LIQUID BIOFUELS

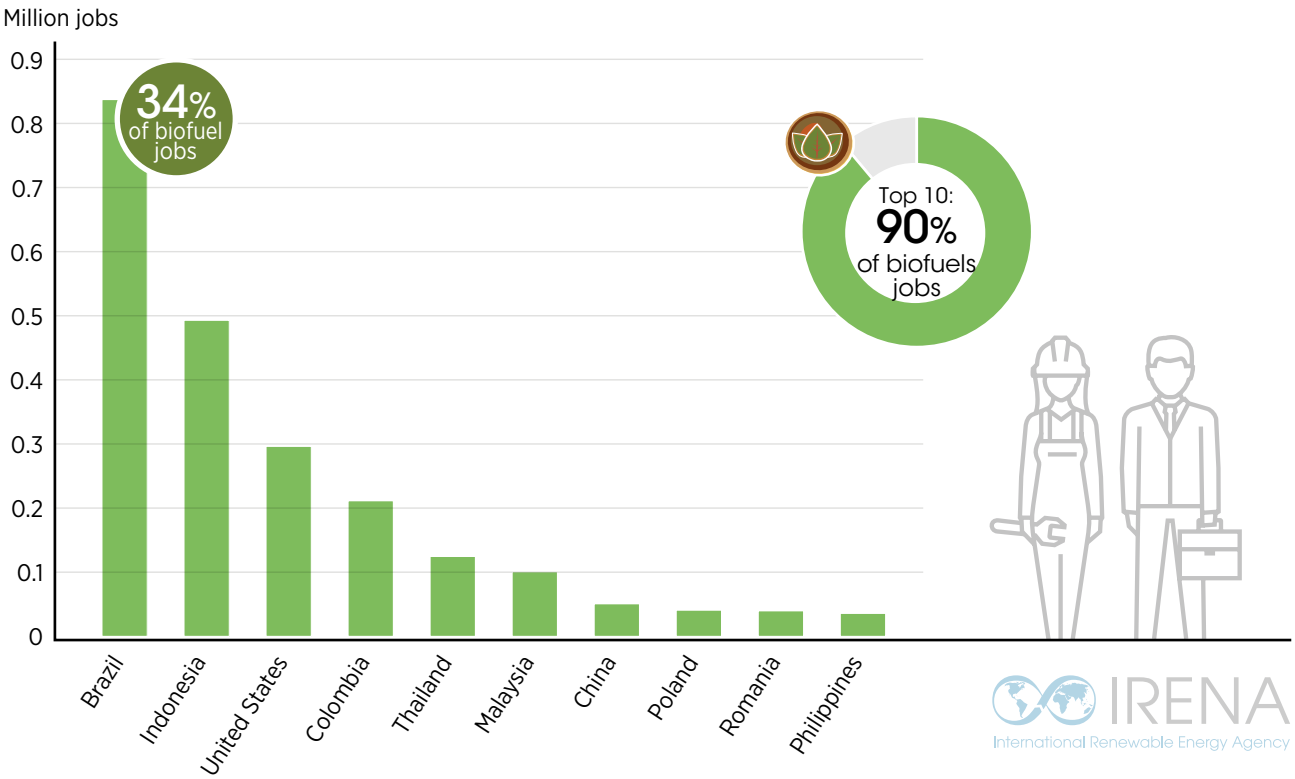
Global biofuels production increased 5% in 2019, principally driven by a 13% expansion of biodiesel (with Indonesia overtaking the United States and Brazil to become the largest national producer), while ethanol production inched up by 2% (REN21, 2020).

Worldwide employment in biofuels was estimated at 2.5 million in 2019.[5] The bulk of these jobs were in the agriculture sector, planting and then harvesting feedstock of various types. Processing the feedstock into fuels requires far fewer people than supplying the feedstock, but processing jobs generally require higher technical skills and offer better pay.

Biofuels employment estimates need to be interpreted carefully. Feedstock such as oil palm, soybeans or corn are also used for a number of non-energy purposes, whether as food, animal feed or ingredients of various commercial products. As the mix of products based on these commodities changes, rising or falling numbers of biofuels jobs do not necessarily equate to net job gains or losses in the economy. Casual and seasonal arrangements – with limited income security – are prevalent in many countries.

The regional profile of biofuels employment differs considerably from that of the solar PV sector. Labour-intensive feedstock supply lines mean that Latin America accounts for 43% of all biofuels jobs worldwide and Asia (principally Southeast Asia) for 34%. The more mechanised agricultural sectors of North America and Europe translate into smaller employment shares of 13% and 10%, respectively. Figure 5 shows the top ten countries, which together account for about 90% of global estimated employment.

FIGURE 5: **LIQUID BIOFUELS EMPLOYMENT: TOP 10 COUNTRIES**



Source: IRENA jobs database.

5 The figure of 2.5 million jobs cannot be directly compared to the 2.1 million in 2018, as published in the 2019 edition of the Annual Review. This is because the estimates of biofuels production were substantially revised upward in the interim, affecting IRENA's employment factor calculations.

With close to 839 000 jobs, Brazil has the world's largest liquid biofuels workforce. The United States is the leading biofuels producer, but its lower labour intensity translates to about 297 000 jobs. Biofuels employment in the European Union was estimated at about 239 000 jobs in 2018, the most recent year for which data are available (EurObserv'ER, 2020).

Colombia's biofuels output rose to a new peak of close to 1.2 billion litres in 2019 (USDA-FAS, 2019d). Based on IRENA estimates, the number of people involved in the country's biofuels supply chain in 2019 could be as high as 212 000, though these may not all be full-time equivalents.[6]

Southeast Asian biodiesel producers all increased their output in 2019, in some cases substantially so. Further, for Indonesia and Malaysia, recent years' estimates have been revised upward considerably in light of improved information (USDA-FAS, 2019a and 2019b). This change carries over into IRENA's job estimates, which rely on a calculation based on labour requirements. Reflecting a jump in production from 5.6 billion litres in 2018 to an estimated 8 billion litres in 2019, IRENA estimates Indonesia's biodiesel employment at 494 400 people.[7] Production in Malaysia, the Philippines and Thailand rose to 5.6 billion litres, and IRENA estimates a combined workforce for these three countries of some 261 600 people.[8]

WIND

Most wind installations continue to be on land, but the offshore market is gaining traction. The 54 GW of onshore capacity added in 2019 brought total installed capacity to 594 GW while installed offshore capacity increased by 4.7 GW reaching a total of 28 GW (IRENA, 2020a).

Worldwide, close to 23 000 wind turbines were installed in 2019. The Chinese market is served almost exclusively by domestic companies, while markets everywhere else in the world are supplied principally by European firms. Eight Chinese turbine manufactures were among the world's top 15 suppliers in 2019. But the top spots were still held by two European companies (Vestas and Siemens Gamesa) accounting for one-third of global wind turbine production, followed by General Electric (GE) of the United States. Market consolidation continues, as the top six vendors increased their market share from 70% in 2018 to 72% in 2019, while the total number of major manufacturers declined from 37 to 33 (Pek, 2020).

China remained the leading country for new installations in 2019, adding 26 GW, of which 1.3 GW is offshore (IRENA, 2020a). The country's wind-related employment was estimated to hold steady at around 518 000 jobs (CNREC, 2020), followed by Germany (121 700 jobs) and the United States (120 000 jobs) (AWEA, 2020).

The total employment in onshore and offshore wind remained steady at 1.17 million people worldwide in 2019.[9] Women represent an estimated 21% of the industry's workforce (see Box 2) (IRENA, 2020b). Most wind jobs are found in a small number of countries. China alone accounts for 44% of the global total; the top five countries represent 74%. Still, the regional picture is more balanced than in the solar PV industry. Asia's 648 000 wind jobs make up about 56% of the total, while Europe accounts for 27% and North America for 11%. Of the top 10 countries shown in Figure 6, four are European, three are Asian, two are from South America and one is from North America.

6 The 212 000 estimate breaks down into 111 676 jobs in ethanol and 100 195 jobs in biodiesel.

7 The calculation relies on revisions of an employment factor initially developed by APEC (2010). This factor is applied as a constant each year for smallholder production, which accounts for 45% of volume (WWF, 2012) and is more labour-intensive than large-scale plantations. For plantations, IRENA applies an assumed "decline" factor of 3% per year as a proxy for rising labour productivity.

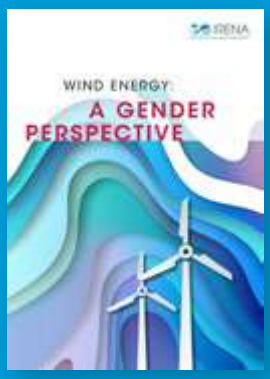
8 In Thailand, IRENA estimates 124 600 jobs. Smallholders have a 73% production share, an average of the values reported by Termmahawong (2014) and by RSPO (2015). In Malaysia, smallholders account for roughly 35% of production (WWF, 2012). IRENA estimates 100 900 jobs in Malaysia and 36 100 in the Philippines. Focusing only on the construction and operations of biofuels processing facilities, the Philippine government estimates direct employment at 2 426 jobs.

9 The countries for which IRENA's database has estimates of wind power employment represent 99.7% of global capacity and cover 99.6% of new installations in 2019.

BOX 2. GENDER DIVERSITY IN THE WIND ENERGY SECTOR

Based on a survey of over 1 000 individuals and organisations, IRENA's *Wind Energy: A Gender Perspective* (IRENA, 2020d carried out in collaboration with the Global Wind Energy Council (GWEC) and the Global Women's Network for the Energy Transition (GWNET)) shows that the wind energy sector is male dominated, with women representing just 21% of the workforce (substantially lower than the 32% share of women in the renewable industry globally [IRENA, 2019a]). While respondents perceived that women possess the required skills and knowledge, they highlighted perceptions of gender roles and cultural-social norms as major barriers to gender equality in the sector.

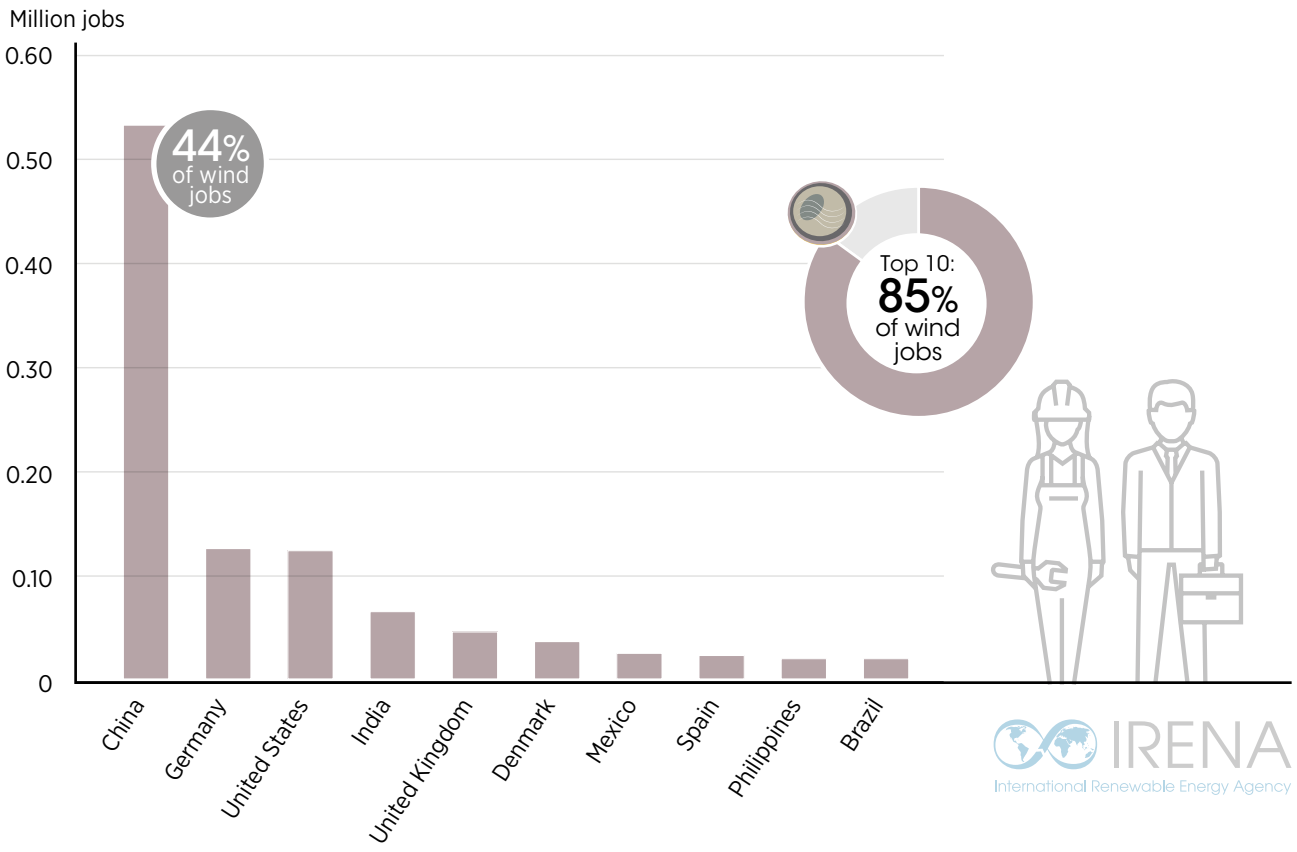
The under-representation of women in the science, technology, engineering and mathematics workforce (at just a 14% share) means that the wind industry is failing to tap a rich pool of talent that could add valuable perspectives and open new pathways for innovation.



To address the persistent gender imbalance, the wind sector needs to diminish ingrained stereotypes, facilitate inclusion and more diverse perspectives, and replicate best practices. Some initiatives already recognise women as agents of change. For instance, Vestas became the first wind-energy supplier to announce ambitious targets to achieve pay equity, support inclusion and address other gender disparities (Vestas, 2020).

GWEC, in partnership with GWNET, launched the Women in Wind Global Leadership Program, designed to accelerate women's careers, support their pathway to leadership positions, and foster a global network of mentorship, knowledge-sharing and empowerment.

FIGURE 6: **WIND EMPLOYMENT: TOP 10 COUNTRIES**



Source: IRENA jobs database.

The Global Wind Energy Council (GWEC) estimates that in the years 2020 to 2024, taking into account the impact of COVID-19, some 344 GW of new onshore and offshore wind power capacity may be installed around the world. These new wind power installations could create an additional 2.4 million job-years, rising from 395 200 job-years created in 2020 to 542 900 job-years created in 2024.[10]

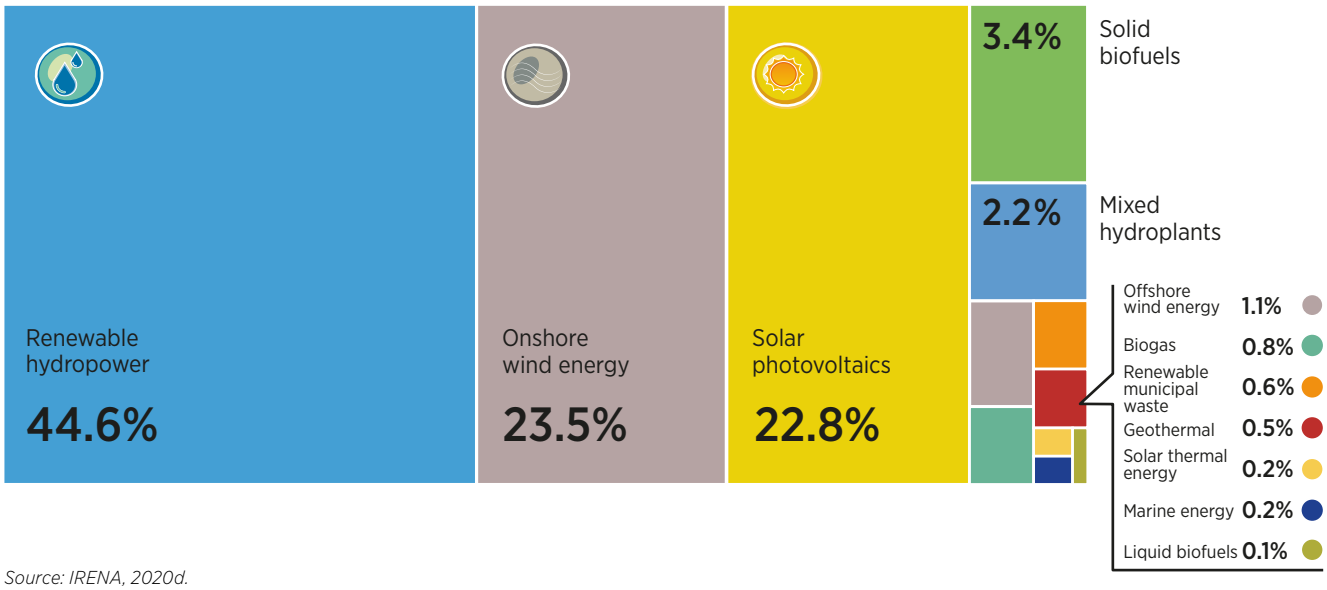
10 This global calculation does not account for market-based learning rates, productivity improvements, technology evolution or other factors which may affect the labour required to deliver and maintain a project. Computations of jobs in operations and maintenance assume a 25-year project lifetime.

HYDROPOWER

Given its deployment over many decades, hydropower is still the largest source of renewable electricity in the world, accounting for 44.6% of the total installed renewable energy capacity in 2019 (see Figure 7).

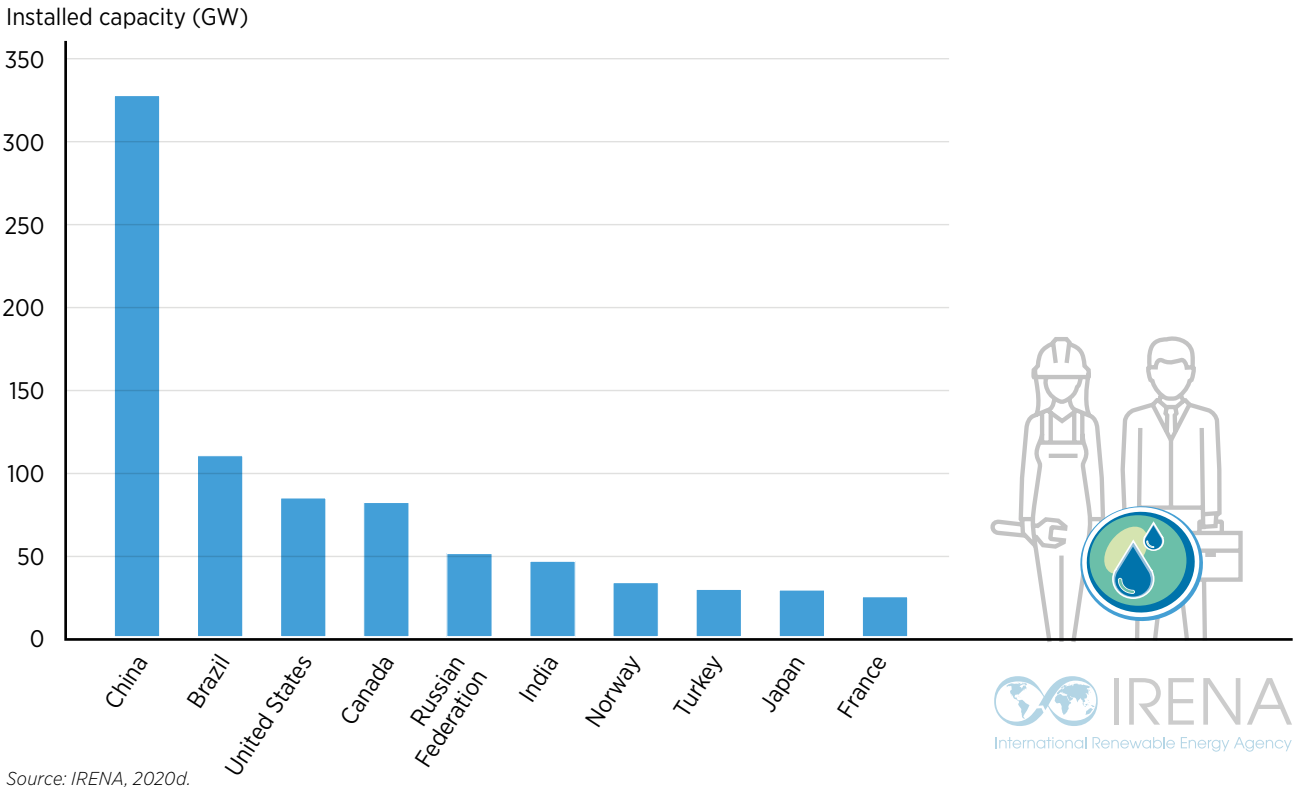
China, Brazil, the United States and Canada were the top countries that year (see Figure 8). However, global net additions of capacity in 2019 were the lowest in the last 17 years and 43% below the value in 2018 (IRENA, 2020a).

FIGURE 7: **HYDROPOWER'S SHARE OF TOTAL INSTALLED RENEWABLE ENERGY CAPACITY, 2019**



Source: IRENA, 2020d.

FIGURE 8: **HYDROPOWER CAPACITY, TOP 10 COUNTRIES, 2019**



Source: IRENA, 2020d.