



European Market Outlook

For Residential Battery Storage
2022–2026

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Foreword

Welcome to our European Market Outlook for Residential Battery Storage 2022-2026.

With an unprecedented energy crisis in Europe driving skyrocketing electricity costs, citizens are increasingly looking at home solar power generation as a key tool to gain control of their energy bills. More and more, the climate crisis context causes citizens to turn their back on the predominance of polluting and costly fossil fuels, while river droughts and ageing fleets challenge the reliability of existing nuclear power plants. As citizens seek to hedge on their energy supply, the distributed solar rooftop boom brings with it something that seems to be often overlooked in policy circles – a massive growth in residential battery energy storage (R-BESS).

Our latest market outlook shows a R-BESS market that more than doubled in 2021 to 2.3 GWh, after the 1 GWh annual installation level was first reached in 2020. In 2022, our most-likely Medium Scenario forecasts another spectacular growth year – the addition of 71% more capacity of 3.9 GWh, which would lead to a total installed R-BESS capacity of 9.3 GWh in Europe. To put this into more tangible numbers – we estimate Europe will install over 420,000 storage batteries in 2022, resulting in more than 1 million homes across the continent powered with joint solar & battery storage systems. It could have been much more, but a lack of installers across Europe limited the growth of solar systems. Batteries, the cells of which are generally imported, are also facing an acute shortage, sharper than any other part of a solar system.

Still, we are upbeat the residential solar & storage boom will continue. By the end of 2026, our Medium Scenario expects over 300% growth of the total operating R-BESS capacity to 32.2 GWh attached to 3.9 million European homes. It could be even more, our High Scenario anticipates over 44 GWh, but also a third less if the right policy frameworks are not put in place.

To unleash further rapid growth of solar and storage and its benefits, we need a comprehensive strategy for electricity storage, and this includes an EU target of at least 200 GW by 2030.

In Europe's strongest residential battery storage market Germany, which had a market share of 59% in 2021, R-BESS attachment rates to new solar systems were in the range of 70%, and are further rising. This market, which has developed over several years and has also several storage system assemblers, proves that well-thought incentive schemes are very helpful to kick-start a battery storage market until it can stand on its own feet. In order to accelerate solar & storage deployment, we call on EU policymakers to use existing funds to support the battery component in emerging residential solar markets.

While mandatory solar for new and renovated buildings, as proposed by the European Commission, would also help the uptake of batteries, another crucial facilitator would be the integration of battery storage targets and national Clean Flexibility Plans in the upcoming revision for the member states' National Energy and Climate Plans (NECPs). Ultimately, we need to ensure the creation of local flexibility markets to enable the business models for battery storage to support grid stabilisation.

In a very short period, residential battery storage has established itself in a handful of European solar markets. In the leading markets, battery storage has essentially become a standard component of a residential solar system. This should be replicated across Europe.

It's now time for European policymakers to recognize and follow the clear market signals coming from their citizens, who are seeking true control of their energy bills and affordable, reliable, and clean power supply – in other words, solar & battery storage.



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Methodology: SolarPower Europe's five-year forecast consists of Low, Medium and High scenarios. The Medium Scenario anticipates the most likely development given the current state of play of the market. The Low Scenario forecast is based on the assumption that policymakers halt solar and storage support and other issues arise, including interest rate hikes and severe financial crisis situations. Conversely, the High Scenario forecasts the best optimal case in which policy support, financial conditions and other factors are enhanced.

Residential solar and storage systems are defined as installations with a PV capacity below 10 kW. SolarPower Europe's methodology includes only grid-connected systems. Installed PV capacity is always expressed in DC. All figures are based on SolarPower Europe's best knowledge at the time of publication.

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Executive summary

In a period characterised by a drastic rise in household electricity prices across Europe, residential battery energy storage systems (R-BESS) have become an attractive means to reduce electricity bills and increase energy resilience while lowering carbon footprints.

In 2021, with 2.3 GWh installed over the course of the year, the European residential battery market grew 107% from 2020, resulting in a total operating fleet of more than 650,000 units with a cumulative capacity of 5.4 GWh. For the second year in a row, the home storage growth path in Europe turned out to be significantly higher than what we had previously forecasted, with the uptake of home storage technology going beyond the highest expectations. In fact, the growth in the market could have been even larger, if it were not for a severe shortage of batteries that limited the possibility to meet customer demand and led to lengthy delays of several months to get products installed.

The rise of R-BESS is a consequence of the great synergy with solar PV installations, as it extends the usage and application of solar power. The recent growth of the residential solar market across Europe has created the foundation for R-BESS market expansion, even more so considering that the average attachment rate between BESS and PV has grown from grown from 23% in 2020 to 27% in 2021.

Although more and more national markets are looking at solar & storage as a means to decrease dependency from volatile electricity prices and make better use of self-produced green energy, the deployment of this technology is still largely driven by a handful of leading countries in Europe.

Driven by high electricity prices and a strong attachment rate with solar PV installations, Germany remains the leading European battery storage market. In 2021, it installed 1.3 GWh of home batteries, with an 81% annual growth rate. Ranked second in the list of European home storage markets, Italy has certainly been the largest surprise in 2021. The Italian market skyrocketed to 321 MWh installed per annum, up 240% from 2020, thanks to the very advantageous conditions of its incentive scheme Superbonus 110%.

In Austria, the third largest European market in 2021, the discontinuation of subsidy schemes did not reduce market growth, which was ultimately driven by a strong increase in the residential PV segment. The country tripled its annual market, which reached 132 MWh and, by a small margin, surpassed the United Kingdom, now ranked fourth with 128 MWh installed. Different market conditions allowed many countries to grow in the two or three digits range, but the increase in household electricity prices has been a common factor across the continent.

The political and economic landscape in 2022, characterised by even higher electricity prices than in 2021, and energy security concerns of a war in Europe also on fossil fuels, has improved the business case for home storage. We expect the residential BESS market to maintain a very high growth path: after the market reached 1 GWh in 2020 and 2.3 GWh in 2021, our Medium Scenario expects 3.9 GWh to be installed in 2022, up 71% from the year before. Over the course of 2022, the remarkable threshold of 1 million homes with solar & storage has been surpassed.

Positive market conditions and supportive frameworks expected in more European countries in the mid-term will increase the continent's annual home battery market most likely to 7.3 GWh by 2026. In cumulative capacity terms, the European battery fleet will amount to 9.3 GWh by the end of 2022 and reach 32.2 GWh in 2026 under our Medium Scenario, with annual growth rates in the range of 30% or above for all the intervening years. Under optimal conditions, Europe's residential prosumers could operate a battery fleet as large as 44.4 GWh by the end of 2026, compared to 23.2 GWh in the most pessimistic scenario.

This report analyses the specific features of the top 4 largest European markets, which are the same as last year, although the order has changed. In our five-year analysis, Germany is poised to remain the undisputed leader in the field of residential storage, followed by Italy by some distance. These, together with the other two leading markets, Austria and the United Kingdom, will still constitute the top 4 markets in 2023, according to our Medium Scenario. By 2026, however, Poland and Sweden take the #3 and #4 position in Europe.

Policy Recommendations

1. **Set clear EU and national storage targets for 2030, and adopt clean flexibility plans.** In its REPowerEU strategy, the EU expressed the ambition to deploy over 1,100 GW_{AC} of solar and wind capacity by 2030.¹ Such expansion of variable renewable energy capacity needs to be matched by a parallel deployment of storage and flexibility solutions. To this end, there is an urgent need to establish electricity storage strategies and storage targets for 2030 at both EU and national levels. Setting a comprehensive strategy for electricity storage including clear targets and an enabling regulatory framework would give long-term visibility and certainty to investors, as well as guidance to national and local authorities.

- a. At the EU level, the EU Commission should develop and launch an EU Electricity Storage Strategy for 2030, replicating in scope and ambition the Hydrogen strategy, including a non-binding electricity storage target of at least 200 GW. EU policymakers should use existing EU funds to accelerate storage deployment, and improve the regulatory framework to support the solar & storage business case;
- b. At the member state level, policymakers must establish the conditions for a rapid storage uptake, in particular residential solar & storage, which needs a supportive regulatory framework to thrive. National Clean Flexibility Plans should be developed to monitor performance, assess needs and set deployment targets accordingly. A key milestone will be integrating such plans and targets in the upcoming NECP revision planned for 2023-2024.

Our extensive recommendations on this topic can be found in SolarPower Europe's whitepaper [Electricity storage for EU renewable deployment and energy resilience](#).

2. **Make solar mandatory for new and renovated residential buildings.** Solar and batteries perform at their best when they are combined. This is why more and more new residential PV systems come together with a battery when they are installed. To speed up the rollout of home storage technology,

rooftop solar deployment, especially on residential rooftops, should be maximised. The solar rooftop mandate for new and renovated residential buildings as proposed by the European Commission as part of the Energy Performance of Buildings Directive (EPBD), should be transposed at national level as soon as possible.

3. **Incentivise individual and collective self-consumption to optimise flexibility and congestion management.** Self-consumption is the first form of demand-side flexibility: it incentivises consumers to flexibilise their consumption and bring it closer to generation. Member states should incentivise self-consumption compared to grid feed-in to increase the attachment rate between solar on buildings and BESS. These configurations help decrease electricity price volatility, reduce needed grid capacity, and shield end-users from high energy prices. Similarly, peer to peer electricity trading, or collective self-consumption, could support congestion management at local level. Individual self-consumption frameworks should be further promoted at national level, and integrated in DSO planning.
4. **Accelerate regulatory frameworks for demand side flexibility.** DSOs must evaluate their flexibility needs as they draft their network development plans and set up frameworks to unlock and incentivise flexibility. As part of this, it is important to roll-out local flexibility markets and finalise the network code on demand side flexibility as soon as possible. Non-market flexibility solutions should also be promoted in parallel.
5. **Set an appropriate sustainability framework for batteries through the EU Battery Regulation.** EU co-legislators are expected to finalise the triologue negotiations regarding the EU Battery Regulation towards the beginning of 2023. This new regulation will enhance the sustainability and safety features in batteries, including stationary storage applications. The new rules must avoid inappropriate minimum recycled content obligations and overly prescriptive design and data access requirements.

¹ Broken down into 510 GW wind and 600 GW_{AC} solar, which is equivalent to 750 GW_{DC}.

1

Introduction

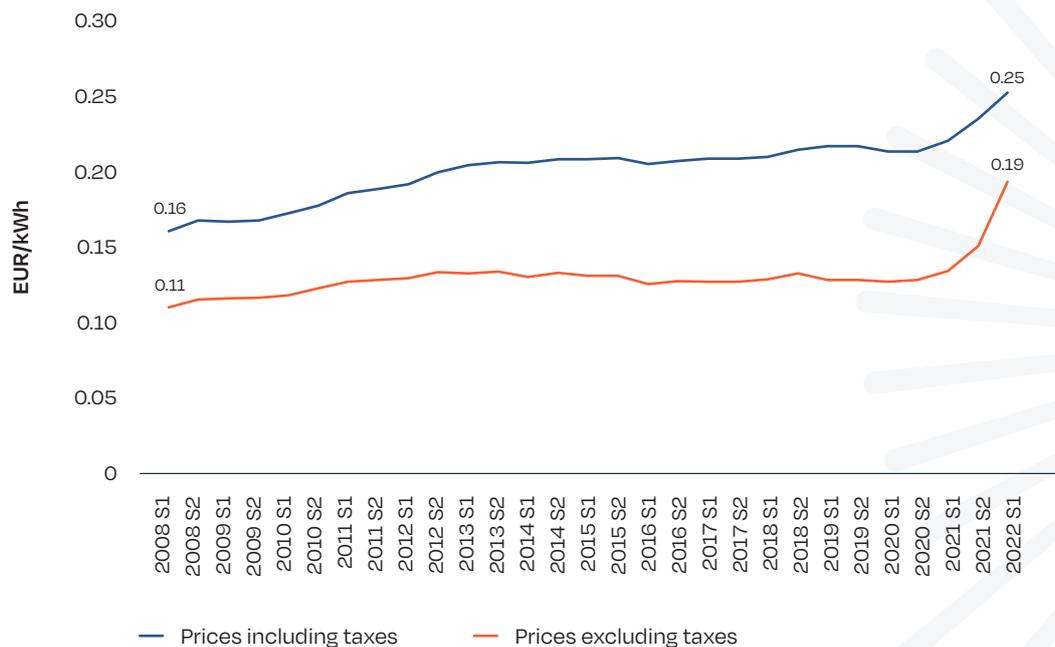


Following the severe impacts of the COVID-19 health emergency on Europe in 2020, with significant lockdown measures enforced in many countries, the following year, 2021, the continent faced a new set of crises.

With the global economy regaining traction after the COVID-19 induced slowdown, also the demand for energy grew and led to a significant rise in prices,

including electricity. This increase was reflected on households as well. In the European Economic Area, average residential electricity prices surpassed for the first time 0.19 EUR/kWh in 2021 and continued growing throughout the year. The Russian invasion of Ukraine in February 2022 has led to a continent-wide energy crisis and, as the war continues, accelerated the electricity price trend to new heights in 2022 (Fig. 1.1).

FIGURE 1.1 AVERAGE ELECTRICITY PRICES FOR HOUSEHOLD CONSUMERS IN THE EU 2008-2022



Source: Eurostat, 2022.

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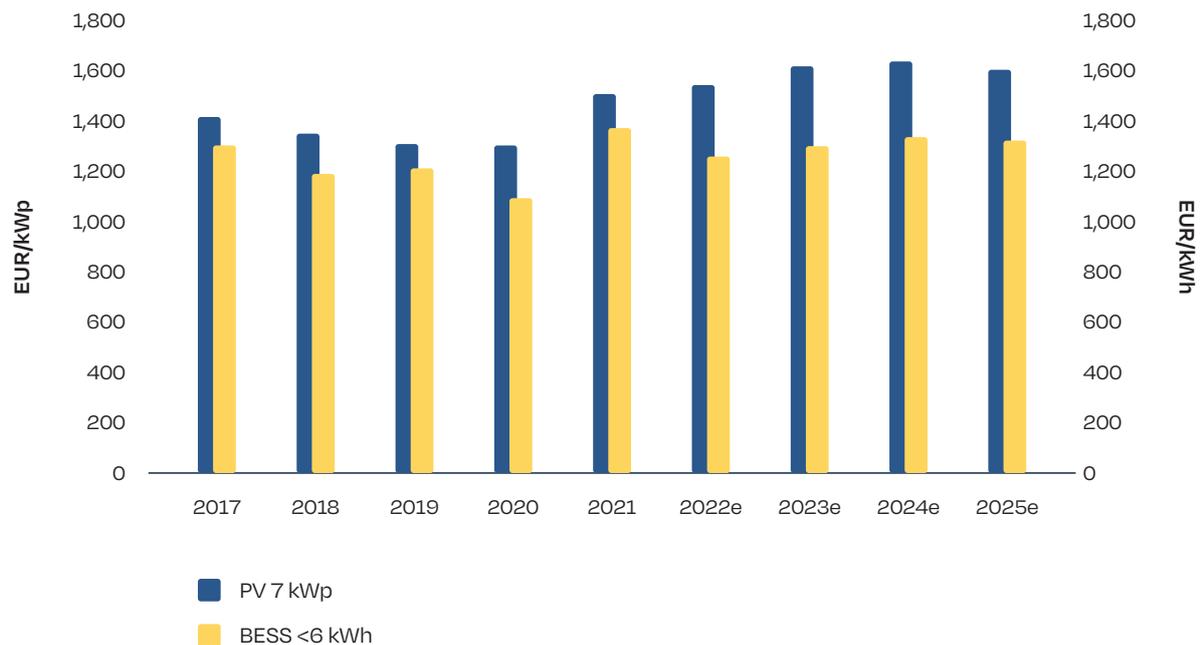
1 Introduction / continued

Within this context, more and more households across Europe are turning to solar PV and battery storage to reduce electricity bills and increase energy resilience while lowering their carbon footprints. Technological advancements have seen Battery Energy Storage Systems (BESS) following the same pattern of steeply declining solar PV costs and prices that have made this technology the most affordable source of energy in many regions around the world. The significant growth of battery storage technologies, including in the electric mobility segment, is contributing to a successful cost reduction story for the sector. Despite a rise in battery prices taking place in 2021 and continuing in 2022 –

due to post-lockdown global trade and economic conditions and soaring energy prices – a decreasing trend in the cost of both solar PV and BESS applications is expected to continue in the medium term (Fig. 1.2).

Against this background, the spread between increasing retail power prices and solar & storage power prices is widening. This trend, already visible in 2021, has become apparent in 2022 as energy prices across Europe have skyrocketed to all-time highs and governments have introduced different forms of emergency measures to curb the impacts on households and businesses.

FIGURE 1.2 SURVEY OF RESIDENTIAL SOLAR & STORAGE PRICES IN GERMANY, 2017-2025



Source: EUPD Research, 2022.

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At the same time, while power from solar rooftop systems has already been much cheaper than retail electricity in most European markets for several years, now battery storage's rapid cost improvements is also now enabling solar & storage to beat grid power in an increasing number of European countries. In Germany, the 'best-in-class' in the residential solar & storage segment, the Levelised Cost of Electricity (LCOEs) for solar & storage systems slightly increased to 14.7 Euro cents/kWh last year, which was less than half of the electricity price at the time of around 32 Euro cents/kWh. While solar system component prices and installation cost have increased as a result of product and labour shortage, and also inflation during 2022, skyrocketing electricity price have made the business case for solar and storage only more attractive.

At the time of drafting this report, the European continent is subject to extreme energy price volatility due to the Russian war on Ukraine and is making concerted effort to decrease dependency on Russian fossil imports and increase the continent's energy resilience. Under the current circumstances, it is hard to imagine that retail electricity prices will decrease in the short to medium term. By contrast, the temporary

price increase of LCOEs of both standalone solar and solar & storage is expected to come to an end as the component price crisis is addressed.

At present, the business case for solar & storage goes beyond the mere economic attractiveness. Many households are interested in these technologies because of their promise of energy security – even though in most European countries, grid failures seem an unlikely possibility, it is a much-debated topic in media. Thus, the psychological aspect should not be underestimated, as it can drive markets even more than economic factors.

European and national policymakers looking for fast, affordable, and long-term solutions to their energy needs will find in solar & storage a versatile and low-cost option to shield end-customers from soaring electricity and gas prices. Adding to that, the electrification of the heat and transport sector across Europe will require smart solutions to increased power demand at the residential level. Solar PV, batteries, heat pumps and electric vehicles all interact very well with each other and can create the right synergies for a rapid phase out of fossil fuels across all sectors, if the right policy framework conditions support this development.



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Residential solar and storage markets in Europe 2021

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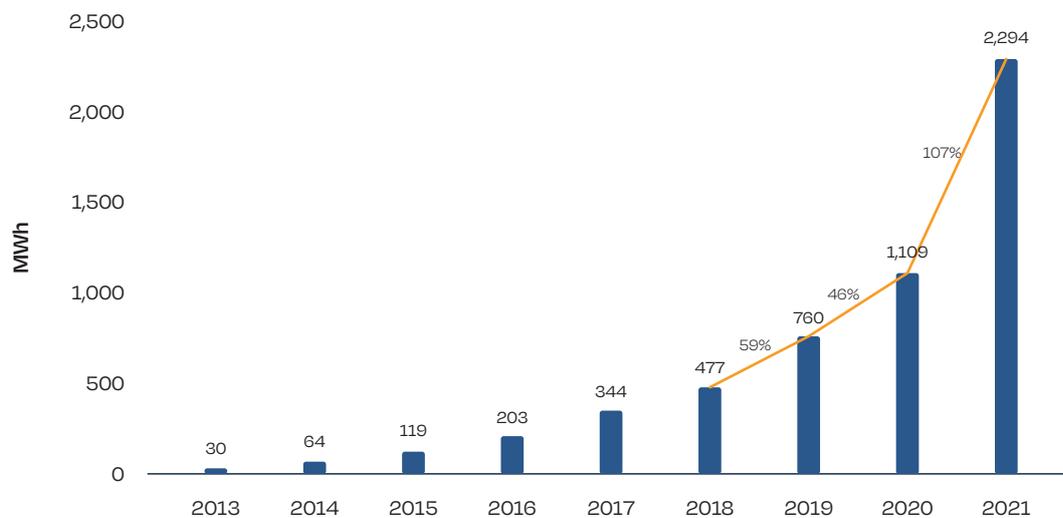
2020 saw residential battery energy storage systems (R-BESS) truly emerge on the energy map in Europe, with two major milestones achieved: it was the first year when the annual market reached the GWh scale; and also, for the first time, more than 100,000 battery units were installed in one single year.

In 2021, the home battery market entered a new phase. With more than 2 GWh installed over the course of the year, the market basically doubled compared to the previous year – to be precise, it grew 107% (Fig. 2.1).

Such a steep level of growth hadn't been registered since 2014; but back then, the market was significantly smaller and had increased to just 64 MWh compared to 30 MWh the year before. To put this into perspective, the size of the R-BESS market in 2021 was 35 times larger than in 2014. That year, only about 9,000 batteries were installed, while in 2021 about 260,000 units have been added.

Remarkably, the growth in the market could have been even larger, if it were not for a severe shortage of batteries

FIGURE 2.1 EUROPE RESIDENTIAL BESS ANNUAL MARKET 2013-2021



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limiting the possibility to meet customer demand and causing, months-long, lengthy delays to install R-BESS products. This issue was particularly felt in less developed markets, where the sudden spike in demand caught distributors by surprise as they struggled to find products for their clients. Even mature R-BESS markets have been suffering from a lack of batteries, which continue to be the missing product link for solar system technology after modules shortages have been solved and inverter shortages are being addressed.

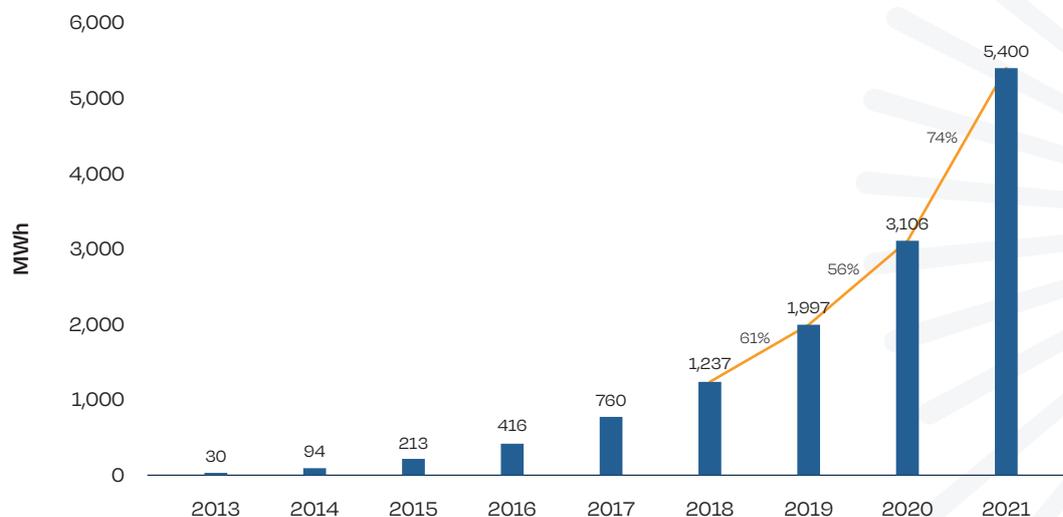
Over the last years, the continent relied on a handful of R-BESS pioneers, primarily Europe's largest solar market Germany, which is also the country with the largest R-BESS installed residential battery storage volume by far. In Germany, home storage started first gaining traction after it switched from a full Feed-in Tariff (FIT) scheme to a model supporting self-consumption, in combination with a premium for excess power, and backed by an attractive R-BESS subsidy programme of its development bank KfW that was slowly phased out. Later, home battery markets started to emerge as well in a few other countries – Italy, the United Kingdom, and Austria – while hardly any capacity was installed in the rest of Europe. Today, R-BESS technology applications can be seen in a quickly

growing number of European countries, and, as volatile energy prices reaching unknown heights are severely affecting households across the whole continent, the home storage business case is becoming appealing in many different European regions.

For the second year in a row, the home storage growth path in Europe turned out to be significantly higher than what we had previously forecasted. In last year's edition of this report, we assumed the market would grow 28% to 1.4 GWh. The positive evolution of the market conditions exceeded even our most optimistic expectations: our High Scenario anticipated 1.8 GWh of annually installed capacity; actual installations were 27% higher.

The exceptional increase in the annual market is well reflected in the growth of the total operating home storage capacity. The residential BESS fleet jumped from just over 3.1 GWh in 2020 to 5.4 GWh in 2021, with a 74% year-on-year increase (see Fig. 2.2). Unlike last year, the annual market growth rate is higher than the growth rate in cumulative capacity, a sign that the total operating fleet has reached substantial volumes and the technology is entering a new deployment phase. Total R-BESS capacity has grown 13 times its size, compared to just five years ago.

FIGURE 2.2 EUROPE RESIDENTIAL BESS CUMULATIVE MARKET 2013-2021



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2 Residential solar and storage markets in Europe 2021

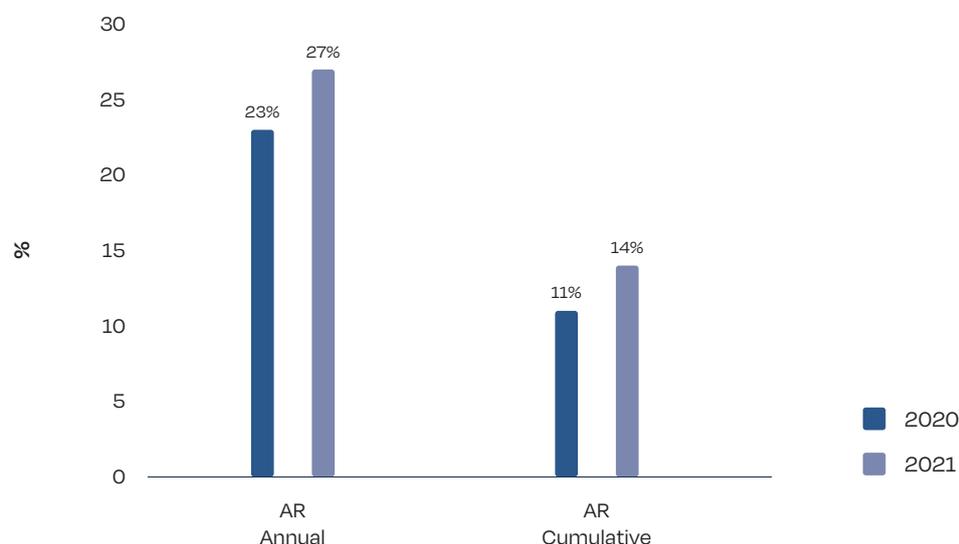
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An important aspect to highlight is that the attachment rate between home storage systems and residential PV systems is rising. In 2021, for every new 10 residential PV systems installed across Europe, 2.7 home batteries were installed (Fig. 2.3). However, it should be specified that not all new batteries are installed together with a new PV system, as some users already equipped with residential solar decide to retrofit their existing PV system with a new battery at a later stage. So far, R-BESS retrofit activity had been negligible compared to new installations in the past. But the strong rise in electricity prices, and an increasing number of solar-only systems exiting their long-term full feed-in tariff contracts, will have this segment become notable as well. However, as long as there is a shortage of product and installers, the sales preference of installers is to build solar & storage systems as these promise higher revenues and profits.

As R-BESS system installations – retrofits and new – are generally not recorded under regulators' renewable energy statistics, it is challenging to determine the average European attachment rate of new BESS with new PV systems. Estimates are based on interviews with solar & storage stakeholders. In 2021, roughly 14% of residential PV systems operating across Europe were equipped with battery storage – that's a 3 percentage point increase from the 11% operating the year before.

Even though the attachment rate between solar and storage is increasing, the untapped market potential for BESS remains huge, even more when considering that over 90% of European buildings are still without solar systems.

FIGURE 2.3 EUROPE ANNUAL AND CUMULATIVE BESS/PV ATTACHMENT RATE, 2020-2021



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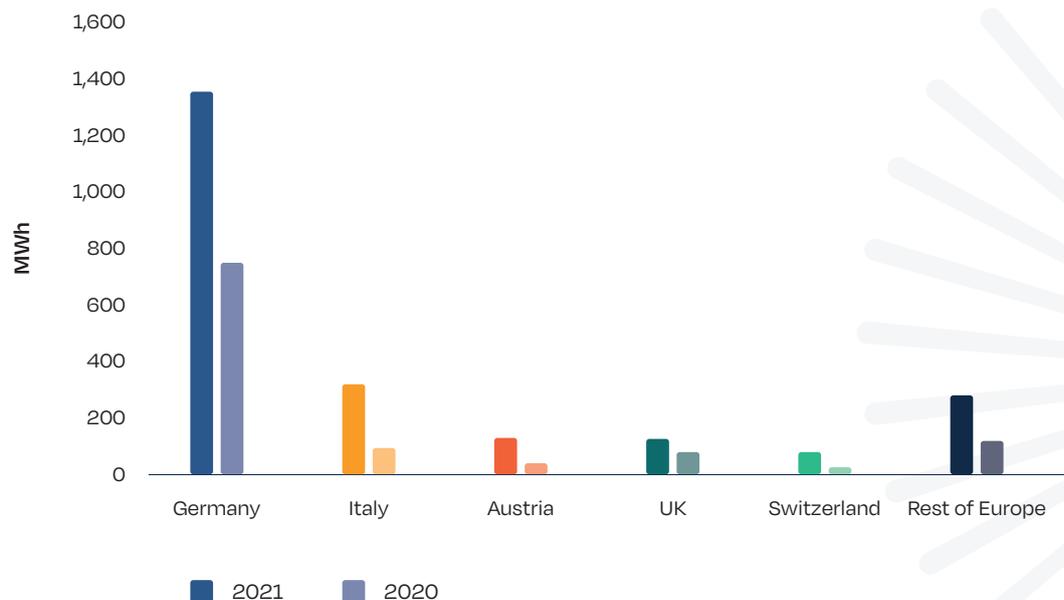
The Top 5 European Residential Storage Markets

Germany remains the leading European country in installations of both residential solar PV and residential battery storage systems (see Fig. 2.4). In 2021, around 150,000 residential BESS were installed in the country, for a total new capacity of about 1.3 GWh. The central role of Germany in the European home storage market cannot be underestimated. However, although still the country currently providing the vast majority of the total European annually installed capacity, with a 59% share, its predominance is decreasing, down 9% absolute compared to the previous year. The annual installed capacity in Germany in 2021 is higher than the whole European home storage market in 2020.

In 2021 the German annual BESS market grew 81% from 2020, when 749 MWh was installed. This growth is mainly due to a surge of residential PV systems installations, the capacity of which increased by 1.8 GW in 2021, the country's best annual performance

ever for the small rooftop segment. The strong increasing rate of R-BESS installed per annum culminating in another record year is a consequence of a coherent strategy, at least when compared with most other European markets. Germany's R-BESS performance can be attributed the active building of a strong distributed solar market as the foundation, the transition to self-consumption, and the incentivisation of BESS behind-the-meter with nationwide, German Development Bank KfW, financial support to establish a solar & storage market that enables consumers turn into prosumers. While the KfW BESS incentive ended in 2018, the BESS sales infrastructure was then ready to support growing demand for solar & storage in a business environment that has made this combination only more attractive. So now we can see that only the right policy frameworks are necessary in Germany to support storage, with financial support no longer necessary. In 2021, the attachment with residential solar further improved to about 70%, compared to 59% in 2020.

FIGURE 2.4 EUROPE TOP 5 RESIDENTIAL BESS MARKETS 2020-2021



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2 Residential solar and storage markets in Europe 2021

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Italy is certainly the largest surprise across European home storage markets in 2021. The positive effects of the *Superbonus 110%*, the fiscal incentive that was introduced in May 2020 as part of the COVID-19 national recovery program, started to fully flourish in 2021. The Italian annual home storage market jumped from 94 MWh in 2020 to 321 MWh in 2021, increasing by over three times year-on-year and totalling more than 31,100 new units in 2021. This highly beneficial tax credit scheme allowed homeowners to deduct up to 110% of the expenses related to home energy efficiency work, which comprise also PV and BESS systems installations. Italy contributed 11% of total European home battery installations, solidifying its #2 rank and distancing itself from the rest of the runners-up.

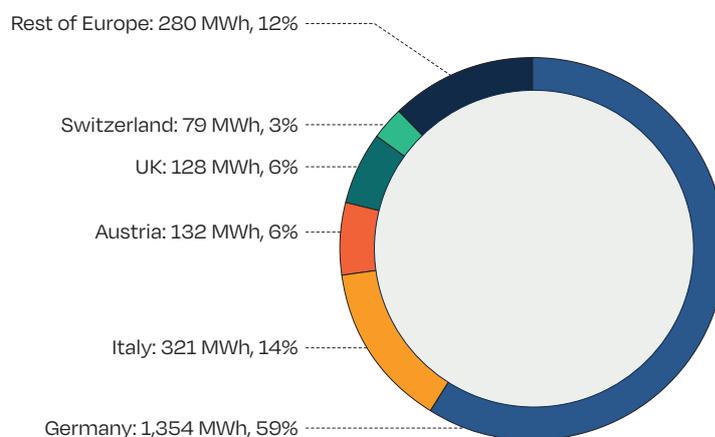
Austria, which was Europe's #4 in 2020, gained one spot and entered the top 3, with the battery market driven by the expansion of its solar peer. Despite subsidy programmes for residential storage being discontinued in 2021, and much lower retail power prices than Germany, the country experienced a large growth in annual battery additions. This was largely due to the increase in the residential PV segment, which grew 143% to 348 MW in 2021. The battery market basically tripled its size, growing 223% from

41 MWh in 2020 to 132 MWh in 2021. This equals to roughly 13,000 residential batteries installed in 2021.

The fourth largest market, the United Kingdom, kept its upward path without subsidies in 2021. With 128 MWh of annual additions and a 58% growth over the previous year, the UK market benefitted from the upward swing of its residential PV segment, which grew 207% to 153 MW in 2021, and accounted for 17,000 residential storage units installed. This, however, was not sufficient to retain rank #3 as in 2020 in terms of capacity installed. Despite the lack of direct subsidies for home storage, since 2020 prosumers are 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 Swiss home battery market remains an important player in the European landscape, and ended 2021 on rank 5. The 6,300 units installed in 2021 resulted in 79 MWh of annual capacity additions, suggesting an average battery size that is significantly higher than its European peers. A strong self-consumption segment supported by a favourable regulatory framework resulted in a three-fold market growth year-on-year.

FIGURE 2.5 EUROPE TOP 5 RESIDENTIAL BESS MARKETS 2021



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In total, the Top 5 European residential storage markets were responsible for 88% of the 2021 installed capacity in the region. In 2021, in all other European countries, the residential battery storage market remained in early development or was still basically non-existent. However, a few notable markets rapidly started to gain traction. Countries outside the top 5 added 280 MWh in 2021, which is 137% more than the 118 MWh installed the year before; but the aggregate capacity installed in 2021 by over 30 countries remains below the annual additions of Europe's second largest market, Italy.

Emerging markets that are set to play a bigger role include **Spain** and **Poland**, who are both characterised by thriving residential PV markets – though the latter is presently much larger than the former in absolute terms. As the attractiveness of self-consumption in these two markets is beginning to have a positive impact on batteries as well, they are expected to become important players in the European context. In 2021, however, their combined annual market share

remained below 5%. A quite different situation can be seen in **France**, where interest in batteries keeps growing, but at much lower pace. Compared to other European countries of similar size, in 2021, its battery market remained very small considering its population of 67.5 million. In **Sweden**, continued growth in the residential PV and home storage sector were driven and supported by subsidies for residential solar & storage. A notable absence continued to be the **Netherlands** – despite having one of the largest European residential PV markets and the continent's highest per capita solar installation rate, it contributed very little to Europe's home storage deployment. The Dutch residential solar market is largely governed by its net-metering policy which, in practice, makes the grid a virtual battery for solar system operators, and severely reduces the attractiveness of storage. However, as net-metering is soon starting its long-term phase out, this market might also emerge on the European home battery map. Despite this outlook, the Netherlands will likely take many years to develop prominence, as net-metering levels will stay high for the coming years.



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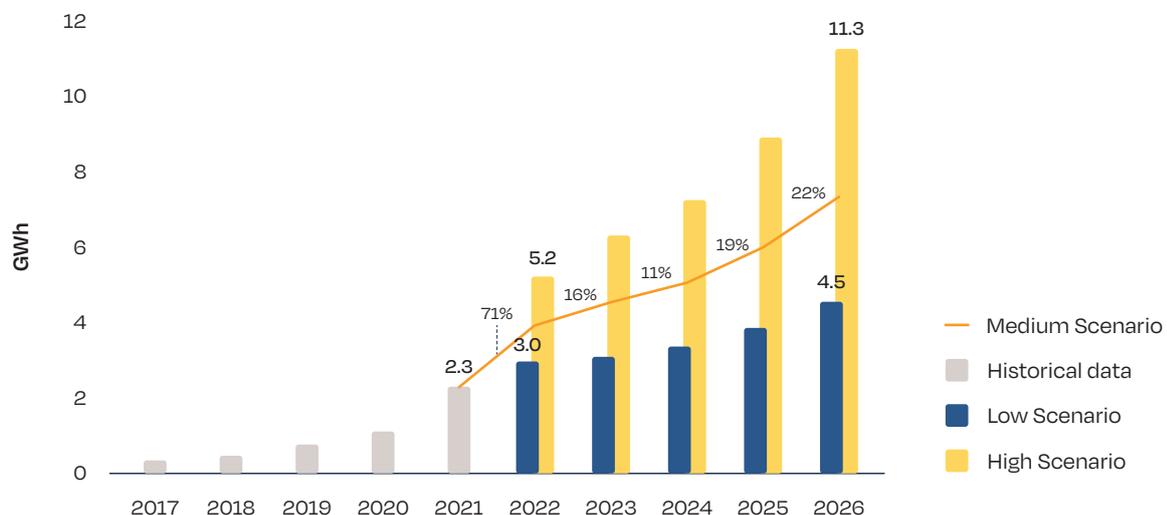


Looking at the next five years, the question is not whether the residential BESS market will continue its upwards path, but rather how steep the growth curve will be.

In recent times, the rapid development of battery storage caught everyone by surprise, overshooting expectations by a large margin. The current political and economic environment, characterised by high electricity prices and energy security concerns, has strongly improved the case for home storage in Europe – both from a business and a psychological point of view. As the COVID-19 recovery packages and other measures contrasting the energy crisis become

available to Europeans households, we expect the R-BESS market to maintain a sustained growth path. After the European residential battery market passed 1 GWh in 2020 and 2 GWh in 2021, our Medium Scenario expects 3.9 GWh to be installed in 2022, up 71% from the year before (Figure 3.1). Compared to last year's outlook, we have significantly revised upwards our expectations: the 2022 market size we forecast this year stands above the 2025 High Scenario we anticipated one year ago. Following a steep two-digit growth trajectory, our revised Medium Scenario forecasts R-BESS deployment of 4.5 GWh in 2023, 5.1 GWh in 2024, 6.0 GWh in 2025 and 7.3 GWh in 2026.

FIGURE 3.1 EUROPE RESIDENTIAL BESS ANNUAL SCENARIOS 2022-2026



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In the short term, much will depend on how fast the current key bottleneck for this segment, the shortage of battery product supply, can be addressed. Europe is strongly dependent on R-BESS products from Asian suppliers; even European R-BESS manufacturers mostly assemble their systems using imported battery cells. The shortage has been so acute that the first major vertically-integrated Chinese solar module manufacturers have expanded into battery cell production. As the transition of the car industry to EVs gains speed, there is fierce competition for many of the raw materials needed to produce lithium-ion batteries, as the technology used in both industries – and this competition won't go away this year or the next, despite rapid expansion of gigantic battery cell manufacturing capacities. However, more BESS product has been available in 2022 than the previous year, and we expect volumes to increase also in the coming years of this overview, even though the shortage will again limit R-BESS growth in 2023. However, the desire for energy security through batteries is often so strong that people installing solar now, already prepare their system with hybrid inverters that enable eventual delivery of a R-BESS system. In the medium to long term, it will be crucial

to preserve the momentum of rooftop solar and batteries, as batteries are a key component to enable consumers transformation to prosumers, and they support distributed grid stabilisation in a renewable-based energy system. Under REPowerEU, the EU Commission gave to solar a central role in the strategy to detach the EU economy from Russian energy imports. A rapid and effective implementation of REPowerEU provisions would equip member states with the right tools to promote residential solar, as well as battery storage. Integrating supportive policies in the EU member states' National Energy and Climate Plans (NECPs) revision process planned for 2023-2024 would further drive the EU market.

As a result of improved market conditions, all three scenarios have been revised upwards significantly from our previous projections. Under the Low Scenario, we anticipate worsened trade conditions, sustained supply chain challenges and other negative market impacts. By contrast, swift adaptation of supply chains to market demand, paired with improved solar & storage policy frameworks, and strong commitment from policymakers are the base assumption for our High Scenario.



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3 Residential solar and storage markets in Europe 2022-2026

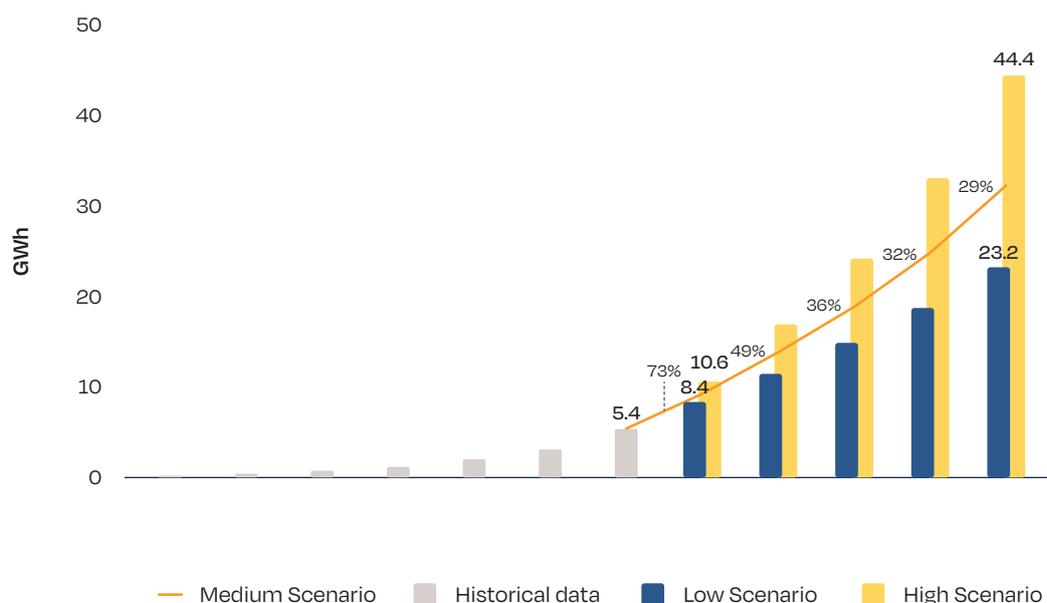
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Although 2022 will be soon ending, we have kept a fairly wide range of 2.2 GWh between the Low Scenario additions of 3 GWh and the High Scenario, reaching 5.2 GWh. Indeed, the market has been growing strongly in the first three quarters of the year, while demand was much higher, but it remains to be seen what will actually be installed in a year characterised by batteries as the major product supply bottleneck in a residential solar system. Even the pessimistic expectations of the Low Scenario are foreseeing a strongly expanding market in 2022, with 3 GWh of storage capacity installed and a 30% year-on-year growth, whereas the 5.2 GW High Scenario would result in a 128% growth. Although this might appear beyond reasonable expectations, the strong growth of the storage market has been very much a surprise in 2021 as well. By 2026, the European home storage market could be as large as 11.3 GWh, according to our High Scenario, while the unlikely Low Scenario foresees a market size of 4.5 GWh, about twice as large as in 2021. When looking at total

installed residential battery storage capacities, our European Market Outlook 2022-2026 shows very high growth rates over the coming years (Figure 3.2). As a market segment whose potential is still to be discovered, the annual growth of 74% in 2021 will be followed by a 73% increase in 2022. The next 4 years are supposed to see lower two-digit growth R-BESS rates in the Medium Scenario, linked to the growth of the residential solar rooftop market and based on increasing attachment rates to solar systems.

In our Medium Scenario, we expect the cumulative residential storage capacity installed across Europe to reach 9.3 GWh in 2022, 13.9 GWh in 2023, 18.9 GWh in 2024, 24.9 GWh in 2025 and 32.2 GWh in 2026. Associated growth rates are consistently above 29% for all the interested years. Under the optimal conditions anticipated in the High Scenario, Europe's residential prosumers could operate a battery fleet as large as 44.4 GWh by the end of 2026, compared to 23.2 GWh in the Low Scenario.

FIGURE 3.2 EUROPE RESIDENTIAL BESS CUMULATIVE SCENARIOS 2022-2026



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Local Developments

Over the coming years, we expect that Germany will retain its leading role in the field of residential storage, supported by a stable residential PV market, and flanked by ambitious climate and energy goals. The largest European economy needs to urgently curb its dependence on fossil imports, and its high retail energy prices will ensure that the economics of solar & storage remain very appealing. While it is not surprising that Germany will keep its #1 role, Italy is anticipated to get close to the German level in 2022. Thanks to its extremely attractive incentive scheme Superbonus 110%, the Italian market is expected to grow more than three-fold and exceed the GWh scale for the first time, only one year after Germany reached that milestone in 2021. Due to their residential PV markets surging in 2022, the United Kingdom and Austria are set to largely increase their BESS markets as well and take rank #3 and #4 respectively in 2022. New players like Poland and Spain are also appearing on the horizon, while the attractiveness of BESS technology significantly increases throughout the continent.

In Germany, the home storage segment is expected to follow the path of its residential solar peer. Strong

demand for solar & storage solutions to shield households from high electricity prices and to curb the fear of blackouts bring the R-BESS market to 1.5 GWh and a 14% growth under the Medium Scenario. The bottleneck caused by a lack of installers and the current unavailability of products prevents larger growth, which however could become more visible in 2023. At present, the very high attachment rate between batteries and residential solar, estimated in the range of 80%, shows that R-BESS become almost part of a standard solar system in Germany, ensuring that the market expansion will remain stable as long as the home rooftop market grows. We expect installations to reach 2.6 GWh in 2026, about twice as much as in 2021.

It is hard to overestimate the impact of the Superbonus 110% on the Italian market. With the support measure in full swing in 2022, the country will comfortably reach the GWh level of annual installations and in 2022 will be playing in the same GWh-league of Germany. After a strong 2023, the reduced attractiveness of the support framework for storage is believed to bring back the market below the GWh scale.



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3 Residential solar and storage markets in Europe 2022-2026

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A newcomer on the European podium in 2021, the residential storage market in **Austria** has bright days ahead. Its growth is supported by the nation's ambition to install 1 million rooftop PV by 2030 and by several subsidies available for storage at state level. The market will follow a stable 2 digit growth path, comfortably cross the 300 MWh mark by 2024, and reach around 450 MWh by 2026.

On the other side of the Channel, the **United Kingdom** is riding on its own at the pace dictated by a free market environment. The year 2022 will be a game changer that elevates the market to just below 300 MWh, more than doubling from 2021's level. However, the lack of supporting scheme and the slow pace of smart meter rollout indicate that the coming years are expected to stabilise at the current level, with a possible small decline in 2023 when the impact from the Ukrainian war on electricity price will temper.

The market in **Switzerland** will follow one of the most sustained paths compared to other European country. The well establish Alpine market benefits from subsidies to support its growth. About one new residential PV system out of three is now combined

with storage solution and the attachment rate is expected to rise in the coming years. Under those conditions, we expect the market to double in the next five years, from 118 MWh in 2022 to almost 240 MWh in 2026.

France, though one of the key markets for PV in Europe, will remain quite low in the coming years because of a lack of incentives and a relatively cheap retail electricity price. The relative growth of the country will be impressive as the market is anticipated to triple from 56 MWh in 2022 to 148 MWh in 2026. But in absolute terms, by 2026 the market will still be the smallest of all the key countries we evaluate in this report.

On the contrary, new players who have surfaced on the scene in 2022 are expected to become key markets in the coming years. First and foremost, **Poland** is projected to be the third country in terms of total battery addition between 2022 and 2026, just behind Germany and Italy (Figure 3.3). The Eastern European country is one of the largest rooftop PV markets, supported by a net-metering program that ended in 2022 and has been replaced by a new incentive scheme. Further north, **Sweden** is a market to keep an

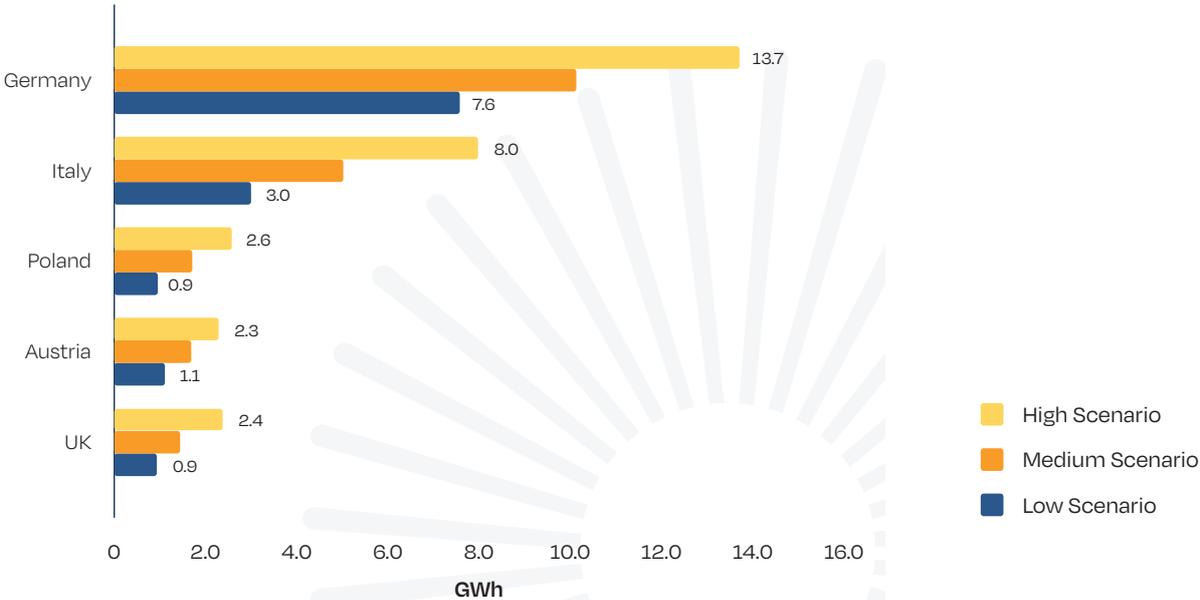


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eye on. We anticipate it to become the fourth largest European market for residential batteries by 2026. The rapid uptake of the residential PV market, combined with subsidies for storage, creates a perfect mix for the R-BESS market to expand. The country is also the first market for electric vehicles in the EU, where the share of new electric car sales reached 43% in 2021, according to the IEA. In the Iberian Peninsula, Spain is creating itself a sweet spot on the European residential storage scene. A subsidy program is in place to support investments, at a time when many consumers are vulnerable to wholesale market fluctuations and are looking to protect themselves against high energy bills.

A big R-BESS disappointment on the European stage is the Netherlands. This major European PV rooftop market has the potential to become a monumental market for residential storage, which could also help to address its increasing grid congestion, but the presence of its net-metering scheme hampers the business case for battery storage and severely limits its growth perspectives. The net-metering programme will eventually be phased-out by 2031, but as it is currently uncertain under which conditions this will happen, we do not see any big positive R-BESS movement in the coming years.

FIGURE 3.3 EUROPE TOP 5 MARKETS RESIDENTIAL BESS ADDITIONS 2022-2026



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The largest residential battery markets in 2021 are Germany, Italy, Austria and the UK. Together, they installed 1.9 GWh of residential storage battery capacity, representing 84% of the 2.3 GWh that Europe installed in 2021.

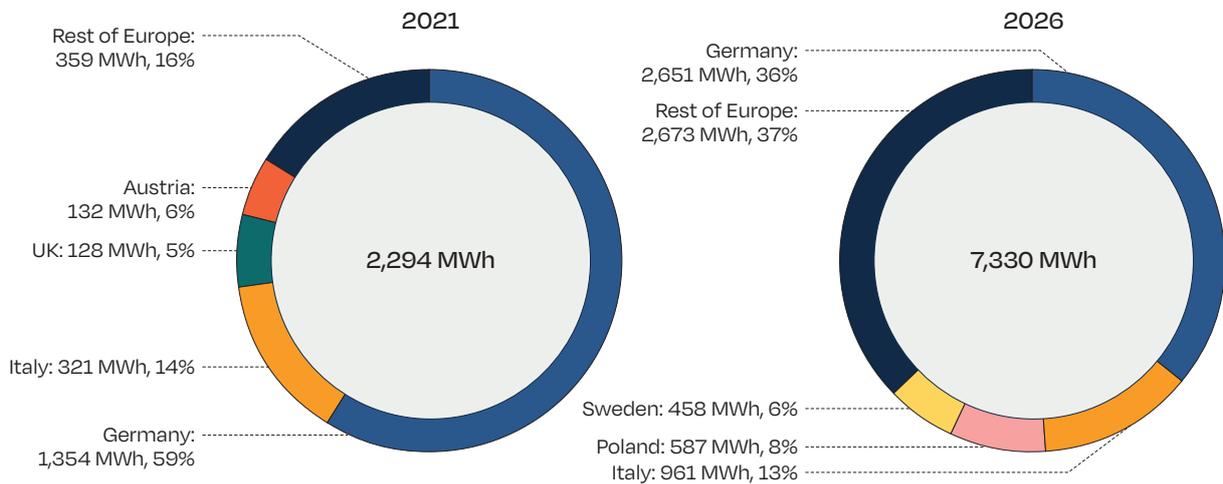
While these four have been playing in their own league for quite some time, we can observe movement in the market shares, partly due to newcomers entering the R-BESS segment. First of all, Austria overtook the UK on the third step of the podium in 2021. Second, the overall share of the top 4 markets decreased from 90% in 2020 to 84% in 2021. This is attributed to the emergence of other countries such as Sweden, Spain, Poland, and a growing R-BESS market in Switzerland. The expanding residential PV market and the high electricity prices resulting from the energy crisis are jointly boosting the

residential storage market in those countries. We expect the top 4 markets to remain the same in 2022 and 2023 as well, with the UK reclaiming the #3 position.

Looking further to 2026, the annual market will grow significantly to 7.3 GWh (+220% from 2021). Germany and Italy are expected to remain the largest residential battery installers, but Poland and Sweden are expected to replace Austria and the UK on positions #3 and #4 respectively. The market share of the four leading countries is supposed to decrease to 64% by 2026, reflecting the diversification of the residential storage market in more and more European countries.

In this chapter, we provide background on the evolution of residential battery storage in Europe's four most prominent markets in 2021.

FIGURE 4.1 TOP 4 MARKETS IN 2021 & 2026



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TABLE 4.1. OVERVIEW OF THE TOP 4 RESIDENTIAL BESS MARKETS

	GERMANY 	ITALY 	UK 	AUSTRIA 
2022 forecast (medium scenario) annual market size (MWh)	1,538 (+14%)	1,111 (+246%)	288 (+124%)	223 (+70%)
2021 annual market size (MWh)	1,354	321	128	132
Cumulative residential BESS capacity 2021 (MWh)	3,430	593	401	293
Cumulative residential PV capacity 2021 (MW)	60,599	22,127	14,599	2,760
Residential BESS-PV attachment rate 2021 (%)	70%	45%	45%	30%
Retail electricity price for residential customers 2021 (EUR/kWh)	0.32135	0.23095	0.21984	0.22505
Overarching framework for prosumer electricity export	Feed-in tariff/feed-in premium	Net-billing	Market based	Feed-in tariff
Average export tariff for residential PV systems 2021 (EUR/kWh)	0.07	0.23	0.06	0.13
Authorization to self-consume	Yes	Yes	Yes	Yes
Energy arbitrage possible	Yes, but uncommon	No	Yes	No
Aggregation and grid services possible	Partially	Pilots ongoing	Yes	Yes
Financial support schemes for BESS	Sporadically, some regional support schemes	Superbonus up to 110% depreciation if combined with other energy efficiency measurements; 50% tax deduction for building renovation	0% VAT if installed alongside a PV system	Federal investment grant for solar and battery storage; some regional support mechanisms
Remaining barriers	Low smart-meter rollout; no dynamic time-of-use tariffs; regional grants with limited funds freezing the market	Net-billing; long permitting times for PV installations; inconsistent regional interpretation of incentive schemes	Low incentivization of battery storage systems; incomplete smart meter rollout	Incomplete smart meter rollout; inconsistency amongst real-time data systems used by DSOs; different permitting of PV installations among DSOs

4 The top 4 European residential battery storage markets

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4.1. Germany

In 2021, Germany was again Europe's largest market for residential battery storage. The country installed 1,354 MWh in 2021, an 81% increase from the 749 MWh added in 2020. The strong leadership of Germany continued in 2021 at a very dominant level, capturing a 59% share of the entire European R-BESS market. However, its relative share decreased by 9% percentage points from the 68% in the previous year. We estimate that nearly 150,000 single residential storage units were installed throughout 2021. This is more than four times higher than Italy, Europe's second largest R-BESS market.

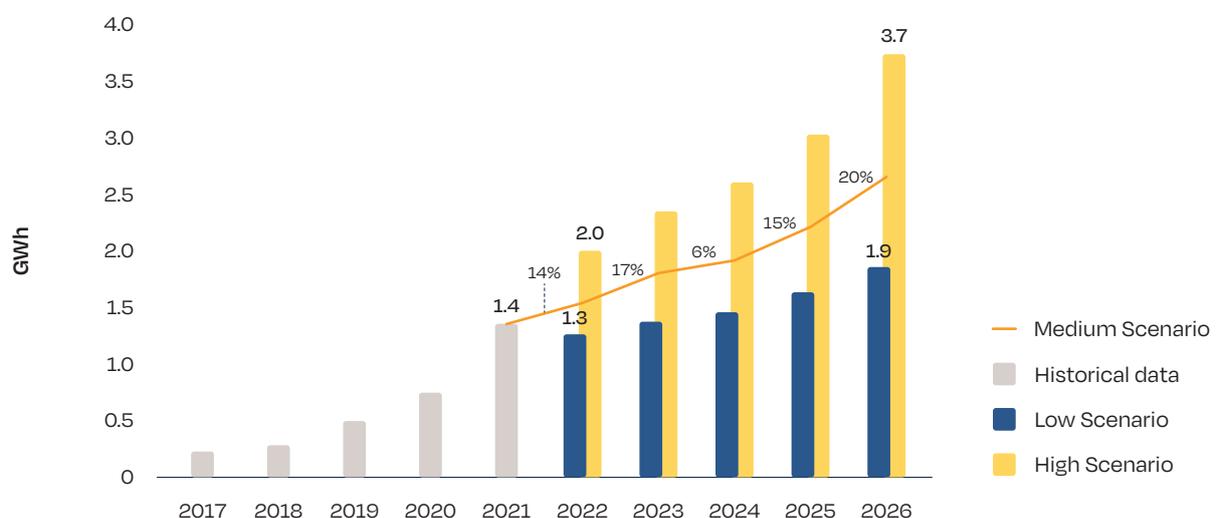
This impressive development even slightly surpassed our previous edition's High Scenario, which assumed that the German market would reach 1,240 MWh in 2021. An established solar and battery storage market for many years, 2021 was the year electricity prices started its rally at the wholesale markets. While retail electricity prices in Germany have been already among the highest in Europe for years, the fear of further price hikes triggered many more home owners to look into solar & storage system technology, a development that has accelerated with the start of the Russian war against Ukraine, which resulted in skyrocketing energy prices.

Residential solar & storage market in Germany

Since the beginning of the millennium, Germany has most-often been the largest solar PV market in Europe. Germany's solar boom began in April 2000, when the first feed-in tariff scheme for solar PV systems was implemented through its EEG law, and experienced a first strong growth phase until 2012, when the size of the market was similar to 2022. Under the FIT scheme, households could sell all electricity generated by their solar PV system at very high rates to the grid for 20 years. Dramatic incentive cuts and regulatory changes that also kick-started a transition to self-consumption depressed demand for several years between 2013 and 2018, when solar cost reductions have made investments into the technology attractive again.

Over the last two decades the feed-in rate was continuously reduced for new systems, reaching around 0.43 EUR/kWh at the end of 2009, 0.24 EUR/kWh in 2012, and about 0.07 EUR/kWh end of 2021. The decreasing price for solar export tariffs, combined with cost reduction in solar technology, generally widened the gap to Germany's very high retail power tariffs over time. As self-consumption became increasingly appealing, the need for battery storage emerged. Since batteries were very costly

FIGURE 4.2 GERMANY RESIDENTIAL BESS ANNUAL SCENARIOS 2022-2026



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10 years ago, the German government initiated a subsidy scheme. This scheme, created in 2013 and applicable to solar installations below 30 kW, was the ignition point for the combined rooftop solar and storage market in Germany. The country's development bank (KfW) first offered low-interest loans and grants between 2013–2015, after which the scheme was renewed for another three years, from 2016–2018, providing the basis for several local battery system manufacturing start-ups, and time for installers to learn about solar and storage.

While several German states had offered incentives for battery storage in recent years, most of these programme budgets are now exhausted. There is still a Germany-wide KfW loan programme for solar, storage, and other renewables available (KfW 270), but the discount rates starting at 3.58% are similar to commercial loans.

Economics for residential storage in Germany

Premium feed-in rates quickly decreased by more than 70% in 2020 and 2021 for residential systems – down to 0.0693 EUR/kWh by end of 2021 – as a result of high installation volumes on the one hand and average electricity prices of 0.3214 EUR/kWh in 2021

on the other. This provided an attractive business case for solar & storage, and explains the 81% annual R-BESS growth rate, despite an increase in product cost due to supply chain issues. The business case remains similar in 2022, only that retail electricity prices exceeded the 0.40 EUR/kWh level in the second half of the year, making the investment in PV and storage even more attractive. For 2022, our estimate is a 14% annual growth to 1.5 GWh in the Medium Scenario, which would be much higher if more batteries and installers were available.

As of July 30, 2022, the EEG 2023 edition of the new government coalition went into effect, which increased the excess solar power feed-in for new systems to 0.086 EUR/kWh, from 0.0624 EUR/kWh in July 2022. The monthly decreasing trajectory of feed-in tariffs is now frozen until 2024, after which it will restart with levels of 1%, but only every 6 months. As the government is looking to increase accessible power volumes during the current energy crises, the technical limit to inject only 70% of a solar system's rated power output was abolished as of January 2023. Moreover, households deciding to export all solar electricity to the grid will benefit from a bonus of 0.048 EUR/kWh, raising total remuneration to 0.134 EUR/kWh. The full feed-in is also aimed at



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4 The top 4 European residential battery storage markets

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investors whose properties have little or no self-consumption needs and encourages maximum usage of available roof space. In the case of residential solar, homeowners will very likely opt mostly for solar & storage and the lower self-consumption tariff, however, the law allows two separate systems on the same house – one optimised for self-consumption, the other for full feed-in.

Prospects

The further prospects for the R-BESS market in Germany are very bright. The new, higher full feed-in rates will not reverse or even slow the trend of new residential PV systems being built together with a battery. The energy crisis has put energy security on the table, a topic Germans have not worried about for decades, and driven significant psychological shifts in the way consumers perceive the self-generation and consumption of energy, and the ways in which households can seize the means of energy production.

The R-BESS rise in Germany will continue in the coming years, mostly following the development of the residential PV sector, which will continue its growth – from around 1.8 GW in 2022, to about 2.2 GW in 2024. We estimate that battery attachment rates will grow close to 90% by 2026, making the battery basically a standard part of a new solar system in Germany. However, due to supply chain issues, heightened by the huge demand for batteries from the car industry, not everyone who wants solar & storage will get the full package in the short run.

Overall, we expect the annual market to expand in 2022 by 14% to 1.5 GWh in our Medium Scenario. There are two reasons for the lower growth than in the previous year – first, the installer shortage limits growth in the residential PV market, and second, there is the earlier mentioned shortage of available batteries. As demand for solar in Germany has swelled dramatically during the energy crises, our High Scenario anticipates as much as 2 GWh in 2022.

The story is similar for 2023. Although the bottleneck on the supply side is anticipated to continue and energy price caps from the government promise some security on increasing energy expenses, the

momentum to get hold of clean and safe power supply will stay, especially as nobody knows how long this energy crisis will last. Our Medium Scenario forecasts 1.8 GWh for 2023, 1.9 GWh in 2024, 2.2 GWh in 2025, and 2.7 GWh in 2026. However, if Germany faced blackouts in the winter 2022/23, and the energy crises aggravated, the run on solar & storage could even get much larger. Our High Scenario anticipates annual additions of 2.3 GWh in 2023, and advancing towards 3.7 GWh in 2026.

In any case, Germany will absorb a lot of battery capacity over the next five years. From 2022 to 2026, a total of 10.1 GWh of residential storage capacity will be installed under the Medium Scenario, and 13.5 GWh under the High Scenario. This would boost the cumulative R-BESS capacity from the 2021 level of 3.4 GWh, to around 13.5 GWh in the Medium Scenario, 17.1 GWh in the High Scenario, and even 11 GWh in the Low Scenario, by the end of 2026.

4.2. Italy

Unlike the overall solar power market, where Italy has severely lagged behind the leading European solar nations for many years, the story is much different for residential energy storage. Since 2018, the Italian R-BESS market has been the second largest in Europe, albeit following by a large margin the continent's #1 Germany. The first residential solar & storage installations in the country were registered in 2015. Since then, the sector started to grow rapidly following financial support schemes available in the regions of Lombardy, Veneto, and Friuli Venezia Giulia, and the extension to batteries of the 50% tax credit for the purchasing of a residential PV system.

The introduction of the Superbonus 110% incentive scheme constituted a strong improvement in BESS attractiveness in the country. Though the scheme was introduced in mid-2020, the effects on R-BESS sales are only fully visible in the 240% year-on-year market growth that took place in 2021, bringing annual installations to 321 MWh. Thanks to this boost, Italy clearly emerged as the second largest market in 2021, distancing itself from Austria and the United Kingdom. The cumulative operating capacity in 2021 stood at just below 600 MWh, growing 118% from the previous year.

Residential solar & storage market in Italy

The residential PV segment remains a key contributor to the Italian solar sector, with an average share of 33% among the annually installed PV capacity in the last 5 years. This has led to a cumulative capacity of 4.5 GW and more than 900,000 homes. The residential PV market in Italy took off between 2005 and 2013, following the five Conto Energia decrees, setting a subsidised feed-in tariff for small-scale solar generation. Between 600,000 and 700,000 homes were equipped during this period, and still benefit from the scheme as the FIT incentive was granted for 20 years from the commissioning of the system. Residential solar installations went down after 2013, fluctuating around 200 MW installed per year since then. The Italian energy authority GSE offers a net-billing scheme (Scambio sul Posto) for any PV system below 500 kW. Under this scheme, on a yearly basis prosumers subtract the value of electricity fed into the grid to the bill of electricity consumed.

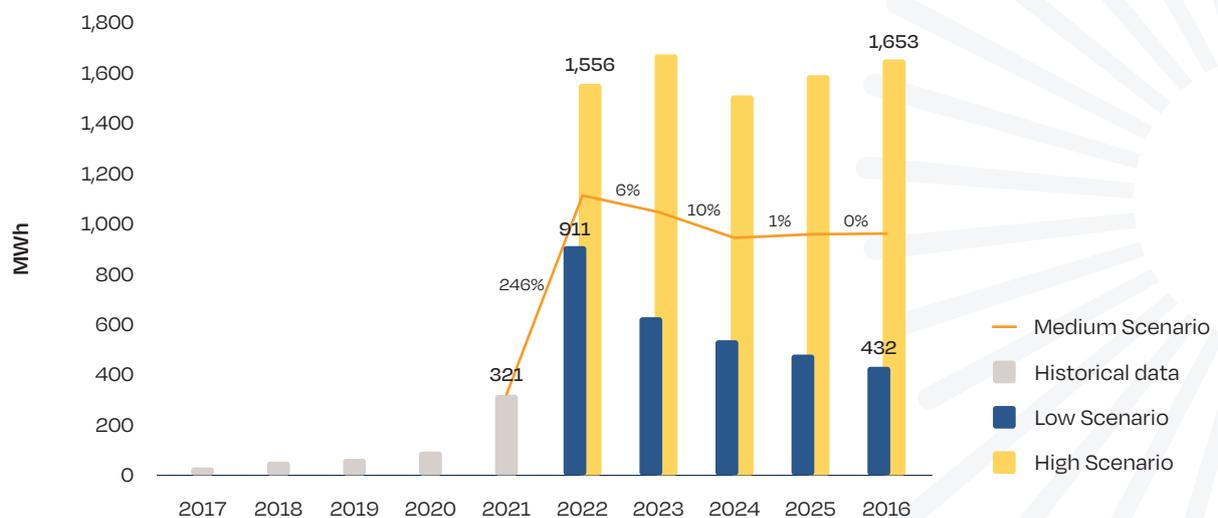
The government also provides an incentive for the installation of small-scale PV generation assets in the form of a 10-year-long tax credit covering 50% of the investment cost. Typically, a household spending 10,000 EUR for a PV system would benefit from a 500 EUR tax rebate per year during the next 10 years.

The residential BESS market in Italy emerged in 2016, when the Lombardy introduced a new incentive specifically for small-scale storage. The budget set was 2 million EUR first and was then renewed every year since, each time amounting to 3–4 million EUR.

In 2018, the 10-year tax incentive for the installation of residential PV covering 50% of the upfront investment cost were extended to small-scale BESS. All systems installed simultaneously or after the commissioning of the PV system were eligible. Veneto and Friuli Venezia Giulia also launched similar incentive programmes in the following years, although the majority of these programmes have been discontinued.

In July 2020, as part of the COVID-19 national recovery plan, the government introduced the aforementioned Superbonus 110%, providing a significant incentive to energy efficiency interventions in residential buildings. The measure originally gave the possibility to obtain a tax credit of 110% for the expenses incurred from July 2020 until 2023, to be spread over a 5-year period in five annual instalments of equal amount. In order to obtain the credit, the law makes an important differentiation between “leading” (trainanti) and “towed” (trainati) improvements. The former concern a thermal insulation, winter air conditioning systems, and seismic risk reduction works; while the latter include the installation of grid-connected PV systems,

FIGURE 4.3 ITALY RESIDENTIAL BESS ANNUAL SCENARIOS 2022-2026



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4 The top 4 European residential battery storage markets

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battery storage, EV charging infrastructure, and other energy efficiency measures. Therefore, in order to benefit from the Superbonus, the PV and the storage systems must be installed in conjunction with one of the main interventions and the overall investment made must lead to an improvement of the building's energy efficiency rating. In the case of ineligibility for the Superbonus, it is still possible to obtain the 10-year 50% tax credit already in place for the installation of small-scale PV generation assets and BESS. In November 2022, the newly formed government announced that starting from January 2023 the Superbonus will be reduced to 90% and will progressively decrease in the following years. However, differently from what previously planned, according to the new rules it will be still possible for single houses to benefit from the Superbonus in 2023.

Economics for residential storage in Italy

The only application for residential BESS in Italy at present is to improve the self-consumption rate of residential PV plants. Household batteries cannot charge from nor feed to the grid but can only interact with the co-located solar PV system, which makes it impossible to use storage for other business models such as energy arbitrage. However, the UVAMs (Mixed Enabled Virtual Units) pilot project allows aggregation of distributed assets for the provision of services such as congestion resolution, balancing and secondary and tertiary reserves.

The current framework for self-consumption under the Scambio sul Posto net-billing scheme also provides a barrier to the storage business case, since prosumers get a remuneration for the electricity they feed into the grid. This scheme is supposedly poised to end in 2024, although this needs to be confirmed in a new legislative decree.

Before the impact of the energy price crisis materialised itself in 2022, the Italian annual average of the retail electricity rate has oscillated between 0.20 and 0.25 EUR/kWh (towards the end of 2021). Italy was one of the pioneers in the rollout of smart meters, but it did not translate into many innovative electricity offers for residential customers. Static time-of-use pricing contracts, with a lower rate at night and during off-peak periods are widely available and often chosen by PV owners. However, dynamic time-of-use tariffs are inexistent yet.

The main drivers for the purchase of BESS by homeowners equipped with PV remain the very generous incentives currently offered. Thanks to those, Italy is by far the most attractive European country for small-scale solar & storage systems regarding payback time. The 110% or 50% tax reliefs drastically eases the investment in a residential BESS, and the additional independence it provides together with a PV appeals many customers. The high electricity prices experienced in 2021 and 2022 have further improved the home storage business case.

Prospects

With the Superbonus 110% in full swing and impacted by volatile electricity prices, the Italian residential BESS market has been skyrocketing in 2022. In the period from January to September 2022, about 100,000 units, equivalent to 859 MWh, were reportedly installed. We expect that by year end the capacity will exceed the GWh mark and reach 1.1 GWh. This expected 246% growth might not be sufficient to surpass Germany as largest European market in 2022, but will certainly place the Italian market in the same order of magnitude. The ability of the market to adapt to the current shortage of installers and its ability to attract enough batteries will play a major role in determining how many new solar and storage systems will be installed. At present, the lack of installers results in delays of 6 months or more for R-BESS orders. However, as the Italian R-BESS boom might be good for another surprise, our High Scenario estimates installations to add 1.56 GWh in 2022, which is the same level as the Mid Scenario for Germany.

In the coming years, the evolution of the market becomes more uncertain. While 2023 is poised to mark another exceptional year, when the market could even exceed the 2022 performance, the progressive phaseout of the Superbonus coupled with the expected termination of the Scambio sul Posto net-billing scheme make room for much uncertainty regarding the direction of the market in the subsequent years. A substantial decrease in the attractiveness of the supporting framework could in theory lead the market to pre-Superbonus levels; however, we expect the market to at least stabilise just below the GWh range. According to the Italian TSO Terna, 16 GWh of residential storage should be deployed by 2030, compared to the 5.6 GWh that would be operating by 2026 in our Medium Scenario.

4.3. Austria

The residential battery storage market in Austria started to get first traction as early as 2015, but started to grow faster after investment grants were launched in 2018 at the federal level. Last year, 132 MWh from 13,000 units of residential storage capacity were added, corresponding to a 223% increase compared to 2020. This enormous growth was enabled primarily by government incentives, mainly for PV systems in combination with storage. The battery storage rollout differs widely among Austria's states, and depends also on local incentive schemes. The renewal of the federal investment grant for storage in mid-2022 has provided another push for battery storage both for new systems and retrofits of PV systems. Our Medium Scenario forecasts residential storage capacity additions of 223 MWh in 2022, corresponding to a strong annual growth rate of 70%. We expect sustained two-digit growth, though at much lower level, for the remaining years taken into account.

Residential solar & storage market in Austria

The Austrian federal government set a new regulatory framework for renewable energy in 2012 by adopting the *Ökostromnovelle* (Green Electricity Act). This

included a generous subsidy for small-scale PV systems, offering a one-time financial grant for installations below 5 kW and a 13-year FIT for systems between 5–200 kW. The support scheme was instrumental for kick-starting the residential solar PV market, which added around 50 MW in this market segment in the period from 2013 to 2017.

In 2017, the government passed a nation-wide investment subsidy for small-scale PV systems (located on rooftops and sealed areas) for the years 2018 and 2019 in coherence with its renewables targets. The scheme, backed by an annual 9 million EUR budget, offered financial support covering up to 30% of the investment costs. Concurrently, a budget of 6 million EUR per year was dedicated to support investments in any storage systems installed with the subsidised PV systems. Overall, the financial support for solar & storage systems could cover up to 45% of the total investment costs. In addition to the federal support scheme, there have been also regional incentives available for both small-scale solar PV and attached storage systems.

In 2020, a larger rebate scheme for solar and energy storage systems was launched. With a budget of around 36 million EUR, about two-third was earmarked for solar and the other third to storage. The



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4 The top 4 European residential battery storage markets

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wide success of the scheme, which offered homeowners 250 EUR/kW of solar and 200 EUR/kWh of battery storage, has led to a reactivation in 2022, and a budget increase to 240 million EUR.

While approximately 4,500 R-BESS installations and a total capacity of 30 MWh were registered in Austria in 2018, the sector experienced steady growth in the coming years. In 2019, 5,500 units and 37 MWh were installed; in 2020, demand grew 11% to about 41 MWh spread over 6,000 systems, before the market was unleashed in 2021, when growth exploded to a level of 222%, resulting in 132 MWh over 13,000 units.

Economics of residential electricity storage in Austria

The residential BESS sector in Austria is mainly driven by homeowners' desire to improve their energy self-sufficiency. The retail electricity rate for household customers was rather stable during the last decade, oscillating around 0.20 EUR/kWh but increased to 0.30 EUR/kWh by the end of 2021.

Unlike in Germany, nearly all traditional Austrian retailers in the country already offer static time-of-use

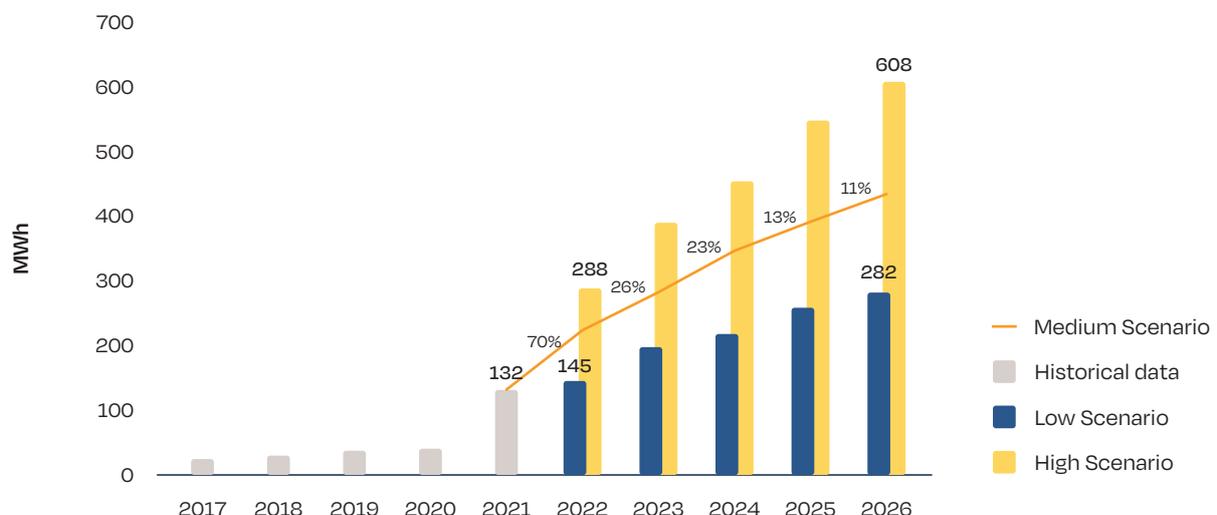
tariffs with specific rates for peak and off-peak times, a further reason to add R-BESS to a solar system. Furthermore, again unlike in Germany, the national smart meter rollout is progressing and reached 47% by the end of 2021, a development that enables more retailers to provide dynamic pricing contracts, with special tariff structures for households equipped with solar & storage systems.

Prospects

While residential electricity prices further increased in 2022, quickly approaching the 0.40 EUR/kWh level, the government passed an electricity cap exactly at that level in September. It remains to be seen what impact that will have on the R-BESS market, but Austria's ambitious solar goals and consumers looking for energy security makes further strong growth very likely.

The federal government of Austria strives to supply 100% of total national electricity consumption with renewable energy sources by 2030, and solar power plays a major role. The country is looking to install solar on 1 million rooftops, a 10-fold increase from the 100,000 rooftop PV systems target that was

FIGURE 4.4 AUSTRIA RESIDENTIAL BESS ANNUAL SCENARIOS 2022-2026



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introduced in 2018. The Renewable Expansion Act (EAG), passed in July 2021, targets additions of 27 TWh of electricity from renewable energies, from which a big part, 11 TWh, should come from solar PV. To achieve this, in 2021, a market premium for the feed-in tariffs scheme was introduced. In addition to this, the market is supported through a solar and storage grant program, which has seen a steep budget increase to 240 million EUR in 2022.

With the smart meter roll out planned for completion by 2024, enabling more innovative electricity supply contracts, and the popular investment schemes under the EAG, the installed battery storage market is anticipated to grow to 223 MWh in 2022, according to our Medium Scenario. This would be a year-on-year marginal growth of 92 MWh or 70%. As the instability in energy supply markets continues, so will consumers increasingly turn to solar & storage. The Medium Scenario forecasts annual market growth rates of 11-26% in the coming four years, and to almost double to 430 MWh in 2026, compared to 2022. However, the High Scenario estimates over 40% more growth with 608 MWh by 2026.

4.4. United Kingdom

Although the UK market dropped one spot to rank 4 in the European arena, as it was overtaken by Austria, the country's performance in the R-BESS segment was better than previously forecasted. Last year, we assumed the market would reach 93 MWh in a Medium Scenario and 112 MWh in a High Scenario. In 2021, but in fact, the market overshoot our predictions, adding 55,000 home storage unit totalling 128 MWh, which was 16 MWh above our most ambitious scenario. This meant a 57% growth in 2021 from the 81 MWh installed the year before. As a result, the United Kingdom operated a total R-BESS fleet of slightly over 400 MWh by the end of 2021.

The UK residential storage market has a solid base despite the absence of any support scheme until very recently. The storage business case improved in 2021 due to rising electricity prices, as in many other European countries. In 2022, we expect the country to pursue its growth trajectory and to surpass all previous records. Supported by a growing residential PV market, the country will add 288 MWh of residential battery capacity according to our Medium Scenario, a 124% increase from the previous year.



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Residential solar & storage market in the UK

In the last decade, the small-scale solar PV segment in the UK was supported by a generous export tariff. From April 2010, households who decided to install a solar PV system on their roof could be remunerated for every kWh generated. On top of that, an extra-payment was granted for every kWh exported. Those subsidies were contracted for a duration of 20 years from the date of commissioning.

Thanks to this scheme, the residential solar PV market saw a steady growth since 2010. The annual additional capacity from the segment stood over 150 MW every year with a peak at 560 MW in 2015. In 2017 and 2018, the government reduced the export rate remuneration for new residential PV capacity, resulting in a decrease of the market segment to levels below 100 MW. Despite the fall in new residential solar installations in these two years, the market was on the rise again in 2019. An additional residential solar capacity of 125 MW was commissioned, accounting for approximately 45,000 households – but that was due to the installation rush in the first three months of the year before the FIT scheme was closed.

Since January 2020, the Smart Export Guarantee (SEG) requires electricity suppliers to pay small-scale

PV owners for the low-carbon electricity they export to the grid. This applies for solar PV systems up to 5 MW. Electricity suppliers decide the rate and duration under which they remunerate the PV owners. This scheme is also available when the PV system is equipped with a battery. The battery can be recharged from the grid, but when that electricity is exported, it is not remunerated.

As a result of this new framework, and due to the rising gap between the electricity retail price and the export rate, the demand for R-BESS has increased significantly. It is estimated that, in 2021, 45% of new residential PV systems installed came together with a battery.

Economics of residential electricity storage in the UK

The main driver for residential storage in the UK is the electricity price. Compared to mainland Europe, the price for household electricity used to be low, but has risen rapidly in recent times. From 0.14 EUR/kWh in early 2010 and 0.19 EUR/kWh in 2015, it reached around 0.22 EUR/kWh in 2021. The economic recovery following the pandemic-induced restrictions has driven the global demand for gas upwards, leading to higher electricity prices and creating improved economic conditions for storage as households looked for ways to increase their energy



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independence. The taxes on electricity for households are relatively low, while the electricity bills provide clear price signals to encourage consumers to optimise their electricity consumption.

The smart meter rollout will also give a boost to the deployment of batteries, but this trend is experiencing some delays. The original plan was to have about 80% of households equipped with smart meters in 2020. Currently, the responsibility to advance smart meter rollout is on the shoulders of energy suppliers, who were required to take steps to assure that all their domestic and small business customers have been equipped with smart meters by the end of 2021. For the remaining customers, gas and electricity suppliers have binding annual rollout targets to reach every year between January 2022 and the end of 2025.

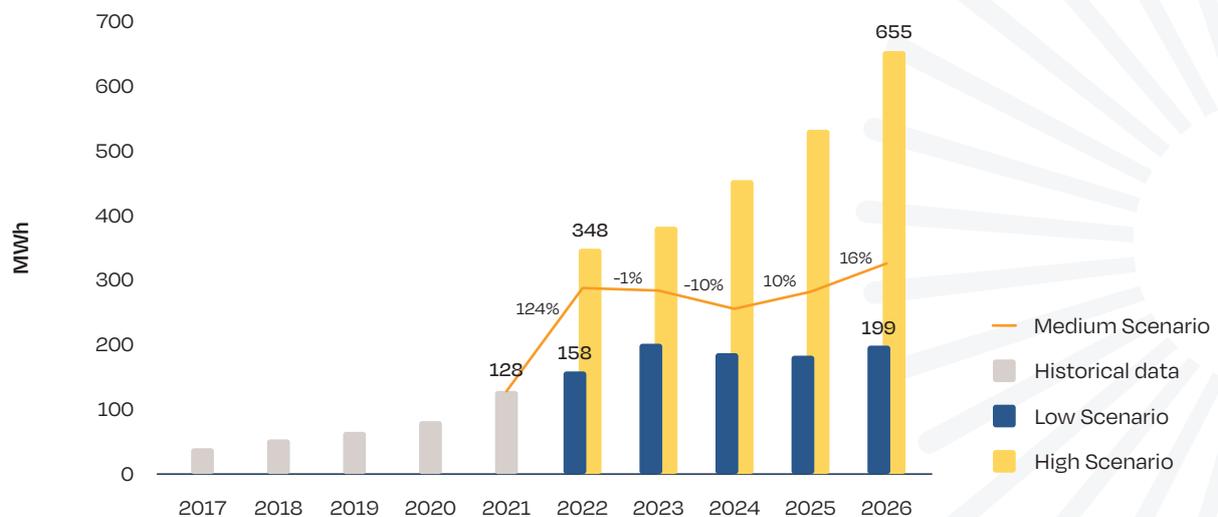
The UK retail electricity market is at an advanced stage of liberalisation, with suppliers being free to design their own tariff structures, both for import and export rates. This already allows storage asset owners to make big savings by smartly managing their energy use. The efforts should now focus on the smart meter rollout, in order to make time-of-use tariffs accessible to all households.

With liberalised export tariffs, the economics of residential solar and storage are difficult to evaluate at the national level and rather depend on the individual retailer. As of 2022, 15 suppliers are licensed to offer Smart Export Guarantee contracts. Most of the tariffs range from 0.035 to 0.064 EUR/kWh. Since these are considerably lower than the retail electricity price, there is a valuable margin to increase self-consumption as much as possible with a residential battery.

Another positive development that took place in 2022 was the introduction, starting from 1 April 2022 until 31 March 2027, of tax relief measures for energy efficiency and renewable energy at the residential level. Under this measures, solar PV and other technologies installed in residential properties are granted a 0% VAT across Great Britain. This is also applicable for batteries, as long as they are installed together with solar PV.

In addition, value could be tapped from energy arbitrage. Home batteries enable prosumers to manage smartly their energy use and production, storing electricity from the grid when it is cheap and exporting it back at a time where the export rate is higher. Some SEG contracts are specifically designed

FIGURE 4.5 UK RESIDENTIAL BESS ANNUAL SCENARIOS 2022-2026



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for consumers equipped with both solar PV and storage, optimising the house load to the benefits of the supplier and the end-consumer. The new SEG regulation provides retailers with the option to offer time-of-use pricing contracts to their customers, which in turn can improve the economics of solar & storage installations.

Prospects

Prospects for the R-BESS market in the UK have considerably improved from last year. The energy price crisis and the war in Ukraine have led to a sharp increase in the demand for residential solar PV. Along with it, the demand for residential storage solutions has grown as well. With no specific government incentive for storage, and the likely transition period still needed for new SEG offers to reach their full maturity, these high electricity prices and the increased residential PV demand are the key drivers for the development of storage.

An additional driver of the market could be represented by a change in residential buildings regulation in England and Wales, where new homes will be required to include a rooftop PV system in order to achieve a better level of energy efficiency. This, in turn, could lead to a higher number of households interested in the purchasing of a BESS that can maximise the benefits of a time-of-use tariff.

In addition, the new nation-wide half-hourly metering plan for the domestic retail market expected to be completed within 4-5 years will ensure a better penetration of new time-of-use tariffs and products that will reward end-consumers for using energy in a more flexible way. This will improve the overall economics of solar & storage, making the combination more attractive for prosumers.

We are expecting to see a stable annual residential PV market of over 300 MW for all years under the scope of our forecast – a significant increase from around 150 MW in 2021. This, and an attachment rate for battery with new PV in the range of 45%, is justifying the strong uptake that the market will experience in 2022. Our Medium Scenario foresees 288 MWh in 2022, up 124% from 2021. Without any significant incentives giving an extra boost to the market, it is expected that annual installations will stabilise around the 300 MWh level and eventually reach 326 MWh in 2026. The market is driven only by market conditions and high energy prices, which might not remain at the current levels after 2023 and could ultimately slow the development pace in 2024 and beyond. Improved policy and market conditions are however reflected in our High Scenario, under which the vast potential of home storage in the country is tapped. According to this scenario, the UK annual market reaches 655 MWh by 2026, which is equal to five times the 2021 market size. The High Scenario also assumes a relief on the supply shortage for batteries that the market is currently experiencing. By contrast, our Low Scenario only foresees a stagnating market for the years to come. As annual installations were already over 100 MWh without any specific support, we are not expecting to see any drops in the market. It would rather remain stable, with a slight push in 2022 and 2023 resulting from the high price of electricity.

Looking at the total operating capacity forecasts, by 2026 the UK will reach a home storage fleet of 1.8 GWh in the Medium Scenario, compared to 1.3 GWh in the Low Scenario and 2.8 GWh in the High Scenario.





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