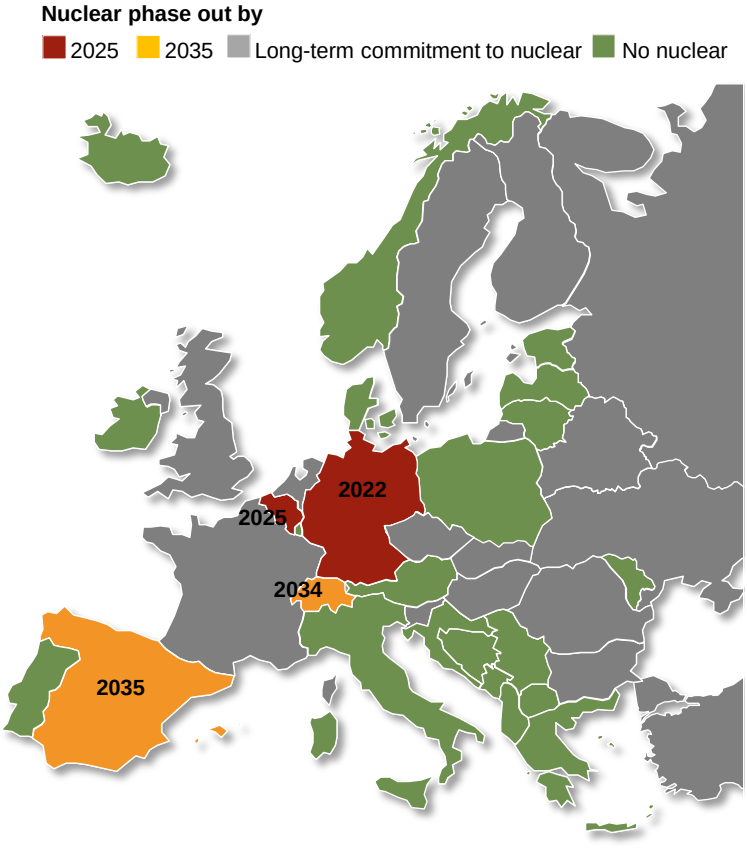
Europe gets serious about nuclear rethink
New investment offers costly, longer-term fix to market, climate, security challenges

Reinvestment in nuclear energy in Europe would help reduce greenhouse-gas emissions, limit electricity-market disruption from growing renewable energy flows and improve security of supply - but it is no quick, easy answer to Europe's energy challenge. Only in the longer term would new investment in nuclear power help Europe stabilise diminishing supplies of baseload electricity as coal and old nuclear power stations close – without relying just on natural gas as an alternative. Europe had a double energy challenge – even before the war in Ukraine pushed energy security to the top of the policy-making agenda. First, utilities need to meet ever-growing demand for energy. Secondly, they have to adapt to the energy transition: accelerating the building up of more renewable capacity; upgrading transmission and distribution infrastructure to handle more intermittent power supplies; and integrating national electricity markets through interconnectors.

Nuclear energy, set to be included in the EU taxonomy, offers at least a partial answer, but, for now, the region's nuclear-energy ambitions are at a curious juncture. France has committed to reinvestment in atomic power. The Dutch government has led the way in reassessing nuclear strategy, deciding last year to drop plans for a scheduled nuclear exit by 2033. Others such as Finland and the UK are sticking to existing nuclear-energy goals. Germany remains committed to a nuclear exit. The result is that the region needs to find alternatives to the projected net 12 GW loss in nuclear capacity by 2030 – equivalent to building significantly more than 40 GW of wind, solar capacity – to keep electricity output stable. Extending the lives of some nuclear reactors would help to fill up the merit order in some markets in the short-to-medium term as would an acceleration in renewables investment and extending the lives of some coal-fuelled power stations.

Figure 1: Few European countries have planned nuclear exits



Source: World Nuclear Association, Scope

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Judging the potential positive impact on the cash flow profile of utilities which benefit from such extensions is hard, given the simultaneous demands on capex, leaving aside the uncertainty about future power prices. For new reactors we estimate capex at EUR 6-10m per MW at current prices, sums that would put significant pressure utilities' balance sheets given that there are no immediate cash inflows from power plants under construction. This sets the stage for significant government participation in new investments. Extending nuclear reactors' lives generates extra cash though it also entails higher annual maintenance capex and/or longer maintenance downtimes. Governments might also introduce additional taxes on windfall profits to appease opponents of extensions to nuclear plants' operating lives.

EU's environmental policy spurs initial rethink of nuclear power

Nuclear likely to be included in EU taxonomy

New investment in nuclear power could help Europe stabilise diminishing supplies of baseload electricity as coal and old nuclear power stations close – without relying just on natural gas as an alternative – but only in the longer term. For now, the region's nuclear-energy ambitions are at a curious juncture. France has committed to a programme of reinvestment in atomic power. Others such as Finland and the UK along with CEE countries are sticking to existing nuclear-energy goals. Some countries phasing out nuclear power have opened the door to slowing that process down, but Germany remains committed to a nuclear exit. However, the new EU taxonomy has spurred renewed discussions about a revival of nuclear power in countries which have already agreed on a nuclear phase-out or an expansion of nuclear energy in markets which haven't yet shut the door to new reactors.

The European Commission started its consultation1 at the start of the year on a draft text for its Taxonomy Complementary Act covering gas and nuclear power which in the meantime has been followed by Complementary Climate Delegated Act2. In its proposal, the EC said that "there is a role for natural gas and nuclear as a means to facilitate the transition towards a predominantly renewable-based future." The EC has taken on board the significant variations of today´s power generation mix among EU member states and different challenges they face in meeting goals for reducing carbon-dioxide emissions.

Taxonomy offers incentives to invest in nuclear energy

If the proposal is approved by the European Parliament and the Council3, companies would become incentivised to invest in renewing or expanding their nuclear power capacity. While this is controversial for environmental activists and some EU members, such renewed investment would likely ease pressure on Europe's energy market, keeping wholesale and end-consumer electricity prices at bay in the medium to long term in vulnerable markets.

Bankability of new nuclear reactors increases significantly

The inclusion of nuclear-power projects within the taxonomy framework would likely ease funding conditions for European utilities which are exposed to nuclear power generation over the medium- and long-term, most prominently Eléctricité de France SA, France's state-owned utility which has a park of more than 50 nuclear plants. Other nuclear utilities include Czech-based CEZ Group, France's Engie SE, Finland's Fortum Oyj, Spain's Iberdrola SA and several other central and eastern European firms (**Figure 5**). Investors and lenders who use exclusion and/or negative screening in their ESG-focused investment approaches could continue to lend to such companies by buying into green bonds and loans. In addition, the likelihood of government co-investment appears

[1] Under the proposal, a new nuclear-power project is deemed green if it can secure funding, find a site to safely dispose of radioactive waste and is permitted before 2045. Existing plants are seen as being "temporarily sustainable" until 2040. Within the taxonomy framework, this would mean classifying these energy sources under clear and tight conditions (for example, gas must come from renewable sources or have low emissions by 2035), in particular as they contribute to the transition to climate neutrality. As for the other activities under the taxonomy regulation, the criteria for gas and nuclear activities will be updated as technology evolves. (https://ec.europa.eu/commission/presscorner/detail/en/ip_22_2)

[2] https://ec.europa.eu/commission/presscorner/detail/en/ip_22_711

[3] Though EU states are unlikely to reject the proposal -- given this would require 20 vetoes out of 27 -- a win in the European Parliament is still uncertain.

significantly higher which could be a major help for the utilities, considering the overall high up-front investment required for new reactors.

Government, regulatory involvement set to increase

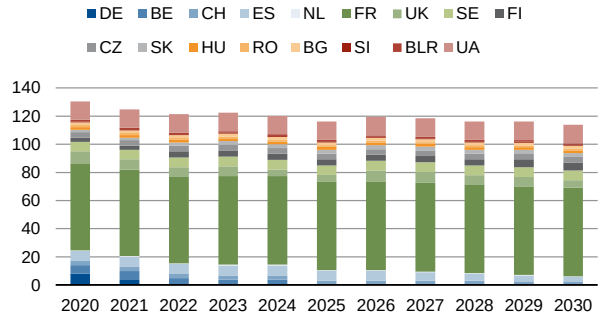
We expect increasing government and regulatory involvement in Europe's energy market to square the circle of ensuring affordable, climate-friendly, and secure energy supplies in the context of surge in energy prices in the 2021-22 winter and heightened political concern over Europe's reliance on Russian gas imports.

Europe faces capacity-substitution conundrum

Net nuclear shutdowns of 12 GW would need replacement of significantly more than 40GW renewables capacity

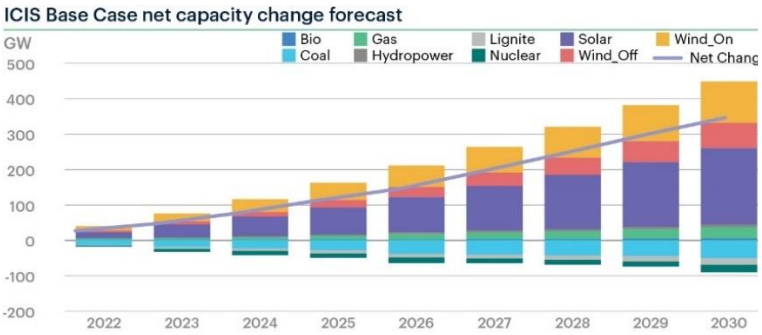
More than 20 GW of nuclear capacity is scheduled for being shut down by 2030 across Europe though the net impact is just about 12 GW considering new power plants currently under construction (**Figure 2**). Additions in France, Finland, Slovakia and the UK will partially offset closing of older plant in the UK and planned nuclear-energy phase-outs in Belgium, Germany and Spain. Given the varying exposures of the different countries' power generation mixes including imports from neighbouring countries, the merit order will be affected differently, most severely in such markets which are highly exposed to nuclear generation and which are persistent net importers of electricity flows from other markets.

Figure 2: Nuclear power capacity in Europe (GW) with currently planned phase-outs 2020-30



Source: World Nuclear Association, Scope Ratings

Figure 3: Potential capacity substitution (GW)



Source: ICIS

Replacing lost nuclear capacity will strain energy system

Replacing the lost nuclear capacity will require massive investment in other power generation assets, let alone increase it. The loss of 12 GW nuclear capacity implies that about 95 TWh (~3.5% of Europe's total electricity consumption) needs to be provided by other new additions such as renewables with all the known limitations: low capacity-utilisation rates of renewable sources and the side effects of substitution of baseload capacity with volatile wind and solar power (**Figure 3**). To replace the missing generation volume from nuclear with renewables would imply the need for gross additions of significantly more than 20 GW of wind and solar capacity each taking into account the different load profiles – on top of the extra capacity to offset the closure of coal-fired power stations which will have an even more severe effect on required capacity and volume substitution. A likely reduction on the dependence of gas-fired electricity generation amid the EU's efforts to reduce reliance on Russian gas imports under the REPowerEU[4] programme would likely add to that. Another long-running challenge is seamlessly integrating the extra intermittent supply into Europe's power grid.

Belgium and UK chronically short of generation capacity

The picture is particularly bleak for Belgium and the UK. Belgium – usually a net importer of electricity – would need to replace around 40% of its generation (about 35 TWh) through other sources considering the current nuclear phase-out by 2025 which points to massive declines in output in 2023 and 2024 after Doel 3 and Tihange 2 nuclear plants will have stopped power generation. The UK could expect a drought of power generation

[4] https://ec.europa.eu/commission/presscorner/detail/en/IP_22_1511

between 2024 and 2027 before the new 2 units of the Hinkley C nuclear power plant (3,200MW) start operations after years of construction delays. Spain has more time with the first nuclear shutdowns scheduled for 2027-29 amid the country`s commitment to phase out nuclear power by 2035.

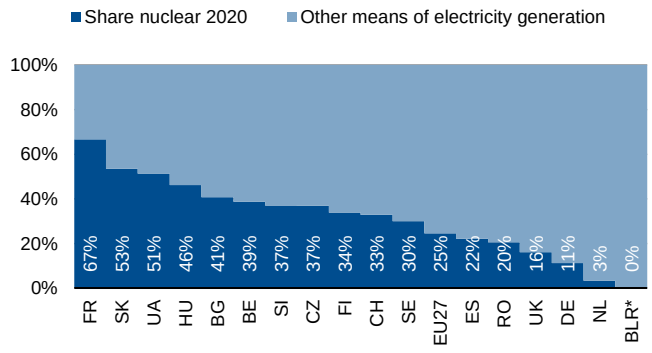
The exit from the exit? … considering the high dependence on nuclear

Energy affordability has moved centre stage with the sharp rise in European electricity and gas prices in recent months, with the tight market partly a reflection of the consequences of the region's accelerating energy transition. Building new nuclear capacity would ease the pressure in some countries, particularly those still dependent on nuclear energy and currently planning to become less so (**Figure 4**). The Dutch government has led the way in reassessing its nuclear strategy, deciding last year to drop plans for a scheduled nuclear exit by 2033.

France leads possible nuclear renaissance

EDF as the largest European producers of nuclear power (**Figure 5**) is in the best position to revive nuclear power generation as the country remains committed to nuclear energy. However, France has now doubled down on nuclear[5], with the issue coming to the fore in 2022 presidential election campaign as the climate transition becomes more prominent in the public debate and the recent surge in energy prices raises the question of energy independence. President Emmanuel Macron has already promised to extend the lives of the country's existing park of atomic power plants wherever possible – possibly to 60 instead of 50 years. Furthermore, he outlined a plan to invest EUR 1bn in small modular reactors before 2030. The programme would do more than help keep wholesale prices low in the long-term and is ultimately a step towards filling the nuclear-power gap by promising to build at least six new-generation European pressurised reactors (EPR2) by 2050 at a cost of roughly EUR 50bn.

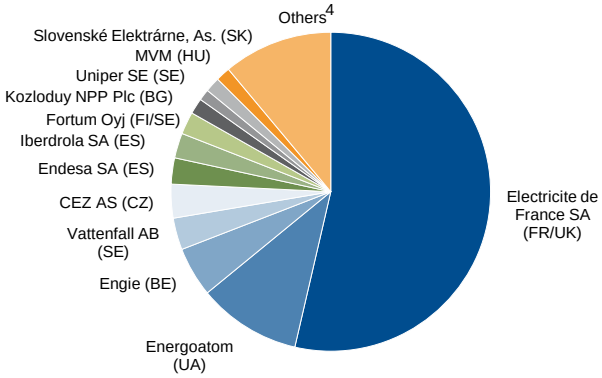
Figure 4: Dependence on nuclear energy of European countries that operate nuclear power plants



* First nuclear reactors in Belarus connected to the grid in Nov 2020

Source: Eurostat, VSE, Gov.UK, Scope Ratings

Figure 5: Owners of European nuclear generation capacity (about 125 GWp in total at YE 2021)



Source: Scope Ratings

Extending lives of existing nuclear plants on the agenda

As approval and construction times – even for smaller nuclear power plants – are very lengthy and have historically been coupled with delays and cost overruns, extending the lives of existing nuclear power plants are potentially a good stopgap. Extensions could help in some western European markets such as Belgium, Spain and the UK and Spain which are all struggling with exceptionally high electricity wholesale prices given these markets` chronic generation shortages and limited integration to other European markets.

[5] In November 2018, a draft of the country's new energy plan confirmed that 2035 was the new target date for the reduction of nuclear's share to 50%. The plan states that 14 of the country's nuclear reactors will shut down by 2035, 4-6 of those by 2030. However the plan also states that the option to build new nuclear reactors remains.

[6] Other asset owners of nuclear power plants: Centrica PLC (UK); E.ON SE (DE); RWE AG (DE); Societatea Nationala Nuclearelectrica, S.A. (RO); Teollisuuden Voima Oyj (FI); EnBW Energie Baden-Wuerttemberg AG (DE); Republican Unitary Enterprise "Belarusian Nuclear Power Plant" (BLR); Nuklearna Elektrarna Krško (SI); Naturgy Energy Group SA (ES); N.V. Elektriciteits-Produktiemaatschappij Zuid-Nederland (NL); BKW AG (CH); Alpiq Holding AG (CH); Axpo Holding AG (CH); CKW AG (CH), Energias de Portugal, SA (PT). Companies are not necessarily the operators of nuclear reactors but only hold shares in entities that operate the plants.

Extensions – implying delays to planned exits in Belgium and Spain could buy some time, potentially at the cost of higher maintenance operating costs and capex mitigated by higher electricity prices.

Belgium's nuclear regulator gave a provisional green light to extend the life of two of the country's nuclear power reactors operated by Engie and urged the government to make a final decision on the issue in the first quarter of 2022.

Netherlands, Switzerland reassess nuclear exit

The Netherlands and Switzerland have already pedalled back on the dates that were scheduled for a nuclear exit and are even reconsidering new investment, despite facing no potential power supply shortages until 2030.

Western Europe paddling back - Eastern Europe actively ramp up

Central and eastern European countries have argued for a long time that nuclear power is vital for their energy transition and should be included in the EU taxonomy. Here, governments are pushing hard to modernise and expand their nuclear fleets to slash carbon emissions from their energy mix. First, CEE countries are proving slower adopters of renewables, with some countries such as Poland, Czechia, Hungary, deriving less than 20% of their electricity from renewable energy sources. Secondly, the surge in input prices for price-setting power plants has affected all markets similarly, which is a problem for the region's households and industrial consumers. The supply of comparatively cheap and reliable baseload-eligible power remains core for such countries´ industrial development. Consequently, a higher provision of nuclear energy in the power generation mix of Bulgaria, Czechia, Hungary, nuclear-free Poland, Slovakia and Slovenia could help to keep the countries´ competitive edge in industrial production and keep rising household energy bills in check.

Only Slovakia with net nuclear additions by 2030

Again, the long lead-times for the planning and the construction of new or extension of nuclear blocks will not change the energy mix in the region in the near term.

- Poland is looking for a substitution of its heavy exposure to coal-fired power plants through a first nuclear power reactor under its updated energy policy (PEP2040).
- The replacement of the Paks nuclear power plant in Hungary will likely require more time until completion given the most recent financing issues related to the imposition of international sanctions on Russian banks.
- Slovenia's government provided the permit for a second nuclear reactor last year, a decade after the first plans for such reactor were already submitted to government.
- The long-discussed plan of the three Baltic states to build two new 1,600 MW nuclear reactors in Lithuania are at a standstill.
- Only in Slovakia and its immediate neighbours can we expect a near-term impact on power prices stemming from new nuclear power plants with the scheduled start-up of 880 MW of new capacity after multi-year construction delays of the Mochovce 3 & 4 nuclear facilities.

Nuclear sector faces huge capex challenge

Plans to revamp nuclear just look good on paper. In practice, they face high hurdles.

France plans EUR 50bn in new capacity

EDF has not commissioned a new nuclear plant since 1993. Its EPR under construction at Flamanville is years behind schedule and billions of euros over budget. The same applies to EDF`s endeavours in the UK where the Hinkley C power blocks are far behind schedule. Meanwhile, EDF's existing nuclear fleet is operating at its lowest capacity since 1991 because of repairs and maintenance. It is not clear yet how many of the 56 operating power stations in France can have their lives extended. EDF, with net debt of EUR 42.3bn at end-December 2021 and capex running at EUR 17bn a year, will receive an equity injection of EUR 2.1bn in the course of 2022 from the government, its main shareholder.

France, Finland projects record long delays, costs overruns

Similar patterns on delays and cost overruns have been observed on the new nuclear capacity in Finland (Olkiluoto power plant of Teollisuuden Voima Oyj) and the two reactors Mochovce in Slovakia for which construction began in 1986 and resumed in 2008 after being suspended for 16 years.

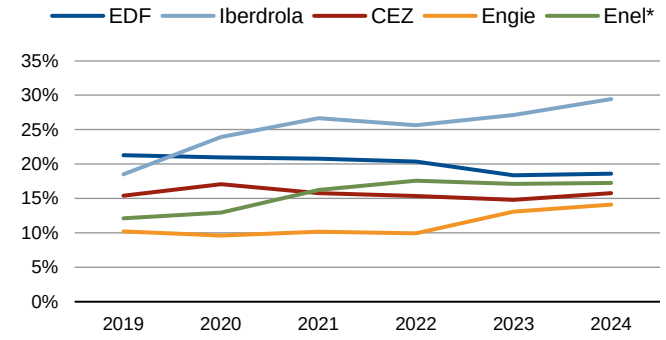
Internationally average planning time for reactor proposals is 10 years, plus another decade for building, and that is for already proven designs. Hence, the build-up of new capacity will not solve any near-term generation shortages.

Public opinion remains important factor

Even the planning and construction of "mini-nuclear" blocks (~300 MW) will take years and the resistance against new reactors by the public cannot be foreseen particularly in Western Europe. Concerns about a potential nuclear fallout have a reached another dimension amid the ongoing tensions between Russia and the Ukraine as nuclear power stations could become the target of military action. Ukraine's state utility Energoatom operates 13 reactors across the country.

Even if new permits are quickly approved, lengthy construction times, high upfront investment costs and potential cost overruns remain a challenge for utilities which are already heavily burdened by high annual capex, typically 15-30% of revenues for the larger European utility incumbents that operate nuclear generation assets (**Figure 6**).

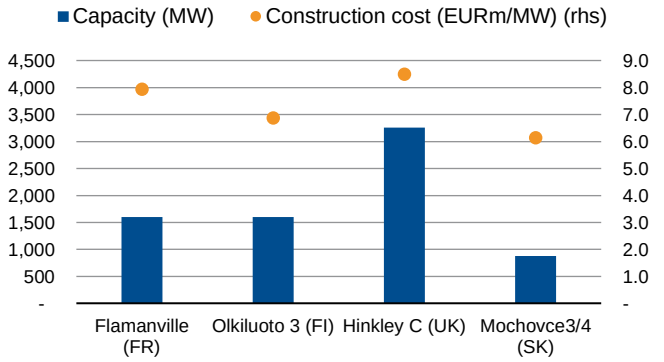
Figure 6: Annual capex as % of sales



* Enel is majority owner of Spain's Endesa

Source: Bloomberg consensus, Scope

Figure 7: Construction cost of newest nuclear power plants in Europe



Source: Scope

Credit quality under pressure; government investment likely

Lifetime extensions could help in the medium term

In conclusion, extending the lives of some nuclear reactors would help to fill up the merit order in the short and medium-term alongside an acceleration of a capacity ramp-up for renewables and selected lifetime extensions of coal-fuelled power stations. Extending nuclear reactors' lives would generate extra cash though it would also likely entail higher annual maintenance capex and/or longer maintenance downtimes. Governments might introduce additional taxes on windfall profits to appease opponents of extensions to nuclear plants' operating lives. Judging the potential positive impact on the cash flow profile of utilities which benefit from such extensions is therefore hard, leaving aside the uncertainty about future power prices.

High upfront investment costs to eat up cash flow

Considering the already high annual investment cost of European utility incumbents, the high upfront multi-year capex for capacity additions of new nuclear blocks will eat into the cash flow of the utilities in question. For new reactors we estimate capex at EUR 6-10m per MW at current prices (**Figure 7**). This would put significant pressure utilities' balance sheets given that there are no immediate cash inflows from power plants under construction, setting the stage for significant government participation in new investments.

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