renewable sources is based on data for 2016 from IEA, *World Energy Statistics and Balances, 2019 edition* (Paris: 2019).

**Transmission and distribution losses.** Such losses may differ (on average) by generating technology. For example, hydropower plants often are located far from load centres, incurring higher than average transmission losses, whereas some solar PV generation may occur near to (or at) the point of consumption, incurring little (or zero) transmission losses. However, specific information by technology on a global scale is not available.

Therefore, the GSR has opted to apply a global average for transmission and distribution losses. Global average electricity losses are based on data for 2017 from IEA, *World Energy Statistics and Balances, 2019 edition* (Paris: 2019).

## NOTES ON RENEWABLE ENERGY IN TOTAL FINAL ENERGY CONSUMPTION, BY ENERGY USE

GSR 2020 presents an illustration of the share of renewable energy in total final energy consumption (TFEC) by sector in 2017. (→ *See Figure 3 in Global Overview chapter.*) The share of TFEC consumed in each sector is provided as follows: thermal (51%), transport (32%) and electricity (17%). There are three important points about this figure and about how the GSR treats end-use TFEC in general:

i For information on renewable energy data and related challenges, see Sidebar 4 in GSR 2015 and Sidebar 1 in GSR 2014.

**1. Definition of Heating and Cooling and Thermal Applications**

In the GSR, the term "heating and cooling" refers to applications of thermal energy including space and water heating, space cooling, refrigeration, drying and industrial process heat, as well as any use of energy other than electricity that is used for motive power in any application other than transport. In other words, thermal demand refers to all end-uses of energy that cannot be classified as electricity demand or transport.

**2. Sectoral Shares of TFEC**

In Figure 3, each sectoral share of TFEC portrays the energy demand for all end-uses within the sector. The shares of TFEC allocated to thermal and to transport also account for the electricity consumed in these sectors – that is, electricity for space heating and space cooling, industrial process heat, etc., and electricity for transport. These amounts have been reallocated from final demand in the electricity sector. Therefore, the share of TFEC allocated to the electricity sector comprises all final end-uses of electricity that are not used for heating, cooling or transport. This is a methodological change from GSR 2018 that is intended to strengthen the accuracy of the representation. In total, the final energy consumption of all electrical energy accounted for 20.8% of TFEC in 2017.

**3. Shares of Non-renewable Electricity**

Figure 3 illustrates the share of non-renewable electricity in thermal and in transport to emphasise that electricity demand is being allocated to each sector. The share of non-renewable electricity is not critical to the figure content, so the percentage value of non-renewable electricity in each sector is not explicitly shown, but it is included in this note. In 2017, all electricity for heating and cooling met 7.2% of final energy demand in the sector (1.9% renewable and 5.3% non-renewable electricity). All electricity for transport met 1.1% of final energy demand in the sector (0.3% renewable and 0.8% non-renewable electricity).

## NOTES ON RENEWABLE ENERGY CAPACITIES AND ENERGY OUTPUT

A number of issues arise when counting renewable energy capacities and energy output. Some of these are discussed below:

**1. Capacity versus Energy Data**

The GSR aims to give accurate estimates of capacity additions and totals, as well as of electricity, heat and transport fuel production in the focus year. These measures are subject to some uncertainty, which varies by technology. The Market and Industry chapter includes estimates for energy produced where possible, but it focuses mainly on power or heat capacity data. This is because capacity data generally can be estimated with a greater degree of confidence than generation data. Official heat and electricity generation data often are not available for the target year within the production time frame of the GSR.

**2. Constructed Capacity versus Connected Capacity and Operational Capacity**

Over a number of years in the past decade, the solar PV and wind power markets saw increasing amounts of capacity that was connected to the grid but not yet deemed officially operational, or constructed capacity that was not connected to the grid by year's end. Therefore, since the 2012 edition the GSR has aimed to count only capacity additions that were grid-connected or that otherwise went into service (e.g., capacity intended for off-grid use) during the previous calendar (focus) year. However, it appears that this phenomenon is no longer an issue, with the exception of wind power installations in China, where it has been particularly evident over the period 2009-2019. For details on the situation in China and on the reasoning for capacity data used in this GSR, see endnote 24 in the Wind Power section of the Market and Industry chapter.

**3. Retirements and Replacements**

Data on capacity retirements and replacements (re-powering) are incomplete for many technologies, although data on several technologies do attempt to account for these directly. It is not uncommon for reported new capacity installations to exceed the implied net increase in cumulative capacity; in some instances, this is explained by revisions to data on installed capacity, while in others it is due to capacity retirements and replacements. Where data are available, they are provided in the text or relevant endnotes.

**4. Bioenergy Data**

Given existing complexities and constraints (→ *see Figure 6 in GSR 2015 and Sidebar 2 in GSR 2012*), the GSR strives to provide the best and latest data available regarding biomass energy developments. The reporting of biomass-fired combined heat and power (CHP) systems varies among countries; this adds to the challenges experienced when assessing total heat and electricity capacities and total bioenergy outputs.

Wherever possible, the bio-power data presented include capacity and generation from both electricity-only and CHP systems using solid biomass, landfill gas, biogas and liquid biofuels. Electricity generation and capacity numbers are based on national data for the focus year in the major producing countries and on forecast data for remaining countries for the focus year from the IEA.

The methodology is similar for biofuels production data, with data for most countries (not major producers) from the IEA; however, data for hydrotreated vegetable oil (HVO) are estimated based on production statistics for the (relatively few) major producers. Bio-heat data are based on an extrapolation of the latest data available from the IEA based on recent growth trends. (→ *See Bioenergy section in Market and Industry chapter.*)

### 5. Hydropower Data and Treatment of Pumped Storage

Starting with the 2012 edition, the GSR has made an effort to report hydropower generating capacity without including pure pumped storage capacity (the capacity used solely for shifting water between reservoirs for storage purposes). The distinction is made because pumped storage is not an energy source but rather a means of energy storage. It involves conversion losses and can be fed by all forms of electricity, renewable and non-renewable.

Some conventional hydropower facilities do have pumping capability that is not separate from, or additional to, their normal generating capability. These facilities are referred to as "mixed" plants and are included, to the extent possible, with conventional hydropower data. It is the aim of the GSR to distinguish and separate only the pure (or incremental) pumped storage component.

Where the GSR presents data for renewable power capacity not including hydropower, the distinction is made because hydropower remains the largest single component by far of renewable power capacity, and thus can mask developments in other renewable energy technologies if included. Investments and jobs data separate out large-scale hydropower where original sources use different methodologies for tracking or estimating values. Footnotes and endnotes provide additional details.

### 6. Solar PV Capacity Data[i]

The capacity of a solar PV panel is rated according to direct current (DC) output, which in most cases must be converted by inverters to alternating current (AC) to be compatible with end-use electricity supply. No single equation is possible for calculating solar PV data in AC because conversion depends on many factors, including the inverters used, shading, dust build-up, line losses and temperature effects on conversion efficiency. The difference between DC and AC power can range from as little as 5% (conversion losses or inverter set at the DC level) to as much as 40% (due to grid regulations limiting output or to the evolution of utility-scale systems), and most utility-scale plants built in 2019 have ratios in the range of 1.1 to 1.6[ii].

The GSR attempts to report all solar PV capacity data on the basis of DC output (where data are known to be provided in AC, this is specified) for consistency across countries. Some countries (for example, Canada, Chile, India, Japan, Malaysia, Spain, Sweden and the United States) report official capacity data on the basis of output in AC; these capacity data were converted to DC output by data providers (see relevant endnotes) for the sake of consistency. Global renewable power capacity totals in this report include solar PV data in DC; as with all statistics in this report, they should be considered as indicative of global capacity and trends rather than as exact statistics.

### 7. Concentrating Solar Thermal Power (CSP) Data

Global CSP data are based on commercial facilities only. Demonstration and pilot facilities as well as facilities of 5 MW or less are excluded from capacity data, with the exception of certain plants in China that are described as "demonstration" plants by government but are nonetheless large- (utility-) scale, grid-connected plants that are operating or will operate commercially. Discrepancies between REN21 data and other reference sources are due primarily to differences in categorisation and thresholds for inclusion of specific CSP facilities in overall global totals. The GSR aims to report net CSP capacities for specific CSP plants that are included. In certain cases, it may not be possible to verify if the reported capacity of a given CSP plant is net or gross capacity. In these cases net capacity is assumed.

### 8. Solar Thermal Heat Data

Starting with GSR 2014, the GSR includes all solar thermal collectors that use water as the heat transfer medium (or heat carrier) in global capacity data and the ranking of top countries. Previous GSRs focused primarily on glazed water collectors (both flat plate and evacuated tube); the GSR now also includes unglazed water collectors, which are used predominantly for swimming pool heating. Since the GSR 2018, data for concentrating collectors are available. These include new installations overall as well as in key markets and total in operation by year's end. The market for solar air collectors (solar thermal collectors that use air as the heat carrier) and hybrid or PV-thermal technologies (elements that produce both electricity and heat) is small and the data rather uncertain. All three collector types – air, concentrating and hybrid collectors – are included where specified.

Estimates for 2019 additions in China were based on produced collector area and included export volumes in the national statistics for 2019 and earlier years. The export volumes for previous years were not known at the time of publication, and to the extent possible GSR 2021 will reflect corrected statistics.

## OTHER NOTES

Editorial content of this report closed by 29 May 2020 for technology data, and by 15 May 2020 or earlier for other content.

Growth rates in the GSR are calculated as compound annual growth rates (CAGR) rather than as an average of annual growth rates.

All exchange rates in this report are as of 31 December 2019 and are calculated using the OANDA currency converter (http://www.oanda.com/currency/converter).

Corporate domicile, where noted, is determined by the location of headquarters.

i Based largely on information drawn from the following: IEA Photovoltaic Power Systems Programme (PVPS), *Snapshot of Global PV Markets 2020* (Paris: April 2020), p. 11, https://iea-pvps.org/wp-content/uploads/2020/04/IEA_PVPS_Snapshot_2020.pdf; IEA PVPS, *Trends in Photovoltaic Applications 2019* (Paris: 2019), p. 9, https://iea-pvps.org/trends_reports/2019-edition; G. Masson, Becquerel Institute and IEA PVPS, personal communication with REN21, May 2017; D. Renné, International Solar Energy Society, personal communication with REN21, March 2017; M. Schmela, SolarPower Europe, personal communication with REN21, 11 May 2019; Becquerel Institute, personal communication with REN21, April 2020.

ii See IEA PVPS, *Trends in Photovoltaic Applications 2019*, p. 9, and IEA PVPS, *Snapshot of Global PV Markets 2020*, p. 11.

# GLOSSARY

**Absorption chillers.** Chillers that use heat energy from any source (solar, biomass, waste heat, etc.) to drive air conditioning or refrigeration systems. The heat source replaces the electric power consumption of a mechanical compressor. Absorption chillers differ from conventional (vapour compression) cooling systems in two ways: 1) the absorption process is thermochemical in nature rather than mechanical, and 2) the substance that is circulated as a refrigerant is water rather than chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs), also called Freon. The chillers generally are supplied with district heat, waste heat or heat from co-generation, and they can operate with heat from geothermal, solar or biomass resources.

**Adsorption chillers.** Chillers that use heat energy from any source to drive air conditioning or refrigeration systems. They differ from absorption chillers in that the adsorption process is based on the interaction between gases and solids. A solid material in the chiller's adsorption chamber releases refrigerant vapour when heated; subsequently, the vapour is cooled and liquefied, providing a cooling effect at the evaporator by absorbing external heat and turning back into a vapour, which is then re-adsorbed into the solid.

**Auction.** See Tendering.

**Bagasse.** The fibrous matter that remains after extraction of sugar from sugar cane.

**Behind-the-meter system.** Any power generation capacity, storage or demand management on the customer side of the interface with the distribution grid (i.e., the meter). (Also see Front-of-meter system.)

**Biodiesel.** A fuel produced from oilseed crops such as soy, rapeseed (canola) and palm oil, and from other oil sources such as waste cooking oil and animal fats. Biodiesel is used in diesel engines installed in cars, trucks, buses and other vehicles, as well as in stationary heat and power applications. Most biodiesel is made by chemically treating vegetable oils and fats (such as palm, soy and canola oils, and some animal fats) to produce fatty acid methyl esters (FAME). (Also see Hydrotreated vegetable oil (HVO) and hydrotreated esters and fatty acids (HEFA).)

**Bioeconomy** (or bio-based economy). Economic activity related to the invention, development, production and use of biomass resources for the production of food, fuel, energy, chemicals and materials.

**Bioenergy.** Energy derived from any form of biomass (solid, liquid or gaseous) for heat, power and transport. (Also see Biofuel.)

**Biofuel.** A liquid or gaseous fuel derived from biomass, primarily ethanol, biodiesel and biogas. Biofuels can be combusted in vehicle engines as transport fuels and in stationary engines for heat and electricity generation. They also can be used for domestic heating and cooking (for example, as ethanol gels). Conventional biofuels are principally ethanol produced by fermentation of sugar or starch crops (such as wheat and corn), and FAME biodiesel produced from oil crops such as palm oil and canola and from waste oils and fats. Advanced biofuels are made from feedstocks derived from the lignocellulosic fractions of biomass sources or from algae. They are made using biochemical and thermochemical conversion processes, some of which are still under development.

**Biogas/Biomethane.** Biogas is a gaseous mixture consisting mainly of methane and carbon dioxide produced by the anaerobic digestion of organic matter (broken down by microorganisms in the absence of oxygen). Organic material and/or waste is converted into biogas in a digester. Suitable feedstocks include agricultural residues, animal wastes, food industry wastes, sewage sludge, purpose-grown green crops and the organic components of municipal solid wastes. Raw biogas can be combusted to produce heat and/or power. It also can be refined to produce biomethane.

**Biomass.** Any material of biological origin, excluding fossil fuels or peat, that contains a chemical store of energy (originally received from the sun) and that is available for conversion to a wide range of convenient energy carriers.

**Biomass, traditional (use of).** Solid biomass (including fuel wood, charcoal, agricultural and forest residues, and animal dung), that is used in rural areas of developing countries with traditional technologies such as open fires and ovens for cooking and residential heating. Often the traditional use of biomass leads to high pollution levels, forest degradation and deforestation.

**Biomass energy, modern.** Energy derived from combustion of solid, liquid and gaseous biomass fuels in high-efficiency conversion systems, which range from small domestic appliances to large-scale industrial conversion plants. Modern applications include heat and electricity generation, combined heat and power (CHP) and transport.

**Biomass gasification.** In a biomass gasification process, biomass is heated with a constrained amount of air or oxygen, leading to the partial combustion of the fuels and production of a mix of combustion gases that, depending on the conditions, can include carbon monoxide and dioxide, methane, hydrogen and more complex materials such as tars. The resulting gas can either be used for power generation (e.g., in an engine or turbine) or else further purified and treated to form a "synthesis gas". This can then be used to produce fuels including methane, alcohols, and higher hydrocarbon fuels, including bio-gasoline or jet fuel. While gasification for power or heat production is relatively common, there are few examples of operating plants producing gas of high enough quality for subsequent synthesis to more complex fuels.

**Biomass pellets.** Solid biomass fuel produced by compressing pulverised dry biomass, such as waste wood and agricultural residues. Pellets typically are cylindrical in shape with a diameter of around 10 millimetres and a length of 30-50 millimetres. Pellets are easy to handle, store and transport and are used as fuel for heating and cooking applications, as well as for electricity generation and CHP. (Also see Torrefied wood.)

**Biomethane.** Biogas can be turned into biomethane by removing impurities including carbon dioxide, siloxanes and hydrogen sulphides, followed by compression. Biomethane can be injected directly into natural gas networks and used as a substitute for natural gas in internal combustion engines without risk of corrosion. Biomethane is often known as renewable natural gas (RNG), especially in North America.