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31 July 2018

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Europe's electricity markets

In Iberia, decarbonisation policies will drive power market evolution to 2030

» **Iberia positioned to deliver 2020 decarbonisation objectives.** Both Spain and Portugal were well placed in 2016 versus their respective 2020 commitments for cuts to greenhouse gas emissions, and improved energy efficiency. Although renewables penetration remains slightly short of the 2020 target, a combination of additional renewables generation capacity and progress in the heating and cooling and transport sectors should bridge the gap.

» **We expect power prices to trade within a range of €45-€55 per megawatt hour (MWh) over five years to 2022.** In 2018, prices will be higher than in recent years despite increased hydro output because of higher coal, gas and carbon dioxide (CO2) prices. We expect them to decline a little over the period to 2022, reflecting our commodity price assumptions, wide reserve margin and modest electricity demand rises; growth in renewables generation will put pressure on power prices, but this will be offset by coal capacity closures. Our range compares with the current one-year wholesale forward power price of approximately €52/MWh and last year's estimate of €42-€47/MWh over 2018-22.

» **Decarbonisation policies to extend power sector evolution into decade to 2030.** Both Spain and Portugal are developing "Energy Transition" strategies to decarbonise further over the decade to 2030, in line with EU targets. Although the June change of government in Spain has introduced some uncertainty around energy policy, we expect the Iberian power market to continue to evolve gradually over the decade to 2030, characterised by the closure of coal-fired generation, increased renewables penetration and measures to secure gas-fired generation as backup, possibly through capacity markets.

» **Utilities will continue to adapt as power market evolves**. Policy emphasis in Spain and Portugal will be on a continuation of the evolution of the power market, as one important element within national decarbonisation objectives. The bias towards maintaining security of supply and keeping a lid on costs will favour a continuation of the progressive change so far. Iberian utilities - EDP (Baa3 stable), Endesa (Baa2 stable), Iberdrola (Baa1 stable) and Naturgy (Baa2 stable) - will therefore have time to adapt their strategies as the energy mix continues to evolve, and to complement these with opportunities from the drive to energy efficiency.

Iberia positioned to deliver 2020 decarbonisation objectives

Both Spain and Portugal are positioned to meet their respective 2020 decarbonisation objectives (each of which contributes to the European Union's (EU) 2020 decarbonisation strategy), although achieving targeted renewables penetration will be a challenge. The EU's strategy comprises three interconnected policy objectives: cutting greenhouse gas (GHG) emissions by 20% from 1990 levels; meeting 20% of gross final energy consumption from renewable energy sources (RES); and improving energy efficiency by cutting the consumption of primary energy.[1]

Spain and Portugal are ahead of schedule on GHGs ...

The EU's aggregate GHG emissions targets were rebased in 2005 following the introduction of the Emissions Trading System (ETS), which was intended to introduce price signalling into the decarbonisation framework. At that time, the overall targets were separated into different aggregate targets for:

1. ETS emissions – that is, those produced by the industrial, power generation and air transport sectors, and controlled by the EU ETS;
2. non-ETS – defined as Effort Sharing Decision (ESD) – emissions, which were calibrated to achieve the overall EU target of a 20% reduction in GHG emissions compared with 1990 levels.[2]

To achieve the EU's objective of a 20% reduction in total GHG emissions by 2020 compared with 1990, the ESD set national targets for each member state on GHG emissions not covered by the ETS. By comparison, there are no targets set at an individual national level for ETS reductions.[3]

Both Spain and Portugal are on track to meet their legally binding, individual 2020 ESD targets, helped in large part by the economic contraction following the financial crisis, but also by investment in renewables. Spain and Portugal's approximated output in 2016 of 197.8 million tonnes of carbon dioxide equivalent (MtCO2e) and 40.4 MtCO2e, respectively, were comfortably below each country's ESD targets; as were the EEA's projections with existing measures (WEM).

Exhibit 1

Spain and Portugal are well positioned versus 2020 ESD targets

		2020 ESD Targets			Projections by 2020 WEM	
	2005 Base year Emissions MtCO2e	Target vs 2005 (%)	Target vs 2005 MtCO2e	2015 ESD emissions MtCO2e	ESD emissions MtCO2e	Gap vs target MtCO2e
Spain	236.0	-10%	212.4	196.3	189.1	23.3
Portugal	48.6	1%	49.1	42.8	40.5	8.6

Source: EEA "Tracking progress towards Europe's climate and energy targets", 2017

... and energy efficiency ...

We believe both countries are also well positioned to achieve their energy efficiency targets. Member states set targets for both primary (PEC) and secondary energy consumption (SEC), as required by the Energy Efficiency Directive. The targets, which are indicative and nonbinding, are set in terms of declining million tonnes of oil equivalent (Mtoe). Monitoring progress is accordingly based simply on an indicative linear trajectory between 2005 energy consumption levels and 2020 targets.

Both Spain and Portugal have reduced energy consumption since 2006, mainly because of economic recessions following the financial crisis, but also because energy efficiency measures are slowly gaining traction. Spain's proxy PEC dropped 12% to 118.9 Mtoe in 2016; Portugal's dropped by 17%. Consumption in both countries appears on course to remain below their respective non-binding targets, although the resumption of economic growth is likely to begin to narrow the existing gap to the allowed levels.

Exhibit 2

Spain and Portugal are well positioned versus 2020 energy efficiency targets

	2005 Mtoe	2015 Mtoe	Proxy 2016 Mtoe	Target 2020 Mtoe
Spain	135.9	117.1	118.9	122.6
Portugal	24.9	21.7	20.7	22.5

Source: EEA "Tracking progress towards Europe's climate and energy targets", 2017

... but progress towards renewable energy targets has been slower

Both Spain's and Portugal's approximated renewables' share of final energy consumption in 2016 was ahead of the Renewable Energy directive's (RED) indicative trajectories to their respective targets of 20% and 31%. However, they had less headroom versus their indicative trajectories per their National Renewable Energy Action Plans (NREAP), which suggests there is some risk to their achievement. Portugal was 1% below its indicative NREAP trajectory. and 3.1% short of its 2020 target of 31%. Spain, by contrast, was a little ahead of its NREAP trajectory, but 2.6% short of its target.

Exhibit 3

Spain and Portugal are a little short of 2020 RES targets

	RES share 2015 (%)	RES share 2016a (%)	RED 2020 target (%)	2016a gap to target (%)
Spain	16.2	17.4	20.0	-2.6
Portugal	28.0	27.9	31.0	-3.1

Source: EEA "Tracking progress towards Europe's climate and energy targets", 2017

In both countries, renewables' share of electricity production (52.1% in Portugal and 36.9% in Spain in 2016) has contributed most to achieving their respective targets because the power sector is one of the most carbon intensive, and best placed to integrate renewables on the necessary scale. However, the hiatus on renewables investment during the middle of the decade, when both countries ended subsidies to cut system deficits, has increased the risk that renewables penetration could fall short of targets. Nevertheless, looking beyond 2017 when weak hydro conditions caused the share of conventional thermal generation to increase, the following developments should help both countries converge on their targets:

» Renewables investment within the power sector has resumed. In Spain, for example, 8.7 GW of additional renewables capacity on the mainland is scheduled to be built by 2020 following auctions in 2016 and 2017 – and if completed will bridge 2% of the gap. [4] This will be complemented by new capacity in the Canary Islands. In Portugal, investment has resumed across renewables technologies: there are pending licensing processes for solar capacity projects, part of which are expected to come online by 2020, some repowering and new additions in wind, and new biomass capacity are also expected.

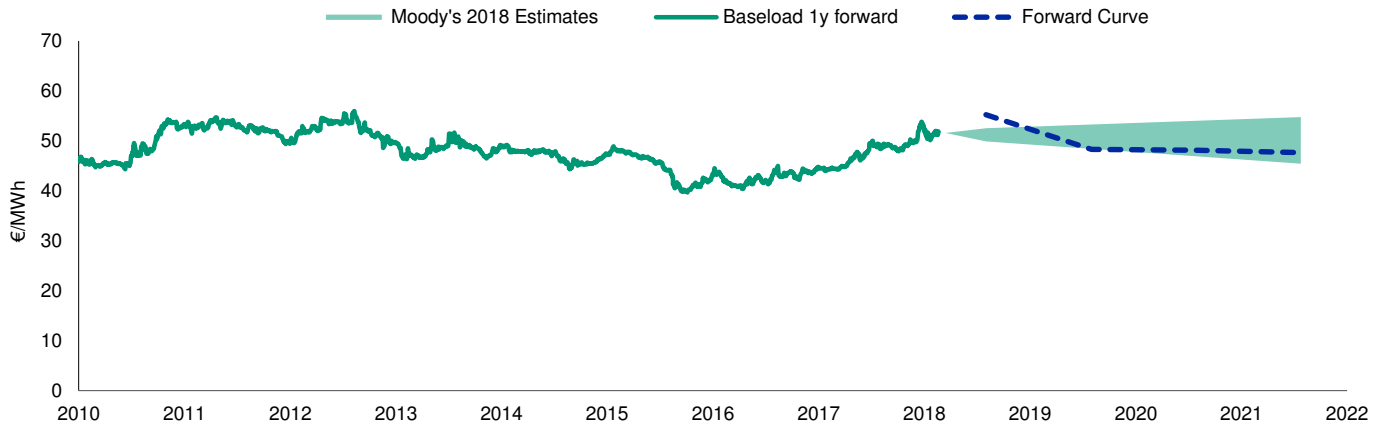
» Rising renewables penetration in the heating/cooling and transport sectors will also contribute to making up the shortfalls by 2020. In Spain, the quota for the use of biofuels in transportation is to rise to 8.5% from 5% in 2017. [5] In Portugal, transportation has lagged behind, but is expected to converge towards its 10% target by 2020.

Power prices will decline gradually within a narrow range through 2022

Following a 7% rise in Iberian wholesale power prices (one-year forward baseload) in the year to date, we expect them to decline slightly within a range of €45-€55/MWh over the period to 2022 (see Exhibit 4). This reflects our commodity price assumptions, including lower gas but broadly stable coal and CO2 prices, a wide reserve margin and modest electricity demand growth.

Exhibit 4

Wholesale power prices (one-year forward base load) in Iberia to trade in narrow range



Sources: Moody's Investors Service estimates, OMIP

Growth in renewable generation will put downward pressure on power prices, but this will be partly offset from 2020 when gas will set the price more often following coal-fired plant closures.

Our latest price estimate compares with (1) current one-year wholesale forward power prices of around €52/MWh; and (2) our estimate last year of €42-€47/MWh over 2018-22. The slightly higher anticipated range this year primarily reflects higher commodity price estimates.

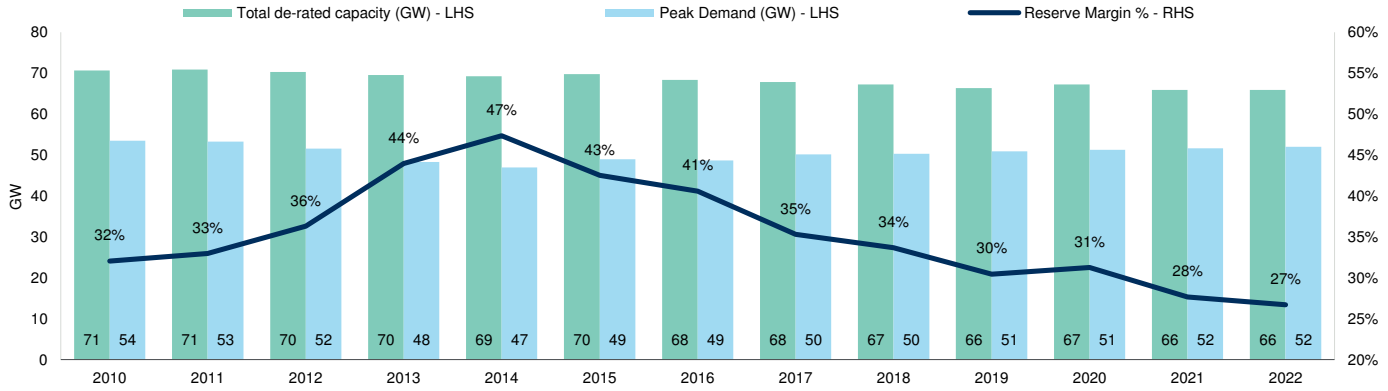
Generation capacity to increase modestly on resumption of renewables investment in Spain

In Spain, a wide reserve margin, low power prices/spreads and environmental policy measures all deter investment in thermal generation capacity. However, the resumption of growth in renewables capacity following auctions in 2017 will drive a gradual rise in aggregate installed capacity over 2018-19. This will offset the gradual closure of some uneconomic thermal plants, primarily domestic coal-fired units, over the rest of the decade. In Portugal, there will be some increases in wind, solar and biomass capacity to support the country's decarbonisation objectives. Overall, the size of the generation fleet will rise modestly, by 4%, in Iberia over 2017-22. Renewables' share (including hydro) will rise to 59% of the peninsula's 123 GW generation capacity in 2022 from 53% in 2016.

For Iberia in aggregate, the reserve margin narrowed to 35% in 2017, as peak demand rose to more than 50 GW (the sum of Spain and Portugal's peaks for the year) for the first time since 2012. The reserve margin has come down gradually from its peak in 2014, in line with slowly rising peak demand and little new capacity. We estimate the Iberian reserve margin will narrow further to less than 30% by 2021 as peak demand rises and outpaces modest capacity growth (see Exhibit 5), most of which will be renewables, and therefore "de-rated" more sharply. The reserve margin will remain narrower in Portugal than in Spain, where it will continue to be sustained by the large investment in renewables and combined cycle gas turbines (CCGTs) over 2003-13.

Exhibit 5

Iberian market reserve margin to decline on rising demand and coal closures



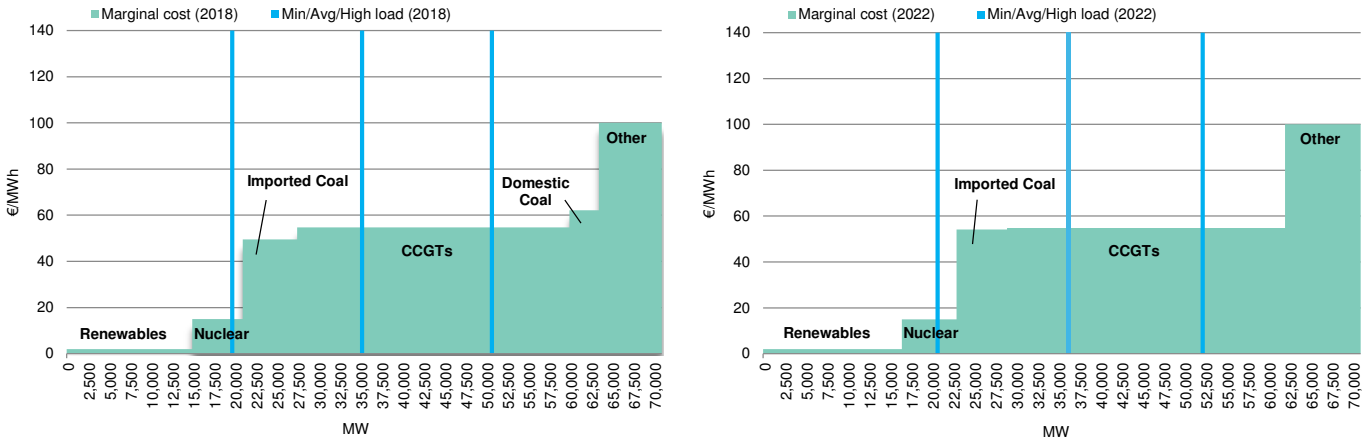
Sources: Red Electrica, Redes Energeticas Nacionais, Moody's Investors Service estimates

Renewables growth and coal shutdowns will alter the merit order over 2018-22

We expect that coal and gas-fired generation will continue to determine the wholesale power price, with the level of demand determining which is the price setter. However, we estimate that gas-fired capacity will determine the price more often as the marginal plant setter over the period because the sharp rise in the CO2 price (which has almost doubled in the year to date to €15/tonne) has increased the relative cost of more carbon-intensive coal-fired generation. As a result, more expensive and less efficient domestic coal-fired generation will run less. The illustrative merit order for 2018 in Exhibit 6 highlights that on the basis of our commodity price assumptions for 2018 (which includes a coal price from 2018 of $75/tonne and CO2 averaging €15/tonne), the 4.5 GW of domestic coal-fired generation has been pushed to the right of the marginal cost "stack".

Exhibit 6

Illustrative merit order: Gas will set price more often as domestic coal capacity closes



Source: Moody's Investors Service estimates

By 2022 we expect the 4.5 GW of more expensive domestic coal-fired plants to have closed. The 5 GW of more efficient international coal plants will continue to operate on the basis of current commodity price assumptions, although they will alternate with gas. By 2022 additional renewables capacity will lead to an increase in low marginal cost output. This will partly replace coal output no longer produced and displace more expensive gas-fired generation to the right in the Iberian merit order, with a constraining effect on power price increases.

Decarbonisation policies to extend power sector evolution into decade to 2030

Poised to deliver on their 2020 commitments, both Spain and Portugal are currently developing strategies to decarbonise further over the following decade, in line with the EU's "Winter Package" targets.[6] These strategies will combine policies to promote the electrification of demand, increase the share of renewables in energy consumption and intensify energy efficiency efforts. As with the policies to 2020, they will affect the transportation, industrial and power sectors in different ways.

In Portugal the government is scheduled to submit to the European Commission its Integrated National Energy and Climate Plan for the period 2021-30 by the end of 2018. This is likely to incorporate many of the goals and policies of the Green Growth Commitment adopted in 2015, which laid the ground for decarbonisation to 2030 and which included, for example, a commitment to reach a 40% share of RES by 2030. The government is also developing a Roadmap for Carbon Neutrality by 2050 that will be released in the spring of 2019.

Spain's Expert Panel

Spain is in the process of drafting its Energy Transition Law, which will form the basis for the National Energy and Climate Plan required by the European Commission.[7] As an input to the process, in April, a 14 member Expert Panel[8] reported its recommendations. The panel's primary purpose was to assess the best path to the EU's 2030 CO2 emissions, renewables and efficiency targets, and recommend accordingly. The panel's principal findings with respect to the electricity sector included:[9]

- Nuclear power plants: these should remain open at least until 2030, under a stable and economically viable regulatory framework. Closure of the nuclear fleet would increase annual CO2 emissions and generation costs by an estimated €2 billion-€3.2 billion
- Renewables: the panel's central scenario envisages an increase of ca 57 GW installed renewables capacity by 2030 to replace expected coal closures
- Coal generation: should be closed, reflecting that its high emission intensity is not compatible with the EU's decarbonisation policies
- Promote security of supply through the creation of a capacity market, allowing operators with efficient and flexible capacity to participate, and to mothball unsuccessful plants
- Promote the electrification of the economy, including the transport sector (by increasing taxes on vehicle pollution and developing a plan for electric vehicle charging points), and encouraging the use of heat pumps
- Rationalise access tariffs by, inter alia, transferring legacy costs, like the tariff deficit, to the national budget
- Promote the development of smart grids through different levers (distributed generation, energy storage, electric vehicles) to provide flexibility to the system

What do the panel's recommendations imply for the Iberian power market?

The panel's recommendations contain few surprises in that they address the three key levers for decarbonisation: altering the structure of demand through electrification; changing the source of supply by increasing renewables output; and improving energy efficiency. In doing so, the panel balances the decarbonisation imperative against considerations of cost and security of supply. The large Spanish utilities' reaction has been broadly supportive, if for varying reasons.

In both countries, we expect policies to require a greater contribution from the heating and cooling and transport sectors, and to impact the power sector both directly and indirectly by (1) affecting the drivers of aggregate demand for electricity – the promotion of electrification will be partially offset by energy efficiency initiatives; and (2) changing the structure of each country's generation

capacity so that power production produces less GHGs – for example, by closing coal-fired generation and increasing renewables' share of the production mix.

New government in Spain introduces some uncertainty …

In Spain, the replacement in June of Mariano Rajoy's centre-right government by Pedro Sanchez's centre-left coalition has introduced some uncertainty around energy policy. The government is scheduled to submit its Integrated National Energy and Climate Plan (Plan Nacional Integrado de Energia y Clima, PIEC) to the EU by the end of 2018. Teresa Ribera, the newly appointed Minister for Ecological Transition, could alter the balance of Spain's Energy Transition strategy to reflect policy preferences of the socialist party (PSOE). These differ in certain respects from those of the former government – for example, in opposing the lifetime extension of nuclear plants beyond 40 years, and advocating more rapid coal closures and faster renewables growth.[10]

If Spain was to incorporate such changes to Spain's generation technology mix, its effect would be at variance with the recommendations in April of the Expert Panel (see blue box) and would significantly alter the merit order in Iberia in the decade to 2030.[11] However, in practice, we think it unlikely that the relatively weak new coalition government will be able to marshal coalition consensus or the support needed in parliament, especially since the main effect of such changes would be to increase power prices and make environmental targets tougher to achieve.

… but we expect National Energy and Climate Plan to promote continuing gradual change of the power sector

Instead, we believe the PIEC is more likely to reflect the substance of the Expert Panel's recommendations, although with a shift in certain aspects to reflect PSOE preferences. We therefore expect the technology mix and merit order to continue to evolve gradually over the decade to 2030, rather than change sharply, and to be characterised by:

» Continued operation of the nuclear power fleet, subject to agreement between utilities and government over the terms of the lifetime extension after 40 years of operation. As the Expert Panel points out, the cost of closure is prohibitively high both in terms of additional GHG emissions and higher power prices, because closure would: (1) be contrary to decarbonisation objectives because conventional thermal generation would replace "cleaner" nuclear power;[12] and (2) add to the costs of energy transition through the investment required to build the required conventional plant and the rise in power prices from increased thermal output.[13] Instead, we think an agreement between owners and government that shares the benefits of lifetime extension beyond the initial 40 years of operation is more likely.

» Increased renewables penetration. Partly to replace nuclear and coal closures, the PSOE is in favour of a more ambitious 34% renewables penetration rate by 2030, compared with the 30% that had been mooted. To incentivise this investment, the current 7.4% fair rate of return could be maintained.[14]

» The closure of more efficient coal plants during the 2020s, following the shutdown of domestic coal by 2020. The PSOE may introduce a date for closure, which would be consistent with policy in other markets like France, Italy and the UK, which have set 2025 as the end date for coal-fired production.

» The introduction of a capacity market to reward all technologies for their contribution to flexibility and security of supply, including conventional generation capacity as the thermal gap (that is, the proportion of demand satisfied by conventional thermal generation) progressively narrows.

Utilities will continue to adapt as power market evolves to 2030

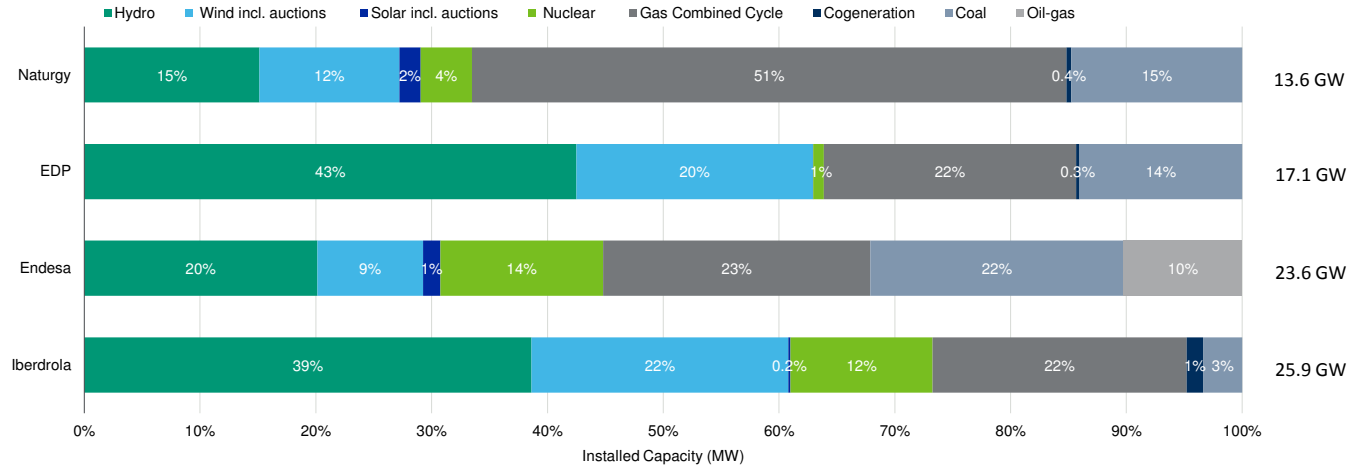
We believe policy emphasis in Spain and Portugal will be on a continuation of the evolution of the power market, as one important element within national decarbonisation objectives. The bias is likely to be towards maintaining security of supply and keeping a lid on costs, which will favour a continuation of the progressive change so far. As a result, Iberian utilities will have time to adapt their strategies as the energy mix continues to evolve and to complement these with opportunities from the drive to energy efficiency.

In terms of generation mix, Iberian utilities have responded in different ways in the past decade to policy changes affecting the power market and rising renewables penetration. Some are better positioned with respect to likely forthcoming changes than others. Exhibit 7 shows how of the four large utilities, Endesa (Baa2 stable) and Naturgy (formerly Gas Natural, Baa2 stable) have more carbon intensive generation fleets than Iberdrola (Baa1 stable) and EDP (Baa3 stable), which have a higher proportion of hydro and onshore wind.

Exhibit 7

Endesa and Naturgy's fleets are more carbon intensive, Iberdrola and EDP's fleets include largest shares of renewables

Main 4 utilities' installed capacity in Iberia by technology at the end of 2017



Note: Wind and Solar capacity includes the awards from 2017 auctions

Source: Company data

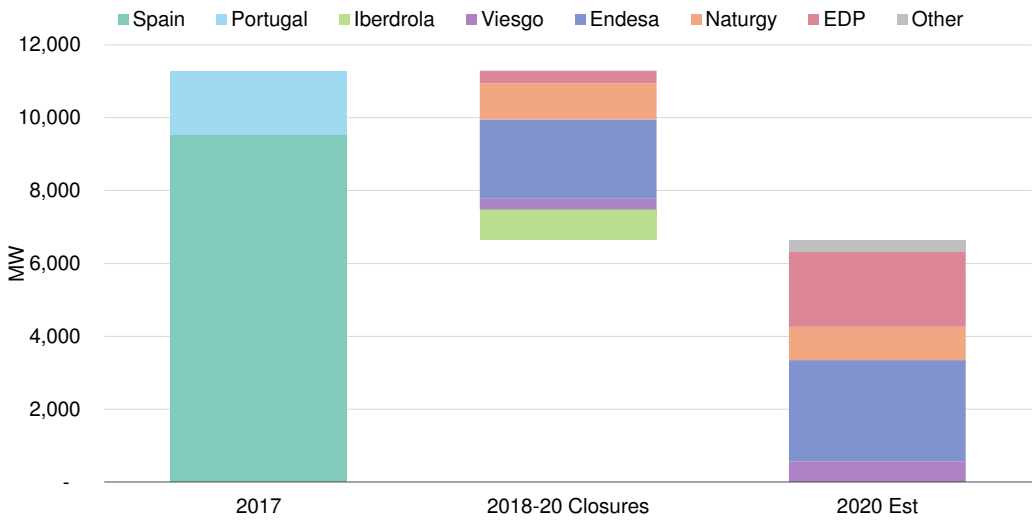
However, we expect both groups to manage this because coal closures in Spain will take place gradually and because they are investing in renewables capacity to increase the carbon-free output of their fleets. Endesa and Naturgy were awarded aggregate wind and solar photo-voltaic capacity of 879 MW and 926 MW, respectively, under two auctions in 2017. This will boost the relatively low percentage of renewables in their generation mix: Endesa will increase its existing 1.8 GW renewables fleet by about 50%, or 4% of total installed capacity; Naturgy will increase its renewables capacity by 80%, to 2.1 GW.[15]

Endesa will be most affected in terms of its capacity mix by the expected near-term coal closures between 2018 and 2020, because a large proportion of its 5.2 GW coal fleet is uneconomic domestic coal-fired capacity (see Exhibit 8) and is set to close. However, we estimate this will have minimal impact on earnings because domestic coal-fired generation has been uneconomic since subsidies ended in 2014 (see Appendix 3).

Exhibit 8

Endesa to carry out the largest share of coal closures following end of subsidies

Iberian utilities' installed coal capacity at end of 2017 and expected closures over 2018-20



Sources: Company data, REE, Moody's Investors Service estimates

In addition to adapting their generation fleets in response to policy and fiscal changes, we expect Iberian utilities to invest in the growing energy-efficiency sector.

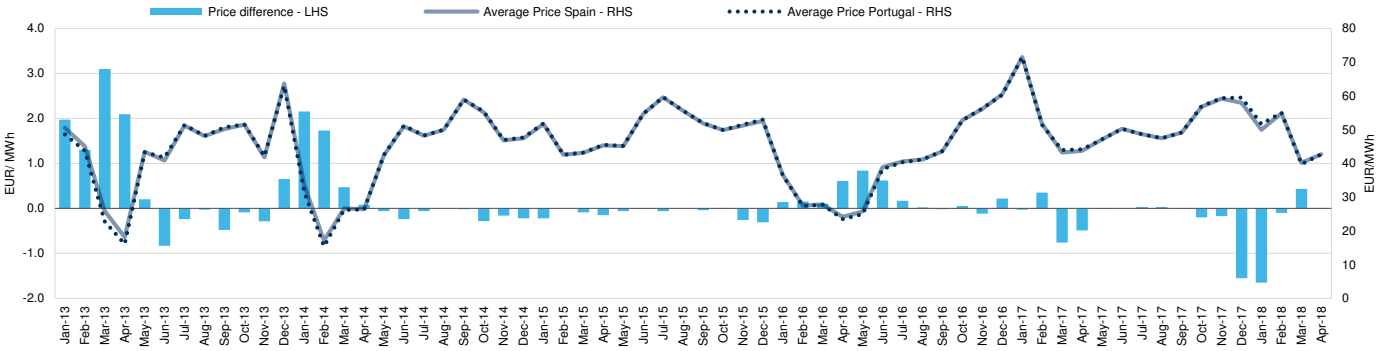
Appendix

Appendix 1: Methodological approach overview

Our approach to analysing the power market in Iberia recognises that power generators operate within Spain and Portugal as if it were a single market. Buying and selling agents trade on the Iberian spot market regardless of whether they are in Spain or in Portugal. Their purchase and sale bids are accepted according to their economic merit order, until the 3.1 GW interconnection capacity from Portugal to Spain or 2.9 GW from Spain to Portugal are fully occupied. In 2017, the interconnection was fully occupied 4.5% of the time when Spain was exporting and 2.2% of the time when Spain was importing, when the prices will have been set separately in Spain and Portugal – a mechanism referred to as market splitting. Exhibit 9 shows how where prices differ, they tend to be slightly higher in Portugal, reflecting that the interconnection is more often fully occupied when Portugal is importing. In the remaining time, the Iberian market worked as an integrated one and the price of electricity was the same in Spain and Portugal. [16]

Exhibit 9

Historic pool prices: Spain and Portugal price differentials



Note: Values over zero show prices in Spain above those in Portugal, and vice versa.
Source: OMIE

Our estimates are therefore based upon the aggregation of data for each country, including for example the evolution of aggregate de-rated capacity in Spain and Portugal, and the evolution of aggregate demand in Spain and Portugal. For simplicity, we have set aside the instances in which the interconnection between Spain and Portugal is fully occupied and therefore prices in the two countries differ.

Appendix 2: Electricity demand growth will shadow GDP growth, but demand elasticity is reducing

We estimate that electricity demand in the Iberian peninsula will grow at a compound annual growth rate (CAGR) of 0.9% over 2018-22, a little higher than our estimate of 0.8% for 2017-22, reflecting slightly higher GDP growth estimates in Spain and Portugal. This is based on our expectations for economic growth in each country, moderated by a demand elasticity coefficient of 0.5. An outlook for faster electricity demand growth in Spain than in more mature European markets reflects the ongoing rebound from the deeper recession Spain experienced earlier in the decade.

Spain

» Spanish mainland electricity consumption picked up slightly in 2017, rising by 1.1% to 253 TWh (or 1.6% adjusted for temperature and working days), compared with 0.7% growth in 2016. Growth was explained by large consumers' demand (predominantly the industrial and services sectors), which represented around 48% of the total and increased by 1.9% compared with 2016. The pace of growth has continued in 2018, with electricity consumption up 1.2% during the first half of the year.

» We estimate that electricity demand in Spain will grow at a CAGR of 0.9% over 2018-22. This includes (1) a slight rise during 2018-19 following the macroeconomic momentum and GDP forecasts; and (2) some gradual growth thereafter, albeit at a slower pace given the cumulative drag of energy efficiency measures. We believe these will gain more traction towards the end of the period.

» Our projections are similar to MINETAD's (Ministry for Energy, Tourism and the Digital Agenda) assumption of a CAGR of 0.8% for Spanish electricity demand from 2018 to 2022, the Spanish regulator CNMC's of 0.9%, and to the Expert Panel's range of 0.9%-1.2%. They are in line with Iberdrola's 0.9% CAGR from 2017 to 2022, and a little lower than Endesa's assumed CAGR of 1.3% over 2017-2020.

Portugal

» Demand in Portugal in 2017 reached its highest since 2011, with consumption up 0.7% to 49.6 TWh (or 1.5% adjusted). Headline growth of 3.7% in the first half of 2018 primarily reflected low temperatures earlier in the year.

» We expect electricity demand to grow at a CAGR of 0.8% during 2018-22, slower than EDP's 1% CAGR assumption for Iberia over 2016-20.

Our estimates for Spain and Portugal reflect the following assumptions:

» Electricity demand growth will continue to shadow GDP growth through 2022. However, growth will be discounted by improving energy efficiency partially offset by energy demand from rising electrification of transport and heating.

» We have applied 0.5 demand elasticity to our GDP forecasts, the average across the EU, and reflecting that Spain has relatively less scope for making efficiency gains than northern Europe. In common with other countries, demand elasticity has been falling, reflecting declining energy intensity and improving efficiency. We apply the same haircut in Portugal, because we assume consumption patterns are similar across the peninsula.

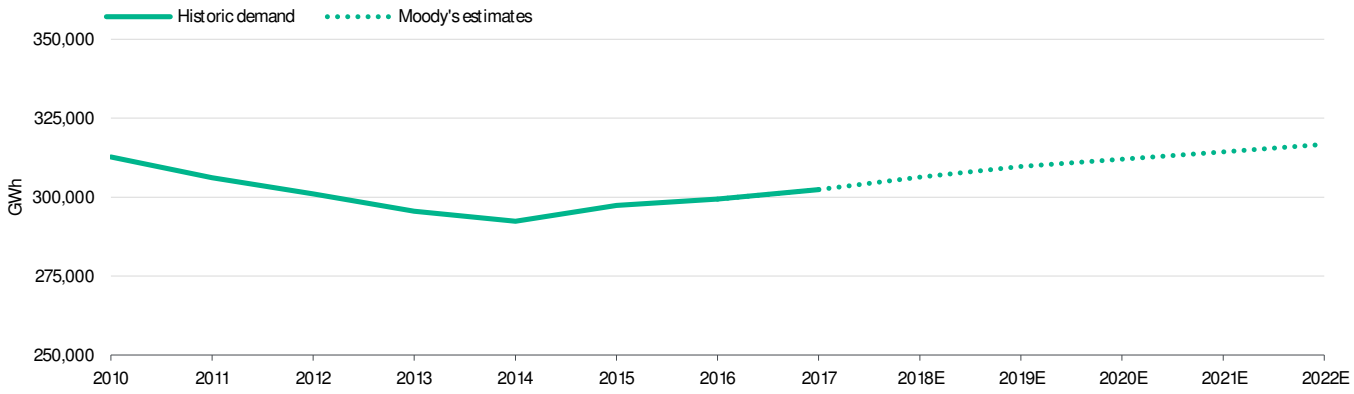
» Moody's Macro Board forecasts of real GDP growth for Spain and Portugal in 2017-2022 of 1.9% CAGR and 1.7% CAGR respectively.

» Looking further into the decade to 2030, growth rates may begin to rise to the extent that there is progress on electrification of the economy in response to increasing decarbonisation objectives.

Exhibit 10 charts our estimates for electricity demand growth in the Iberian peninsula, which reflects the aggregation of our estimates for Spain and Portugal. In practice this is driven primarily by our view on Spain, which accounts for 84% of Iberian demand.

Exhibit 10

Electricity demand in Iberia: We estimate a gradual continued recovery over 2018-22



Sources: REN, Red Electrica, Moody's Investors Service estimates

Appendix 3: Generation capacity: Gradual, modest decline in installed capacity in the Iberian power market over 2017-22

In common with other markets, Spain and Portugal are considering their response to the EU's Clean Energy Package, presented by the European Commission in November 2016. To that end, the governments of both countries are developing plans and legislation designed to meet the EU's climate change and energy transition goals, and which are scheduled to be presented to the EU in 2019.

We expect the focus of both plans to be on the 2020-30 period, with little impact on either country's capacity mix in the short term. Pending the plans we expect aggregate capacity to evolve only slowly between 2018 and 2022, increasing by a net 4.2 GW over the period. The increased capacity reflects additional renewable capacity in Spain and hydro in Portugal, partially offset by the gradual closure of uneconomic coal plants in Spain.

» In Spain, installed generation capacity dropped by almost 600 MW to 98,877 MW in 2017, corresponding mostly to the definitive closure of Garoña's nuclear plant, which had been inactive since 2012, and reflecting little, if any, investment in new capacity. There was almost no change in the capacity of the system's other primary technologies – including CCGT, wind and solar – so the Spanish system's technology mix remained broadly unchanged. Given Spain's wide reserve margin we expect some moderate investment in new capacity over 2018-22. Most will be in renewables, following the reactivation of the auction process in 2017, with current prices providing little if any incentive for new thermal investment. Conversely, we expect uneconomic thermal plants gradually to close. Unlike the Popular Party's reluctance to approve coal closure requests, the recently appointed PSOE coalition government is not supportive of domestic coal-fired plants, which have an aggregate capacity of 4.5 GW. In contrast, most international coal-fired capacity has undergone necessary Selective Catalytic Reduction (SCR) investment, and given our commodity price assumptions we expect those to remain operational to 2022.

» In Portugal, where the reserve margin is narrower, installed capacity increased by just under 260 MW to 19.8 GW during 2017, most of which was newly commissioned hydro, with some wind and solar. We estimate that capacity will be broadly flat at 20 GW through to 2022.

Our estimates for each generation technology over 2018-22 (see exhibits 11-13) reflect the following:

Hydro. There will be an increasing need for the flexibility of pumped storage as the share of renewables output in the system continues to rise. However, following EDP's commissioning in late 2016/early 2017 of the Foz Tua and Venda Nova III hydro plants, there are no plans for additions of large hydro capacity before 2020. Looking into the next decade, Iberdrola has begun investment in the planned 1,158 MW Tamega pumped storage facility in Portugal, but this will not be commissioned until 2023 according to the company's estimates.

Renewables. We incorporate 8.7 GW of additions to Spain's renewables capacity over the period. These include (1) the 500 MW of wind and 200 MW of biomass capacity awarded at auction in January 2016; and (2) the 4.1 GW of wind and 3.9 GW of solar capacity awarded at auction in May and July 2017. We assume this capacity will contribute to the system from 2020, after a two-year construction period. In Portugal, following little if any new capacity for several years when the focus has been on containing system costs, we expect there to be some growth over the period from a combination of technologies: licensing processes for solar capacity projects are ongoing, part of which are expected to come online by 2020; and some repowering and new additions of onshore wind are also expected.

Nuclear. The Spanish nuclear fleet, whose seven reactors were commissioned between 1981 and 1988, is subject to periodic licence renewal. After the definitive closure of the 455 MW Garoña plant in November 2017, the licences of the remaining operating plants expire between 2023 and 2028. It is unclear whether the licenses will be extended, although the PSOE-led minority government's preference is to substitute them for renewables at the end of that period. For modelling purposes we have left the current 7.1 GW capacity unchanged until 2022.

Looking beyond the time frame of this report, we think closure of the nuclear fleet is unlikely given the investment needed to sustain a safe reserve margin, the politically costly impact of an around 20% increase in power prices and the twofold increase in CO2 emissions that closure would imply. The Expert Panel estimated that a complete nuclear closure by 2030 would (1) require the addition of around 12 GW of de-rated capacity to keep the reserve margin above 10%; and (2) cause power prices to rise by €10-€11/MWh because of the increased contribution of more expensive thermal plants, which would also add some extra 15 Mt of CO2 per annum.

Coal. In Spain the termination of domestic coal subsidies from the end of 2014 changed the economics of domestic coal-fired plants. Under current conditions these plants, which represented 4.5 GW of 9.5 GW of coal capacity at the end of 2017, generate little cash flow and are likely to close by end June 2020. Without subsidy, there is no incentive for these plants to invest in Selective Catalytic Reduction (SCR) to comply with the Industrial Emissions Directive (IED).

So, although many plants will obtain derogation from IED requirements and be available to run for 17,500 hours over 2016-23, we estimate the remaining domestic coal-fired capacity will close at the rate of 1 GW per annum by 2021: for example, Anllares plant (347 MW), jointly owned by Naturgy and Endesa, has announced its closure for 2019; Endesa's Compostilla and Teruel plants are planned to be closed by 2020; while Iberdrola's Lada and Velilla plants (874 MW combined) have requested authorisation to close.

By contrast, SCR has been or is to be fitted to 4.7 GW of predominantly international coal fired plant, according to Spanish transmission grid operator, Red Electrica, to ensure compliance with the IED's DeSOx/DeNOx regulations, and will therefore continue to operate beyond 2021. Some have already announced plans: EDP, for example, is to ensure that approximately 85% of its Iberian coal fleet will be compliant, while Endesa has completed the necessary investments to keep its Almería plants running into the next decade, and is to do the same for Puentes.

In Portugal, where coal represents less than 10% of system capacity, we expect limited coal unit closures subject to the price of CO2. Thermal production in Portugal is not subject to Spain's energy and fuel tax, but a government clawback effectively equalises costs between the two.

CCGT. Given wide reserve margins and 36.5 GW of installed plant in Iberia at the end of 2017, we see no prospect of an increase in CCGT capacity over the period in either Spain or Portugal. In Spain, we have maintained the current installed capacity, reflecting our view that closures will be limited over the period because:

» most CCGT plant continues to be eligible for capacity payments and retains some option value

» the authorities remain reluctant to authorise closures given CCGT's value as backup capacity

» recovering load factors (thanks to rising demand, coal closures and very weak hydro conditions in 2017) have eased the pressure on operators to close or mothball plant. For example, Iberdrola's 800 MW CCGT at Castellon, which had received authorisation to close in 2015, has continued in operation as power demand recovered.

In Portugal, we expect limited CCGT shutdowns because the absence of generation taxes gives them a cost advantage over Spain, and because capacity payments are underpinned by the country's narrower reserve margin. Most plant operates as backup; beyond 2,000 hours, CCGTs begin to pay the off-peak/peak clawback.

Interconnection. Red Electrica's near-term focus is to improve inter-island interconnections, a priority to improve the reliability of supply. The connection of the two Balearic systems of Mallorca-Menorca and Ibiza-Formentera was completed in 2016, while other similar projects are underway in the Canary Islands under the recently presented €434 million Wind Energy Plan. The plan includes several links between Tenerife-La Gomera, Fuerteventura-Lanzarote and Gran Canaria-Fuerteventura, as well as 400 MW of new wind capacity and the €320 million Soria-Chira pumped-storage station.

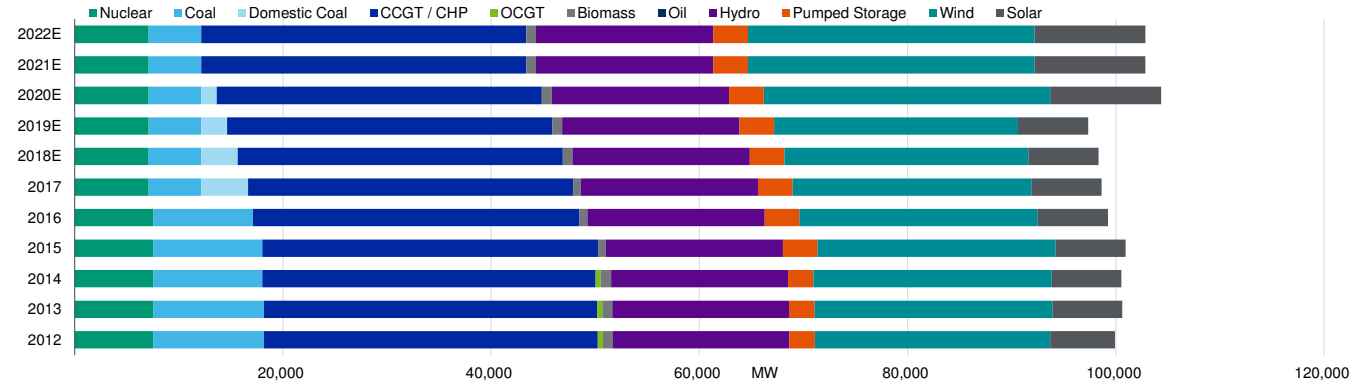
In addition, the expansion of international connections remains a long-term goal for Spain, which is behind EU recommendations with only 2.8 GW linking capacity with France and 3 GW with Portugal. Red Electrica expects to fall short of the 10 GW interconnection target established by the EU for 2020.

Nonetheless, several long-dated projects are underway to take it well above 10 GW by 2030, reaching a total interconnection capacity of 15% with respect to national installed capacity. The main additions will come from the completion of a submarine connection crossing the Bay of Biscay, which will increase the interconnection capacity with France to 5,000 MW from the current 2,800 MW. The regulators of both Spain and France agreed on the cost split of the project in 2017, which is in its technical specifications planning stage and aims to be operational in 2025.[17]

Capacity evolution, 2012-22E (GW)

Exhibit 11

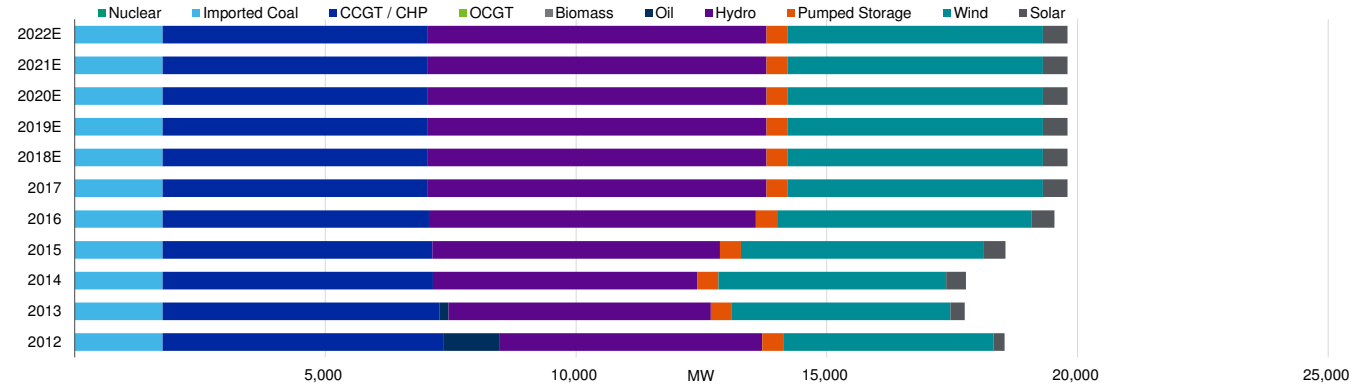
Spain



Sources: Red Electrica, Moody's Investors Service estimates

Exhibit 12

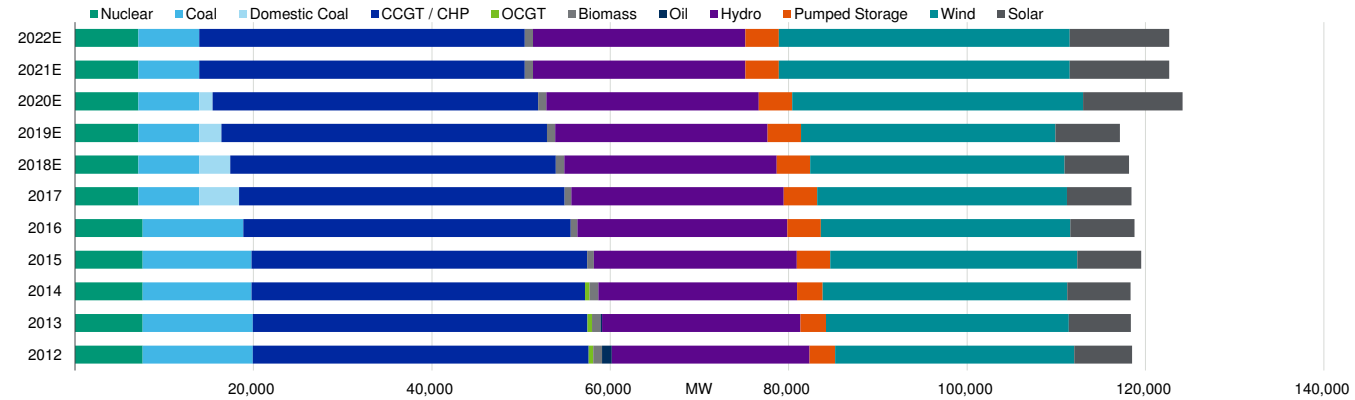
Portugal



Sources: REN, Moody's Investors Service estimates

Exhibit 13

Iberia



Sources: Red Electrica, REN, Moody's Investors Service estimates

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Endnotes

1 The three targets are contained within the 2013-2020 Energy and Climate Change Package, adopted in 2007 by the European Council. Each member state's targets are tailored to reflect the characteristics of its economy and power market.

2 The targets with a 1990 base year are in reference to total GHG emissions, whereas the targets relative to 2005 are split between ETS emissions and non-ETS emissions. The EEA explains that the ESD targets (base year 2005) were calibrated to achieve the overall EU target of a 20% reduction in GHG emissions compared with 1990 levels.

3 National ESD targets cover sectors such as transport, buildings, agriculture and waste management, which account for almost 60% of total EU GHG emissions. Mitigation actions take place at national level through a mix of EU-driven policies and measures, and national initiatives. ESD targets range from 20% reductions (Denmark, Ireland and Luxembourg) to 20% allowed increases (Bulgaria), compared with 2005 base year levels. Taken together, the aggregated ESD targets for 2020 represent a 9.3% reduction at EU level compared with 2005 base year levels. The ESD also sets annual targets for the period 2013-20 to monitor progress across the EU, to allow for corrective action and ensure the attainment of the EU's GHG emission target by 2020.

4 See "Unregulated Electric & Gas Utilities - Spain: Spain's renewables auctions boost utilities' carbon free generation", 14 September 2017.

5 Wholesalers and retailers of fuels, as well as consumers of fuels not supplied by wholesale or retail operators, are obliged to sell/consume a minimum quota of biofuels.

6 The 2030 Framework was adopted in 2014 as an extension of the 2013-20 Climate Change package, and validated at the COP 21 conference in Paris. Also known as the EU's "Winter Package", this includes a binding target to cut GHG emissions by 40% versus 1990 levels, increasing renewable energy by at least 27% and improving energy efficiency by 27%

7 See endnote 4

8 La Comisión de Expertos de Transición Energética.

9 The panel also made certain more general recommendations including: (1) the use of fiscal reform to achieve environmental objectives, distributing the damage of CO2 and rest of emissions on every energy product. Furthermore, gasoline and diesel prices should finance their infrastructure (motorways); (2) measures to improve the efficiency of existing buildings and industrial sector; and (3) revisions to the treatment of vulnerable customers, extending the financing of the Social Bonus to all energies, in a context of fighting poverty using public resources (national budget).

10 Ribera was a member of an advisory group to the Socialist party (Advisory Council for the Ecological Transition of the Economy, or Capte) that in March presented a "Base proposal for an energy transition strategy".

11 In Spain, the government is to present the Expert Panel's report to parliament

12 Deloitte estimated closure would generate additional emissions of around 170 MtCO2, roughly half Spain's output in 2013 (Deloitte 2016 report pg 54).

13 Deloitte estimated the replacement of nuclear by baseload technologies with higher variable costs would add €8-€10/MWh to the wholesale power price (Deloitte 2016 report pg 54).

14 See "Unregulated Electric & Gas Utilities - Spain: Spain's renewables auctions boost utilities' carbon free generation", 14 September 2017.

15 See "Unregulated Electric & Gas Utilities - Spain: Spain's renewables auctions boost utilities' carbon free generation", 14 September 2017.

16 The Spanish system was a net importer of electricity in 2017 - from Portugal, but mainly from France, whence it imported 12.7 TWh - reflecting the inflated pool prices from very dry conditions. See 'Unregulated electric & gas Utilities - Iberia: Rain in Spain will boost utilities' generation earnings recovery in 2018.'

17 Red Electrica had considered a second project - comprised of two trans-Pyrenees lines with France adding 3,000 MW of capacity. However, the grid operator has expressed its preference to progress on the Biscayan project before advancing the more technically complex project crossing the mountain range, which is not expected to be completed before 2026.

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