This steep growth trajectory is even more impressive looking back at the market just a few years back, when the residential solar PV market was struggling to gain pace and poor investment conditions made solar & storage attractive to a limited number of customers. In 2015, only five years before these milestones were reached, less than 18,000 home battery systems had been installed, totalling 119 MWh. The market has grown eightfold since then.

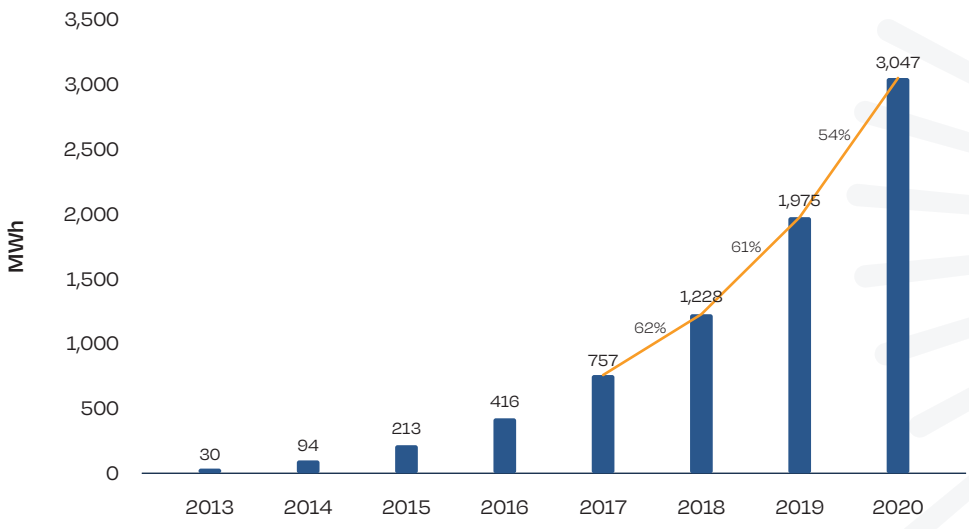
Back in 2015, the European continent was basically relying on a handful of BESS pioneer markets. Germany, the country where home storage started first gaining traction and which is still today the largest market, had switched from a full Feed-in Tariff (FIT) scheme to a model supporting self-consumption in combination with a premium for excess power. Home battery markets started to emerge in a few other countries – Italy, the United Kingdom, and Austria, with hardly any capacity installed in the rest of Europe. Today, battery technologies are an established reality in more and more European countries. The early adopters have been joined by many other countries, even though the home storage story there is just at the beginning.

The home storage growth path in Europe turned out to be significantly higher than what we forecasted one year ago, when the first edition of the European Market Outlook for Residential Battery Storage was published. Back then, we assumed the market would grow 9% to about 800 MWh. The positive evolution of the market conditions slightly exceeded even our most optimistic expectations – our High Scenario anticipated about 1,000 MWh of annually installed capacity. This yearly review of our model takes into account this strong improvement.

While the increase in the annual market has been very steep, the growth in cumulative installed storage capacity is even more pronounced. The residential BESS fleet jumped from less than 2 GWh in 2019 to over 3 GWh in 2020, with a 54% year-on-year increase (see Fig. 2.2). Such high growth in cumulative capacity gives an even better perspective of the speed of adoption of BESS technologies. Total storage capacity has grown 14 times its size, compared to just five years ago.

Taking residential BESS into perspective with its solar peer, it accounted for approximately 8% of the total residential PV systems in operation in Europe. Even though the attachment rate is rising, the untapped market potential for BESS remains huge, especially when taking into account that over 90% of European buildings are still without solar systems.

FIGURE 2.2 EUROPE RESIDENTIAL BESS CUMULATIVE MARKET 2013-2020



2 Residential solar and storage markets in Europe today

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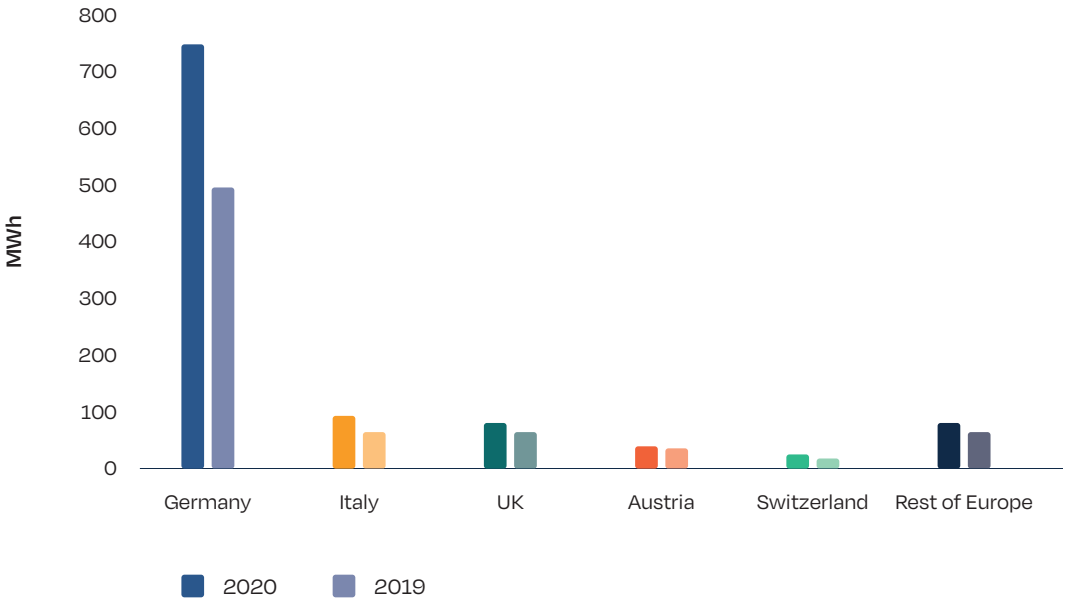
The Top 5 European Residential Storage Markets

Germany remains the leading European country in installations of both residential solar PV and residential battery storage systems (see Fig. 2.3). In 2020, over 90,000 residential BESS were installed in the country, for a total new capacity of about 750 MWh. The central role of Germany in the European home storage market cannot be underestimated. Not only is it the country currently providing the great majority of the total European annually installed capacity, with a 70% share; its predominance is growing, up 2% absolute compared to the previous year. The annual installed capacity in Germany in 2020 is higher than total European installed capacity in 2019.

The German annual BESS market has grown 51% from 2019, when it installed 496 MWh. This growth is mainly due to a surge of residential PV systems installations, which in 2020 accounted for over 1 GW of annual capacity, the country's best performance ever for the small rooftop segment. The growth rate of BESS installed per annum continues to increase steadily, despite the end of the nation-wide financial support mechanism from the German Development Bank (KfW) in 2018. On the other hand, a few German states continue to offer support schemes for residential storage systems, although some of these regional schemes are changing or running out of money. The attachment rate with residential solar remains high, with about 60% of new home PV systems coming together with a battery.

Italy retained and consolidated the #2 position thanks to strong public support schemes. In 2020, an additional capacity of 94 MWh was installed in the country, corresponding to a 44% growth in comparison to the previous year. The Italian residential BESS market has been driven and continues to maintain its attractiveness thanks to appealing subsidy schemes. In addition to the already existing 50% tax credit for small-scale solar PV and residential BESS (*Ecobonus*), a new fiscal incentive, the *Superbonus* 110%, was introduced as part of the COVID-19 national recovery program. This highly beneficial tax credit scheme allows homeowners to deduct up to 110% of the expenses related to home energy efficiency work, which comprise also PV and

FIGURE 2.3 EUROPE TOP 5 RESIDENTIAL BESS MARKETS 2019-2020



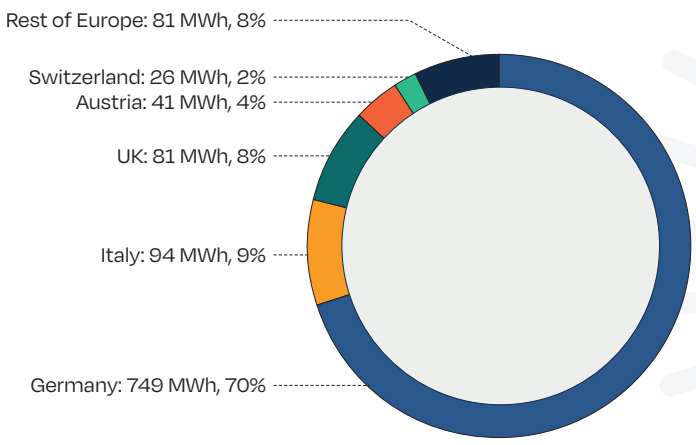
BESS systems installations. By contrast, the financial grants for solar & storage offered by some regions as Lombardia, Veneto and Friuli Venezia Giulia were not renewed in 2020.

The United Kingdom, the third European core home storage market, is also experiencing notable growth without subsidies. About 11,000 residential BESS units, corresponding to around 81 MWh, were commissioned in 2020 across the country, resulting in a 25% increase year-by-year compared to the 65 MWh registered in 2019. Despite a relatively high attachment rate with residential PV systems, the market remains limited by the rather small volume of home PV capacity installed. Residential solar still suffers from the drastic reduction of feed-in rates in the UK rooftop solar programme. After completely closing the PV rooftop FIT scheme in 2019, both residential solar and battery storage now rely basically on free market forces. However, with the introduction of the Smart Export Guarantee regulation in January 2020, prosumers are being offered specific tariff structures by energy retailers to reward the export of renewable electricity to the grid, which provides an incentive to adopt battery storage solutions.

The Austrian market remains a relevant European BESS market amidst continued low two-digit expansion. With 41 MWh of residential storage capacity installed in 2020 from around 6,000 individual systems, the market grew 10% compared to 2019. The 100,000 rooftop PV target from the Mission2030 programme has been upscaled to a 1 million rooftop PV systems target as per the country's National Energy and Climate Plan. To support this ambitious target, an investment subsidy scheme for small-scale solar that was launched in 2017 was extended in 2018 to also cover battery storage, and then renewed again in 2019 for the following 3 years.

Despite low retail electricity prices, Switzerland has seen large growth during the last year, backed by favourable policies. Thanks to the government's efforts to push solar PV development through attractive funding schemes, storage installations experienced high growth rates. In 2020, an additional capacity of 26 MWh was installed, corresponding to a 39% increase from 2019, when a capacity of 18 MWh was added. The country's high average income and the good awareness of battery technologies among PV installers acted as key drivers for residential solar & storage.

FIGURE 2.4 EUROPE TOP 5 RESIDENTIAL BESS MARKETS 2020



2 Residential solar and storage markets in Europe today

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In total, the Top 5 European residential storage markets were responsible for 93% of the 2020 installed capacity in the region. In all other European countries, the residential battery storage market remains at an early stage of development or is even non-existent as of today. These rest of Europe countries added 81 MWh in 2020, 25% more than the 65 MWh installed the year before; but the 81 MWh total installed in 2020 by over 30 countries only equals the additions of Europe's third largest market, the UK.

In **France**, the low retail electricity price of 0.196 EUR/kWh registered in H2/2020 proved to be a major barrier to the take-off of the residential battery business – in comparison, retail electricity prices in Germany stood at 0.3 EUR/kWh. Although the EU's second biggest economy has more than 400,000 residential solar PV installations across the country, the home storage segment is still very small. The storage capacity installed during 2020 amounted to about 4,000 units for an overall additional capacity of 15 MWh, which is a small raise compared to 2019 levels. Overall, the residential BESS market in France is still in a nascent phase, where a small group of technology-aware customers is opting for low-capacity batteries.

In the **Netherlands** and **Belgium**, countries with large residential solar PV markets, net-metering solar incentive schemes constitute the main disincentive for the uptake of battery storage. As both markets are slowly transitioning out of their net-metering schemes, the business case for solar & storage is poised to improve accordingly. In **Sweden**, continued growth in the residential PV sector is driven and supported by subsidies for residential solar & storage. **Spain**, which is one of Europe's solar pioneers, blessed by optimum weather conditions and boosted by a new incentive package for both solar and storage, has also entered the battery storage map and will play a more prominent role in the future as the rate of residential PV installations grows. Most eastern European countries on the other hand continue to have low retail electricity prices and still lack appealing investment frameworks for batteries, with the exception of the **Czech Republic**, which saw a significant number of installed home storage systems in 2020. In the rest of European countries, no noteworthy pro-storage developments took place.

Box 1. Small Commercial Solar & Storage

We have seen how the field of residential BESS is growing very rapidly in Europe and especially in countries like Germany and Italy, where a series of favourable conditions and policy measures from national governments are increasing the interest of prosumers to couple their PV systems with a home storage battery. Many factors such as increasing electricity retail rates, declining storage technology costs, and a constant decline of grid export tariffs, are making the overall economics of batteries more and more convenient for those households who decide to benefit from several storage applications.

But apart from the residential storage segment – those batteries coupled with a PV system smaller than 10 kW and with a storage capacity generally lower than 20 kWh – there is another niche that is slowly gaining traction across the biggest European markets. It is what we define as the "small commercial" segment, that refers to BESS paired with PV systems between 10 and 100 kW and with a storage capacity comprised from 20-30 kWh to 200 kWh. As the name suggests, the users of these bigger batteries are generally medium-size businesses or entities like small manufacturing activities, shopping malls, office buildings or small energy communities. The small commercial segment is not too different from residential households in terms of the battery usage applications, which in most cases are linked to support an already existing rooftop PV system.

Business cases

From a broader perspective, energy storage systems offer a wide range of applications and services that create remarkable value streams for the energy grid. There are several services that BESS can provide to the electricity system, depending on the level at which the battery is installed – if behind the meter, at the distribution level, or at the transmission level. In this section, we focus on behind-the-meter customer services, which are beneficial to end-users such as residential households, and commercial or small industrial businesses.

Although the segment is still at a very early stage of development, some business cases are already emerging:

- **Increased solar energy consumption.** As it happens for residential customers, a common use case for small commercials is to couple battery storage with a solar PV system to increase the consumption share of solar energy. In this way, the excess clean energy during the day is stored into the battery device and is discharged later in the evening when the sun is not shining anymore. By maximising self-consumption, the business can save on the lower amount of expensive electricity purchased from the grid and by not selling solar power back to the grid at a low grid export tariff. This business case is more appealing in countries with high electricity tariffs and where there are no net-metering or net-billing schemes. In doing so, it is possible to reduce the electricity bill by becoming less dependent from the grid during costly peak hours and therefore improving the overall PV system economics. In addition to this, using a higher share of green electricity in its operation allows a business to brand itself as a sustainable company to its clients. This business case is viable for businesses that can benefit from excess solar power stored during the day by using it later in the evening or in night-time hours.
- **Demand charges reduction.** An important use case for small businesses is a reduction of demand charges, whereby the energy storage device is used to manage the power load of the company to avoid expensive demand charges during periods of the day when prices and electricity usage are higher. This is done by keeping the load "under control" below a certain threshold by charging the battery either with excess renewable energy coming from the rooftop PV system, or during off-peak periods when energy prices are lower. Then, the battery is discharged during on-peak periods when costs are higher. In this manner, the stored energy is used to reduce and shift the energy amount drawn during peak times, thereby providing significant savings on the electricity bill. In addition, by shaping the load profile in a more distributed manner, it is also possible to smooth the fluctuations of the intermittent energy output to improve reliability and achieve better overall performances. This use case is particularly convenient when the policy framework includes some form of dynamic pricing or time-of-use tariffs, which incentivise end-users to adapt their electricity demand in response to time-varying electricity prices. With increased volatility in power prices across Europe, this feature can prove critical to avoid relying on the grid when electricity becomes very expensive.