



TRENDS  
RENEWABLE ENERGY

# With PPAs, Businesses and Cities Are Making the Production and Supply of Low-Carbon Electricity Safer

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A major trend that the pandemic had little impact on in 2020 was the increasing number of businesses that are contractualising their long-term renewable electricity supply through Power Purchase Agreements (PPAs). These contracts also contribute to the installation of new renewable production capacities, by ensuring that producers have a stable revenue. This movement has already spread to large Australian and American municipalities, as well as to the city of London in 2020.



## DATA OVERVIEW

### Pro-renewable energy commitments are multiplying, and their implementation is becoming more organized

The pandemic has not put a stop to the exponential increase of the renewable energy sector, which has been going on for a few years now. On the contrary: the installed renewable energy capacities reached 2,800 GW in 2020<sup>1</sup>, a record increase of 260 GW from 2019, which is almost 50% higher than the previous year (**fig. 1**). Globally, fossil capacities remain much higher (around 4,460 GW in late 2020<sup>2</sup>), but their increase slowed down (60 GW added in 2020, the lowest increase since 2000, **cf. trend "Fossil Fuels"**). As a result, even though fossil fuels continue to dominate the installed capacities, renewable energies represent most of the increase.

Solar (127 GW) and wind power (111 GW) are responsible for 91% of this increase. The vast majority of their new installations are located in China (49 GW solar, the second record year after 2017, 72 GW wind power), and to a lesser extent in the United States (14 GW solar, 14 GW wind power) and in the European Union (19 GW solar, 10 GW wind power). Vietnam experienced an unprecedented boom in solar energy, tripling its installed capacities in a year to reach 16 GW, notably thanks to the establishment of feed-in tariffs which came to a close in 2021 (**cf. case study Vietnam**). Extremely reliant on coal, South Korea, India and Japan have each installed 4 GW of solar capacities.

Regarding electricity consumption, the drop in demand following the pandemic and the priority given to renewable energy on electricity grids led to a two percent increase of the share of renewables in the global *electricity* mix between 2019 and 2020, from 27% to 29%, the highest ever recorded<sup>3</sup>. Once again, the strong dynamics of solar and wind power, for which electricity production has increased by 20% and 12% respectively between 2019 and 2020, have greatly contributed to this increase<sup>4</sup>. However, the share of renewable energy in the global *energy* mix has only slightly increased between 2009 (9%) and 2019 (11%)<sup>5</sup>.

In total during 2020, around 260 cities set new objectives or adopted new policies relating to renewable energy, bringing the number of inhabitants living in a city with such objectives to around 1 billion (from around 1,300 cities). Amongst them, 617 have the objective of achieving "100% renewable". Furthermore, 799 municipalities have adopted policies to promote renewable energy in different sectors. The majority are related to electricity, but heating and transport were also featured<sup>6</sup>.

The global dynamic is similar amongst the private players. The RE100 initiative, which groups together businesses committed to solely using renewable energies for their activities, had over 300 members in April 2021, totalling an electricity consumption of over 278 TWh/year (more than Australia). Amongst them, 77 of the members were already powered by 90% renewable energy. Overall, around 40% of the total electricity used by the members is generated from renewable energy<sup>7</sup>.

However, the technical and physical structure of an electrical grid makes it impossible to follow and trace where an electron originates, thus whether is from renewable energy or fossil fuels. Therefore, what are levers for non-state actors to stick to their commitments? Several tools guarantee renewable



energy is supplied besides auto-consumption, such as the now-essential Energy Attribute Certificates. One tool stands out due to the strong dynamic it has benefitted from over the past few years on all continents for all of the actors: Power Purchase Agreements (PPAs).

## THE OBSERVATORY'S LENS

### With PPAs, cities and businesses are diversifying their methods for the supply of renewable energy

#### Energy Attribute Certificates are essential cogs in the machine, but they have a limited impact

Since the end of the 2000s, the markets for energy certificates have progressively been established in the United States, in Europe and other areas of the world. These electronic documents are sent out by renewable energy producers and are certified by the authorities of the obligatory or voluntary market they are in. They are then bought by suppliers wishing to certify the origin of their electricity, sometimes to meet minimum consumption quotas, such as in certain American states. They can also be bought by companies wishing to declare that their electricity has been produced by a renewable source. By offering a source of complementary revenue to certified producers, the sale of certificates helps to support renewable energy production. These markets are booming: in Europe, the number of "guarantees of origin" (European label) has almost doubled between 2014 and 2018<sup>8</sup>. This was notably brought about by hydroelectricity which accounts for

two thirds. In 2020, over 737 TWh of guarantees were bought, 41.7% more than in 2018<sup>9</sup>. This has encouraged a multitude of alternative suppliers to emerge, hoping to stand out on the European electricity market, which has been open to competition since the late 1990s<sup>10</sup>.

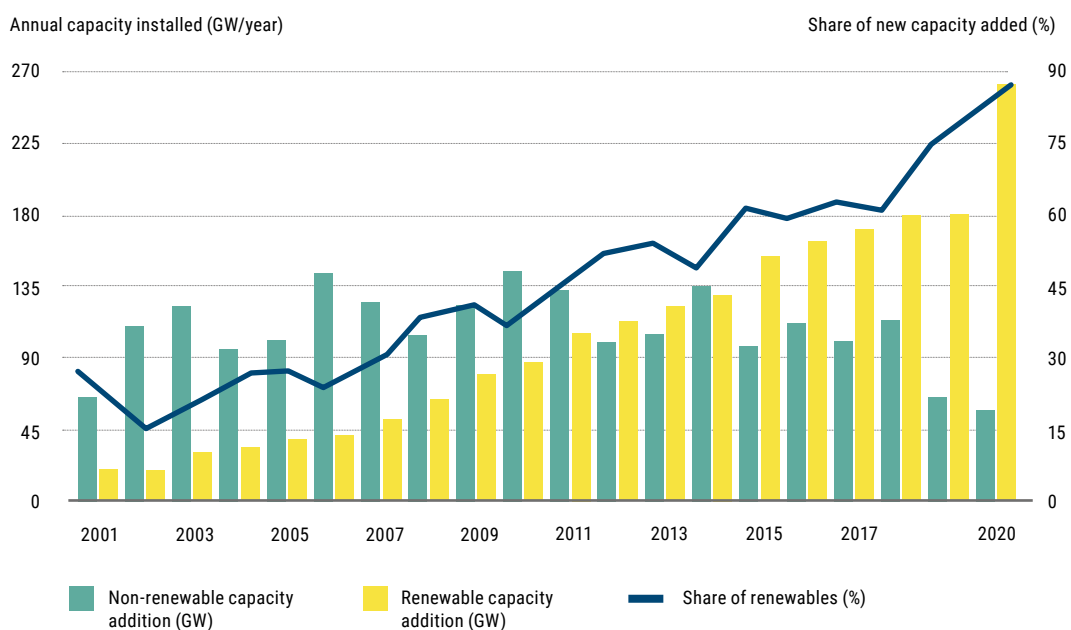
However, the absence of geographical restrictions between the certificates and the actual origins of the electricity showed there were certain limitations to this system<sup>5</sup>. For example, Iceland is a major exporter of guarantees of origin thanks to its several geothermal and hydroelectric power stations. However, its electrical grid is not physically linked up to the European continent. There is therefore the risk that the avoided emissions will be double counted, both in the countries producing the renewable energies and in the countries importing the guarantees of origin<sup>11</sup>. Furthermore, this tool does not allow to secure the demands of consumers, as the certificates relate to electricity which has already been produced by existing installations. Therefore, they in no way guarantee the availability of future renewable energy or the construction of new local capacities.

Furthermore, with the offer being twice as high as the demand in the EU in 2018, the low prices of guarantees of origin (in the range of 1€/MWh in May 2020<sup>8</sup>, similar to those of American Renewable Energy Certificates (REC)), are not currently lucrative enough to encourage producers to invest in new projects<sup>11</sup>.

However, the French Agency for ecological transition (Ademe) estimates that the increasing popularity of 'local' guarantees of origin (certifying a production geographically close to the consumer) could accelerate the emergence of local tensions between the offer and demand and thus increase the prices

**FIGURE 1**  
RENEWABLE AND NON-RENEWABLE CAPACITY ADDITION BETWEEN 2001 AND 2020.

Source: IRENA, 2021





in several areas over the next few years. According to the international RECS organisation, the global demand for guarantees of origin could meet the level of supply prior to 2023<sup>8</sup>.

**With an exponential increase amongst businesses, PPAs are now being extended to cities**

Alongside renewable energy certificates, public and private consumers are increasingly turning towards other renewable energy supply mechanisms allowing them to play a more active role in the development of these energies<sup>6</sup> and to secure the supply. The key tool, which has been booming for a few years now, are the Power Purchase Agreements (PPAs).

Generally, PPAs (**see Keys to Understanding**) are long-term contracts, at a fixed or variable price, negotiated directly between the producers and consumers (buyers) of renewable electricity, without going via an intermediary supplier. Relatively marginal up until 2016, they experienced a big increase with the development of renewable energies and the drop in their prices: PPAs were at the origin of almost 10% of renewable capacities installed globally in 2019<sup>12</sup>. In 2020, the pandemic had little impact on this dynamic: 23.7 GW of renewable energy was contractualised with PPAs by private actors in 2020, 18% more than in 2019 and almost four times more than in 2017<sup>13</sup>. Although the first semester of 2020 saw a clear drop in the contractualisation of PPAs in America (AMER) due to the pandemic, the volume of new contracts almost tripled between 2019 and 2020 in Europe, the Middle East and Africa (EMEA), as well as in Asia and the Pacific (APAC) (**fig. 2**). The last trimester of 2020 even established a new record, with 7.2 GW contractualised in the world<sup>13</sup>, and the volume of PPAs rose by 86% in the first semester of 2021 compared to the same period from the previous year<sup>14</sup>. PPAs are mostly relating to solar and wind energy.

The market is largely dominated by digital companies: Amazon is the leader, with 35 PPAs announced in 2020, representing 5.1 GW, bringing the total contractualised by the company

since 2010 at 7.5 GW. Google and Facebook follow on from this with 6.6 GW and 5.9 GW respectively contractualised since 2010. Heavy industries also have an interest in them, such as the Norwegian aluminium producing group Norsk Hydro (1.8 GW contractualised in 2020)<sup>15</sup>. A quarter of the renewable electricity used by companies that are members of the RE100 initiative originate from PPAs, compared to 3% five years ago<sup>16</sup>.

In November, over 4 GW have been contractualised since the beginning of the year in Europe<sup>15</sup>. For example, Air Liquide signed a 15-year PPA with Vattenfall to supply 15% of its electricity consumption to the Netherlands with renewable energies, thanks to the production of a 25 MW wind farm which will begin operating in 2023<sup>17</sup>. This electricity will power industrial gas generation installations, as well as a new hydrogen generation plant in the port of Moerdijk. A few weeks later, EDF Renewables and the rail group SNCF (which aims to have 40 to 50% renewable energy for its trains between now and 2025), signed a PPA to supply SNCF with the production of a 20 MW solar power station for 20 years from when it is brought into operation in 2023<sup>18</sup>.

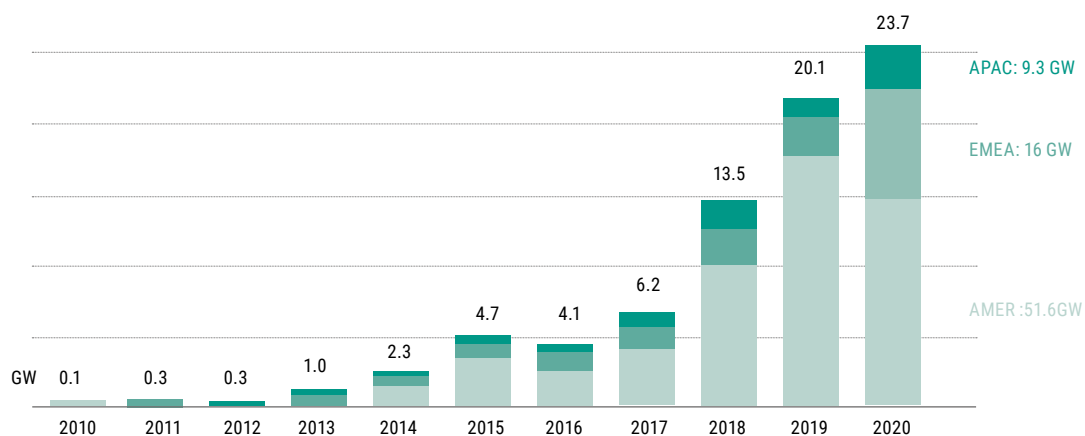
PPAs also attract more and more public actors, even if the volumes are still rather weak compared to those from the private sector. In total, between 2015 and 2020, the volume of PPAs contractualised by American cities more than tripled, going from 1,062 MW (2015) to 3,306 MW (2020)<sup>20</sup>. During this period, almost 90% of the renewable energy bought by these cities was the subject of an off-site PPA<sup>21</sup>.

In the United States, PPAs are sometimes contractualised by Community Choice Aggregations (CCA), entities which unite the demand of several actors from a territory, often grouped around a municipality, which wouldn't be big enough to contractualise a PPA individually. California has 23 CCAs which group together 182 cities and counties, and are accessible to over 30% of the population. Fourteen of them buy 100% renewable electricity and almost all impose a minimum

**FIGURE 2**

**VOLUMES OF PPAs BOUGHT BY COMPANIES FROM 2010 TO 2020 AROUND THE WORLD.**

Source: [BloombergNEF](#), 2021





## KEYS TO UNDERSTANDING

### THE DIFFERENT TYPES OF PPAs

The term PPA indicates an electricity purchasing mode which, in reality, covers several different types of contracts, depending on local legislative contexts and the organisation of different electricity markets. Most PPAs concern off-site installations which are geographically disconnected from the buyer, contrary to on-site installations which can be the subject of PPAs, but are also sometimes simply the property of the business or the municipality. In these cases they can be recovered by auto-consumption. PPAs can also be cross-border, meaning that the actors need not belong to the same electricity markets. In that case, an agreement can be established between the grid operator for the transportation of electricity, but most of the time, cross-border PPAs are “virtual”. The producer sells electricity on the market it belongs to, the consumer continues to buy its electricity from the supplier on the market it is developing, and it compensates for any potential fluctuations in prices on the producer’s market via the PPA. In such a situation, the two markets are not necessarily physically connected<sup>19</sup>. PPAs can also be drawn up via an intermediary, often the energy service provider who is in charge of bringing together different producers to form an installations portfolio, supplying them with any potential electricity that is lacking, selling surplus electricity or even insuring different risks concerning producers or consumers. That is referring to a *sleeved PPA*. Whatever the type of PPA, if it concerns renewable energy (which is often the case these days), the buyer almost systematically couples their contract with the purchase of any corresponding Energy Attribute Certificates. These are either those owned by the PPA production site, or those found elsewhere on the certificate market which are equal to the volume of purchased electricity.

threshold for renewable energy.<sup>22</sup> As a result, 6,000 MW of renewable energy contractualised by Californian CCAs, including 2,600 MW in 2020, were the subject of a PPA. Most of them concern solar energy (3,800 MW), followed by wind energy (1,030 MW).<sup>23</sup>

In the rest of the world, the public actors resorting to PPAs are, first and foremost, large cities. For example, London signed a 15-year PPA with the French renewable energy producer Voltalia. The city has committed to buying all the electricity from a solar farm with 95,000 solar panels being built in the county of Dorset (south of England). In Australia, since 2019, the municipality of Melbourne has covered 100% of the energy consumption of its infrastructure with renewables. In June 2020, the city facilitated the signing of a second grouped PPA with seven local actors including universities and enterprises, which will prevent the equivalent of 1 MtCO<sub>2</sub> being produced over the decade of the project’s span (**see case study Melbourne**).<sup>24</sup>

The dynamics of PPAs are particularly strong in Australia, in both the public and private sectors. Between 2017 and 2020, 79 PPAs covering 3 GW (of which over a third were in 2020 despite the pandemic) were contractualised by businesses or local governments based in Australia, including over half concerning new solar and wind farms.<sup>25</sup> The Australian supermarket chain Coles, for example, has signed two PPAs with the French groups Engie and Neoen to source its electricity from on-site solar power stations.<sup>26</sup>

In most cases, the capacities concerned by the PPA have not yet been installed. The contract helps the business to finance the project, whereas the buyer saves money in supply costs (around 3 million pounds in the case of London)<sup>27</sup>. PPAs therefore emerged as a means of securing both the investments from producers of renewable energy, which were often victims of the volatility of the market’s prices, and the supply of consumers who wish to turn towards renewables.

To a lesser degree, PPAs also emerged in Africa (notably in Kenya, Tanzania and South Africa), as well as Asia, sometimes

under different forms so they could be adapted to smaller scale projects in terms of capacity and of contract duration.<sup>28</sup> During COP22, when Morocco had just opened the Noor solar power station (580 MW) near Ouarzazate, the country signed a Sustainable Electricity Trade (SET) Roadmap with four European countries (Spain, Portugal, France and Germany) to trade electricity from renewable sources thanks to cross-border PPAs. Within the framework of this agreement, the European businesses, which are now driven towards renewable energy by the Green Deal, will be in a position to virtually contractualise their supply from Moroccan producers. In fact, the country is running an ambitious solar policy, that allowed to reach a 37% share of renewable energy in its capacity until now.<sup>29</sup> However, the SET is late in making this a reality as it came across regulatory, infrastructural and markets barriers,<sup>30</sup> and Morocco recorded major financial losses for these projects.<sup>31</sup>

On the face of it, this global dynamic isn’t set to wind down. The International Energy Agency (IEA) estimates that the PPAs will be the first point of leverage for the deployment of wind power in North America between 2020 and 2025.<sup>32</sup>

#### **The civil society and municipalities are exploring alternative models of renewable energy production**

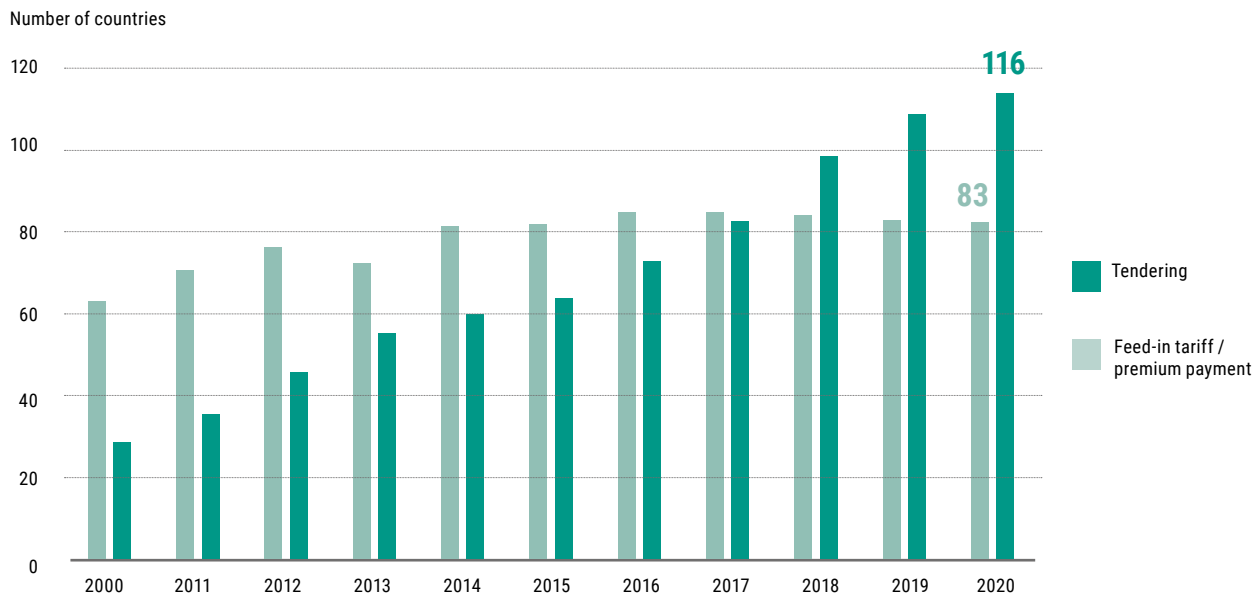
PPAs mainly concern big actors who, on the one hand are setting up giant wind and solar farms, and on the other hand, are buying electricity for high-energy industrial sites or large settlements.

In general, populations do not have access to this type of contract (except through a CCA). To be supplied with renewable energy, a household has several tools at its disposal, among which self-consumption, feeding renewables energy into the grid leading to a reduction in bills, the choice of a supplier who supplies on the renewable energy market (and therefore also in the Energy Attribute Certificate market) and even the direct purchase of Energy Attribute Certificates. In order to have a greater impact in directing the market towards renewable energy, several “energy communities” have grouped together individuals (generally) to work on

**FIGURE 3**

**NUMBER OF COUNTRIES APPLYING FEED-IN TARIFF AND TENDERS MECHANISMS FROM 2010 TO 2020.**

Source: [REN21, 2021](#)



a specific electricity production project. These communities have particularly emerged in Europe, often assisted by public powers (via subsidies or feed-in tariffs).

Energy communities have been formally recognised in the 2018 renewable energy Directive of the EU. In 2019, there were over 3,600 of them, compared to 2,400 four years earlier, a really high figure compared to the few hundred others spread across the other continents<sup>6</sup>. This total certainly increased in 2020. For example, in Croatia, the European Institute of Innovation and Technology (EIT) and Climate KIC financed the construction of a thousand solar parks in the form of cooperatives in ten cities<sup>6</sup>. The vast majority is focused on electricity production, but more and more communities have been set up to manage heating networks, to organise electric mobility or to lead energy efficiency projects.<sup>33</sup>

However, a few years of acceleration, this dynamic showed some weaknesses. In Germany, for example, the system of feed-in tariffs for citizen energy cooperatives, which had been in place for 20 years, ended on 1 January 2021. The 883 cooperatives<sup>9</sup> from the country are now in competition with major energy players who have emerged on the market in recent years and are better equipped to take on the major investments required by public markets (for example offshore installations). Observers fear this redevelopment of a capitalistic concentration will impact the popularity of the development of renewable energy and how it is accepted.<sup>34</sup> The dynamic of the cooperatives losing impetus in this country is clearly visible. Only 14 new projects were set up in 2019, compared with a record of 167 in 2011.<sup>6</sup>

To have a greater influence in the markets where calls for tender and bids are increasingly important (**fig. 3**), and to promote a democratic and citizen view of energy production, these cooperatives are grouped together in networks and federations. Joined by 400 new members in 2020, the REScoop networks now unite 1,900 European cooperatives, representing 1.25 million citizens.

The cities also play a role in diversifying renewable electricity generation models, by municipalising all or certain parts of the production activities and the supply of electricity. They can then direct these activities towards renewable energy. In 2019 in the United States, around 1,800 organisations, controlled entirely or partially by cities, supplied 15 million clients. However, they are not always committed to low carbon energy transition. The NGO Massachusetts Climate Action Network (MCAN) observed that local energy companies were not restricted, like private businesses, to access renewable energy within their public lighting system to reach the State's objectives.<sup>35</sup>

Europe has 1,500 local electricity companies which supply 85 million clients. For example, Stadtwerke München (SWM) recently set out to buy twelve photovoltaic parks to supply the city of Munich with electricity.<sup>36</sup> In Spain, the municipality of Cádiz owns 55% of the electricity supply and distribution company Eléctrica de Cádiz (EdC), which allowed for the supply of 100% certified renewable energy (thanks to guarantees of origin) and the implementation of assistance for disadvantaged households, financed in equal parts by the municipality and EdC (**see Cadiz case study**).

<sup>a</sup> There are 883 "energy cooperatives" or members of the DGRV (the federal office of energy cooperatives) out of the 1,750 "energy communities" in Germany, according to the European Union's Joint Research Centre. The energy cooperatives indicate a category of "energy communities" which is more close-knit, marked by a governance of rules which are specific to cooperatives. For further information see: Caramizaru, A., Uihlein, A. (2020). [Energy communities: an overview of energy and social innovation](#). Joint Research Centre of the European Commission



However, a few municipalisation projects had to be abandoned in 2020. In the Netherlands, the 44 municipalities which owned the renewable energy production company Eneco, got rid of all of their shares in March 2020 and sold them to a Japanese consortium made up of Mitsubishi (80%) and Chubu (20%). Reduced to the role of electricity supplier by the opening of the market to competition, Eneco's mission was no longer considered by its shareholder municipalities as a public service. In August 2020, Nottingham had to sell Robin Hood Energy, the first municipal energy company set up by a local British council over 75 years ago due to losses of up to around 34 million pounds.<sup>37</sup> A few months earlier, the city of Bristol had also to split from Bristol Energy, which was in debt by over 30 million pounds.<sup>38</sup>

As a result, the opening of competition on the electricity market in Europe created an increase in new actors, desiring to offer democratic and local alternatives. However, this liberalisation also constitutes a threat for these fragile models. Public assistance is gradually being reduced for them and they are ending up in competition with big actors which have considerable investment capacities at the heart of a market whose capitalistic concentration is constantly growing (see **Renewable Energy trend**).



## KEY TAKEAWAYS

**Since the creation of Energy Attribute Certificates, the standard for claiming a supply of renewable energy, meant to stimulate the market and assist producers, it is evident that overall the assessment was mixed: the demand does not meet the supply, the prices are low, and their credibility has been called into question. As an alternative, the Power Purchase Agreements, sales contracts for electricity from renewable origins, directly drawn up between a producer and a consumer, have experienced a thriving success by securing a stable revenue over the long term for producers, who are able to install large capacities, and also by guaranteeing the supply of renewable energy to high-energy consumers (often businesses, but also a few cities more recently).**

**In parallel: whilst energy communities were becoming increasingly important with their sights set on citizen re-appropriation of electricity production, they are now being left to the side in "wholesale market" and find themselves at threat, even in the countries where they were established. Some cities, however, are still managing to give a voice to their inhabitants through local companies who generate or supply electricity. But the question remains: for how much longer? The recent bankruptcy of several of them has planted a seed of doubt with regards to their resilience.**



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