

Edito



**Claude
Fischer Herzog**

Director, ASCPE
Les Entretiens Européens
& Eurafricains

Nuclear electricity, a public good at the service of our Europe

The fighting spirit of this 18th edition of the Entretiens Européens has breathed new energy into the debate on the future of nuclear power in Europe! There is an emerging consensus on the need for nuclear power in the energy mix, to not only defeat climate change but also achieve growth and prosperity objectives. Even the Commission has recognised that without nuclear power it will be impossible for the Union to meet its goal of reducing its carbon footprint, and that nuclear power has its rightful place in the mix alongside renewables. Better still, Massimo Garribba has continuously praised the public service role played by nuclear power during the health and economic crises. Yet the debate surrounding the nuclear/renewables balance is ongoing, despite many studies tending to prove that our systems would not survive an energy mix relying on over 40% renewables. In Germany, environmentalists have condemned the damaging effects of too many renewables, and populations are saying they would rather nuclear power than reopen coal-fired, and in the future gas-fired power plants!

Public incentives and guarantees to fund investments

A subject that came up often was the cost of nuclear power. The Commission has received questions on financing for investments and the associated guarantees, with requests for favourable conditions in the European market which, as everyone knows, discourages long-term investments. There is a lot of money in the form of public guarantees and aid for renewables and for financing sustainable growth, with eco-labels and other green certificates, and we are currently waiting to see if the Commission will (or will not) include nuclear power in the taxonomy still under discussion (the list of activities for a sustainable economy). Using nuclear as a "pretext" for refusing nuclear power its place is spurious! The Joint Research Centre (JRC), tasked by the Commission to examine the environmental "dangers" of nuclear power, must submit its report at the beginning of this year. It is hoped that pressure from Germany will not weigh on the shoulders of waste managers, who have put forward scientific and ethical arguments for solutions (the worst being to do nothing!). Likewise, it is important that we give a voice to the operators and researchers proposing various innovative and flexible technologies, including third-generation EPR and SMR type reactors (which use MOX, the fuel created from waste), in anticipation of the fourth-generation reactors which will close the cycle in a virtuous manner.

Diverse technologies needed to renew Europe's facilities

The Commission prefers SMRs... and hydrogen. But beware of the technological choices these impose! SMRs, which need our support, can neither replace 1,000 MW power plants nor take over from EPRs. We must diversify according to requirements and needs, which differ depending on whether we want to replace power plants in France, create a 6,000 MW generating capacity to replace coal in Poland... or help cities to power their heating networks, as in Finland. As for hydrogen, beware of smoke and mirrors! We are not ready, and hydrogen produced from gas (even natural) will never be a carbon-free source. As for that produced from surplus renewable energy production, it requires batteries and storage which will send prices through the roof.

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Les Entretiens Européens & Eurafricains

9 rue des Larris, 93800 Epinay sur seine

Tél. : + 33 (0)6 72 84 13 59

www.entretiens-europeens.org

Les Entretiens Européens 2020

Claude Fischer Herzog - An innovative conference

What an innovative conference! It was held on Zoom and lasted for five hours! Of course, it couldn't compare to a face-to-face meeting where you can shake hands, exchange business cards and talk to each other during and after the sessions... But it really was something else: over 320 people took part (more than usual, as there was no need to travel!), the debates began on time and there were a lot of "raised hands", far more than at a normal conference. After the conference, we received around 30 emails, some of them not just congratulating us, but providing valuable input for further work!! La Lettre features our guest speakers' presentations in the form of articles, columns, information boxes and illustrations. There were 24 guest speakers from eight countries in Europe, as well as from European and international institutions (the European Commission and Parliament, the NEA and the IAEA). Below are some of the highlights identified by Bernard Boullis, a loyal supporter of the *Entretiens Européens*. Some of the "chats" and participants' comments will be shown in verbatim form throughout.

Bernard Boullis - What I keep in mind

Perhaps too much support for renewables - The clearly dawning realisation on the part of the European Commission that the unconditional support for renewables has perhaps been a little excessive in recent years would, if translated into action, represent significant progress. The debate on the taxonomy rages on, and a committee of experts has been tasked with clarifying the "dangers" of the nuclear industry.

Nuclear energy is too costly - A determining factor for many of the participants: measures must be taken to reduce costs and perhaps also the initial capital requirements (which partly explains the current enthusiasm for SMRs), and to improve long-term visibility in order to attract investors. The path to profitability is long and, while the low cost of fuel is a real advantage, the unchanging nature of regulatory and policy frameworks remains (very) controversial and is an obstacle to opportunity.

Germany's failure - To ensure grid stability; a consensus seems to have emerged that non-controllable renewables should account for no more than 30 to 40% of the energy mix, as non-nuclear options have failed to demonstrate their ability to meet climate requirements in the long term. Germany seems to be failing, with GHG emissions falling little despite the widespread roll-out of wind and solar power, and the planned phase-out of coal will lead to soaring gas imports.

The geological storage solution - As regards waste, geological storage is widely regarded as an efficient, scientifically mature and flexible solution, which it would be dangerous and negligent to dismiss. This does not, however, prevent ongoing efforts to seek potential improvements, as part of a conventional continuous improvement approach.

The appetite for nuclear revival - There is clearly a strong interest in the nuclear option in Eastern Europe, and an upswing in research on future generations of reactors: fast neutron reactors (including "small" reactors) and new concepts such as molten salt reactors, with the emergence of new, very dynamic actors in the United States for example.

GEN 3, the cornerstone of nuclear energy in the coming decades - In the meantime, third-generation technology will form the basis of the nuclear industry in the coming decades, and there is potential for considerable progress in this area too.

No consensus in Europe, and no permanent structured cooperation between nuclear states - Nuclear energy could form the nucleus of major industrial and/or research projects on a Europe-wide scale. But it is proving impossible to build a consensus between the Member States, and it is difficult under the current arrangements to create the conditions for an effective partnership, even between interested countries alone.

Verbatims

Jan Bartak, NucAdvisor - Congratulations to Claude Fischer Herzog for organising this edition of the Entretiens Européens. She put together an excellent panel and facilitated the meeting perfectly, with her usual energy and enthusiasm. Fantastic!

Alexis Merville, Fideas Capital - Generally speaking, this conference made me realise that the stars may be aligning when it comes to nuclear energy in Europe: the fight against global warming, the European recovery plan, European industrial expertise, technological innovation (reactors, waste), a shift in public opinion in several countries, and even a possible agreement on phasing out coal and moving forward on hydrogen. So, now's the time to act!

A new golden age of nuclear power



During his address, William Magwood, Director-General of the OECD Nuclear Energy Agency, praised the innovations being developed by the nuclear industry worldwide

which are opening up new prospects for the technology. The health and economic crises have opened our eyes to the need to develop this sector as a priority if we are to restore growth in Europe, meet the needs of emerging countries and protect our planet. And so the tone of these Entretiens Européens was set from the outset, a fighting and unifying spirit maintained throughout the five hours of the conference.

The crisis we have just experienced is unprecedented. The Member States have had to adapt, working with regulators and operators to meet demand for electricity so we can continue working and living with our families. Nuclear power has proved particularly efficient, in contrast to renewable energies.

Combining growth and environmental concerns

Citizens and political decision-makers alike have realised the importance of nuclear power, which has consistently provided reliable and cost-effective electricity. It has an important place, not only for our advanced economies but also in emerging countries needing to develop and to provide their populations with essential goods, such as health and water. Electricity is crucial in meeting these challenges. It has a role to play in supporting both development and the energy transition, with its CO₂ reduction and environmental protection objectives. Because we must not sacrifice economic growth for the sake of the environment. If populations were to be told they cannot receive the electricity needed for their children to study because of environmental concerns, they would no doubt choose development over the planet. But why force people to choose? With long-term use of nuclear power, we can satisfy both growth and environmental objectives.

Anticipating the right energy mix based on cost analysis

How can we choose the best energy mix

to meet this requirement? Member States must not make arbitrary decisions based on whether or not a source has a positive image. In-depth cost analyses will help us to decide on the right mix of energy technologies, and choices must differ from country to country depending on needs and realities. The NEA suggests carrying out an electricity and system cost analysis, and helping countries to project the costs of intermittent renewables and nuclear power over the long term. Because resources need to be mobilised and allocated in markets that are dysfunctional and not sending out the right signals. All our analyses have shown that renewables have a limited capacity in most grids¹. Countries might choose to force their taxpayers and make them pay, but from an economic, safety and sustainability point of view, the right proportion of renewable energy for a balanced mix is 30 to 40%. The share may be higher in some regions, in case of solar energy for example, but this is generally the most logical threshold.

No CO₂ emission reduction without nuclear power

How, then, can we meet the objectives of the Paris agreement to not increase global warming by more than 2 °C and reduce our emissions to 50 g of CO₂/kWh? This represents a huge 80% reduction for the OECD and a major challenge. To be honest, it will be very difficult, and, let's face it, without nuclear power impossible. For those advocating 100% renewables, we will need to prove it! Combined use of renewables and nuclear power has demonstrated its potential, and is the preferable option. It is being developed worldwide and has a bright future. Admittedly, the very large projects are too costly, but budget overruns result from the fact it is not possible to share infrastructure across the entire chain, and from the regulatory obstacles in the market. The nuclear industry must do better and send the right messages to investors.

An exciting time for innovation

In addition, more prospects are opening up, with smaller SMR type reactors. These are exciting times, probably the most exciting in terms of nuclear innovations since the 1950s. Because in addition to SMRs there is a lot of enthusiasm about

the fourth-generation technologies, with high-temperature molten salt reactors, fast neutron reactors, etc. Some 70 projects are currently underway, and regulatory frameworks will be needed to roll out these technologies and ensure their success. If I may dare a comparison, should we stop building airports but continue producing planes? Some questions remain to be answered. The issue of waste is controversial. Yet it is not a problem. We have the technologies to manage it, with burial and storage. If countries like Finland lead the way, others will follow. We need to silence the critics. We know how to do this and can prove it.

Over time, governments will need to adopt the right public policies and work with regulators, who can assess the technologies and their safety. New technologies have received a green light in the USA and will be developed elsewhere in the world. We are at the dawn of a new golden age for nuclear power. It is an important step, not only for the nuclear industry but also far beyond, to preserve our way of life, achieve prosperity and save the environment.

William MAGWOOD
Director, AEN - OCDE

Les Entretiens Eurafricains

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¹ Cf. The costs of decarbonization - https://www.oecd-nea.org/jcms/pL_15000/the-costs-of-decarbonisation-system-costs-with-high-shares-of-nuclear-and-renewables

What is the right energy mix for Europe's future?



What is the right energy mix to deal with the current crisis and changes? The answer to this question will of course be informed by the objectives sought, which means that

anything is possible. While reducing the carbon intensity of the mix is a solution in principle shared throughout Europe, it is complemented by the European Commission's greater objectives to increase renewable energies and reduce energy consumption¹, ultimately paving the way for a fully renewable energy mix backed up by green hydrogen, temporarily supplemented with nuclear power in those countries that have it.

However, given the close correlation observed between energy use and wealth production, I must say again that any policy to quickly and dramatically reduce energy use – and which is based on an unequivocal transformation of the energy mix that dismisses the benefits and complementarities of regional mixes – is akin to a policy to impoverish society in general. If we are committed to promoting inclusive growth in Europe, then such a policy will get us nowhere.

Changes in the energy mix in the light of CO₂ targets

We should note first of all that fossil energy sources raise intractable CO₂ emissions problems and are becoming scarce in Europe sufficiently abruptly for us to attempt to agree on the objective of removing them from the mix as quickly as possible. Therefore, to meet our development goals – however unrelated to material growth they may be – we must transform our energy mix without rationing power to transport networks, heating systems and manufacturing. Bearing in mind the immense challenge that tripling the electricity supply in this way represents, let's think about the qualities of such a mix: efficient monitoring of needs, minimal greenhouse gas emissions and competitive prices. Thus, there are three categories of objectives, which are the driving force behind our energy policy:

1. supply quality and security;
2. CO₂ emissions;
3. the price of electricity and the price per metric ton of carbon avoided.

The future mix must therefore be compatible with three objectives, which are the driving force behind our energy policy:

1. supply quality and security,
2. greenhouse gas emissions;

3. the price of electricity and the price per metric ton of carbon avoided.

How compatible is Europe's energy policy with these objectives? The balance sheets produced by Eurostat showing the evolution of the energy mix and its CO₂ emissions over the past 30 years provide us with some useful information in this respect².

- First balance sheet: between 1990 and 2004, before the renewable energy development programmes, power sector emissions fell by around 1% per year; between 2004 and 2017, they continued to fall by around 1% per year, despite the systemic deployment of wind and solar power. Why didn't they drop faster? Mainly because nuclear generation rose by 200 TWh over the first period, and decreased by 200 TWh over the second. First observation: a good mix is one in which nuclear energy is added to renewable energy sources, rather than removed.

- Second balance sheet: European energy consumption increased by 13% between 2000 and 2017, at the same rate as controllable electricity supply sources, despite the substantial increase in renewable power from 13 to 177 GW. Conclusion: the thirteen-fold increase in renewable power was achieved without shutting down controllable capacity. Worse, the closure of almost 20 GW of nuclear capacity over the same period resulted in a more than 50 GW increase in fossil fuel power to make up for the drop in nuclear generation and provide a back-up for renewable sources. Second observation: the development of renewables and the closure of nuclear capacity require the construction of new renewable energy facilities on top of fossil-fired plants, which is as far as one can get from optimising investment.

Successfully changing energy mixes based on regional assets

The search for an optimal energy mix must take account of local geographical, political and historical realities. In mainland France, for example, there is virtually no need for intermittent renewables given the size of the nuclear and hydropower industries³. At the very most, it may be conceded that renewable power is needed to replace the few GW of installed coal and oil capacity. Even then, it is important to point out that intermittent renewable sources often generate energy when it is not needed, and that they primarily replace low-carbon nuclear and hydraulic power rather than fossil fuels, which are still vital at peak times; what's more, their cost/benefit ratio is poor, at €1,400 per metric ton of CO₂ avoided.

In Germany⁴, renewable energies are

expected to replace fossil fuels more obviously than in France, but renewables have above all replaced nuclear power, and even natural gas when carbon prices were still low and encouraged use of lignite. Then, when carbon quota prices rose, they contributed to the decline in high-carbon sources and also in nuclear power. This pushed up the share of gas in the mix, the result being an average cost of CO₂ avoided of €1,500/tCO₂, and the highest household electricity rates (per kWh) in Europe.

Grid security disrupted by too many renewables

Whatever the mix, a controllable base is needed to ensure grid security, which is vital for supply quality and continuity. Difficulties arise where intermittent renewables account for over 30 to 40% of supply. This is a crucial issue, which lies at the crux of our ability to strike a balance between production and consumption, and to control the frequency and voltage on our shared supply system. Renewables are either fully or partially responsible for every incident that occurs, be it the power cuts in Germany and the United Kingdom, the near blackouts in France in January 2017 and in Germany in June 2019, and the power shortages in South Australia and California. To prevent such incidents, we have no other choice but to cut intermittent renewable production or to store intermittent, unreliable electricity. But that would increase supply prices considerably!

Why store intermittent electricity when nuclear plants can generate more, without interruption?

The volumes that would need to be stored are huge: Europe's 132-GW solar energy capacity is affected by a common-mode failure event every evening and the amplitude of supply voltage varies up to fivefold depending on the season; its 205-GW wind energy capacity regularly delivers less than 10% of its installed capacity across the whole of Europe! By way of comparison, the modest 118-GW nuclear capacity delivered almost 800 TWh of carbon-free electricity last year, whenever it was needed. Meanwhile, solar farms generated only 100 TWh of electricity, which was three to five times richer in carbon, and a significant proportion of which served no other purpose on the grid than to help ruin the business model of controllable plants, which alone are able to guarantee a reliable energy supply.

¹ 1. See *The Green Deal*: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_fr

² See Lionel Taccoen's excellent geopolitical newsletter on electricity, in particular the issues of January 2019 and January and February 2020.

³ Together, nuclear and hydraulic power supply nearly 85% of France's electricity.

⁴ Read Veronika Wendland's article on page 6.

Organising cooperation between national systems based on the complementarity of sources

As far as storage is concerned, hydropower is of course the ideal solution and should be prioritised wherever possible. It is the perfect complement to nuclear power in terms of load following, or indeed supplying basic energy needs in places like Scandinavia where Mother Nature has been bounteous in her gifts. Unfortunately, Europe is far from having the capacity to store the equivalent of all the intermittent energy produced! However, this observation highlights an important point that ought to encourage the Union to organise cooperation between national energy systems. As both geographic and technological complementarity are high, it is time to allow Member States to adopt the same approach as Denmark, Sweden and Norway, which pool their resources and cooperate freely as and when required, with no discrimination between sources, but using the most appropriate drivers: electricity prices, supply security, and the cost of carbon avoided.

It has to be said that the German model – reinforced by the Union's strategy – lays the foundation for widespread cooperation between the gas and intermittent renewable energy sectors in Europe so that, by 2030, there is no chance that CO2 reduction targets will have been reached, the replacement of natural gas by green

hydrogen will increase electricity prices by an order of magnitude, and we may have caused far-reaching and perhaps decades-long damage to Europe's social, economic and even institutional fabric and to its energy independence.

The crisis calls for a reliable, minimum cost mix

Now, let's go back to the original question: what is the best energy mix for dealing with the health and economic crises? Ultimately, the right mix is one that, regardless of the circumstances, will best meet the needs of our hospitals, our schools, our factories, our homes and our transport systems:

- a minimum cost mix is a necessity right now, as it is crucial that we control our energy expenditure in order to finance health-care and education, sport and culture, law enforcement and justice, solidarity and development, and so on. This necessity is all the more pressing because our collective resources are dwindling, with Europe's GDP shrinking by 8% in 2020.

- a minimum cost mix will also be necessary going forward, to ensure a future without shortages, blackouts, climate disruption likely to derail our development, and damage to our investment capacity (without which our energy systems will fail), while generating as much added value as possible in Europe.

The COVID-19 lockdown, which inflated

Europe's intermittent renewable energy sector by 15 to 20% and drove electricity market prices down to less than €20 per MWh, has reminded us that only producers kept afloat by price guarantees can survive long term in such an environment and that, unless political objectives and market rules change, the mix that Europe needs will not materialise.

Hervé FISCHER
CEO of EuroLorraine

FROID: LES FRANÇAIS SONT INVITÉS À RÉDUIRE LEUR CONSOMMATION D'ÉLECTRICITÉ



L'album à crabouillages de Frizou.

The stratosphere above the North Pole has just gained 50 °C! A phenomenon that may explain a cold, harsh winter in Europe.

According to Futura-Sciences, published on 8 January 2021 by the journalist Nathalie Mayer



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Visit us at
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Contacts
+33(0)3 87 80 10 04

Hervé FISCHER, Head of E2I Dept.
Measurement & Engineering Expert
contact@eurolorraine.com

Agnès SEGONDY, Head of TEC-REG Dept.
ICPE & ETS Expert
asnes.sesondy@eurolorraine.com

Emmanuelle VAUCHER-ROBERT, Head of CIMES Dept.
Environmental Monitoring & Health Hazard Expert
emmanuelle.vaucher@eurolorraine.com

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Germany: reopening the debate Nuclear power rather than fossil fuels



A German historian specialised in eastern Europe, Anna Veronika Wendland works on nuclear plants and the safety culture. A leading figure in the anti-nuclear campaign in Germany after the Chernobyl accident, she is now close to the so-called "eco-modernist" environmental movements that defend nuclear power and new technologies. Last July, she co-wrote an article in "Die Zeit" with Rainer Moormann, calling for fossil fuels to be phased out before nuclear power.

With 30% of its electricity sourced from nuclear, and the development of renewable energy, Germany could have achieved its climate goals. But after Fukushima it decided to gradually withdraw from nuclear power, and to phase it out completely by 2022. Today, there are six nuclear plants in operation, with a total output of 8,000 MW – just over 10% of Germany's electricity production (61 TWh).

With the development of renewable sources, Germany has run into structural problems owing to intermittent power production and storage issues. We are reliant on the weather conditions and, when they are unfavourable, renewable energy must be backed up by nuclear and lignite. This is a major setback to our climate goals! We are spending €30 billion a year on renewables, a substantial amount of money to achieve very little!¹

Nuclear energy is failing because of the prevailing narrative

This is the argument that Rainer Moorman and I put forward. We are calling for lignite to be phased out before nuclear power. However, we are encountering a great deal of opposition from the supporters of renewable energy, who have not considered how effective a combination of carbon-free sources might be compared with

fossil fuels. Policymaking is being influenced by NGOs. Germany's nuclear industry has failed not because of its technology, which is just as efficient and well-respected as anywhere else, but because of the prevailing narrative. If we want to open up new opportunities for a complementary energy mix based on renewable and nuclear capacity, then we must challenge the anti-nuclear narrative².

The governments of Ukraine, the Czech Republic, Poland and Hungary have decided to include nuclear power in their energy mix, but they are under pressure from Germany, which refuses to accept their choice. Nonetheless, they must decarbonise their energy systems – in Poland, for instance, 80% of electricity is produced from coal – and they deserve our help and support³.

Germany is beset by contradictions

It won't achieve carbon neutrality because, once nuclear power and coal have been phased out in 2022 and 2038, respectively, it will be reliant on natural gas to compensate for the intermittency of renewables⁴! This is not a good backup solution for Germany, which is beset by contradictions!

Who is prepared to try and persuade the German government and the European Union to change direction? The debate in Germany is toxic, and although several political groups – including the Christian Democrats, the Social Democrats and even sometimes the Greens – think that we cannot go on like this, none will say so publicly for fear of losing their seats⁵. Except perhaps pro-nuclear, right-wing populists, but it would be very unwise to associate oneself with them! There is less controversy in East Germany, which is more pragmatic, but the narrative is very much dominated by West Germany, and the climate movement is heavily influenced by the traditionalist green approach, in which nuclear power is still a taboo subject.

¹ According to an Environment Ministry report published in the German press and quoted by Le Monde, "the gap between actual and target emissions is much wider than anticipated. Unless corrective measures are taken, the reduction achieved by the agreed deadline will be just 32.5% or, at worst, 31.7%." The Federal Republic is expected to reduce its CO2 emissions from 906 to 751 million metric tons in 2020. Berlin has already informed Brussels that its emissions will fall by 35.7% instead of the 40% planned, a figure that even the ministry believes is over-optimistic."

² Les Entretiens Européens in Berlin in 2006 were organised with the CERES and our dearly departed Rolf Linkhor (former member of the European Parliament) to alert on the dangers of anti-nuclear rhetoric in the context of a nuclear renaissance in Europe.

³ In 2013, at the Entretiens Européens in Warsaw, 40,000 people signed a petition opposing plans to build nuclear power plants in Pomerania. Not the reason for failure! But a challenge for investors!

⁴ Germany will import Russian gas via North Stream 1 (and, shortly, North Stream 2), as well as American shale gas in the form of LPG thanks to the future construction of methane terminals. Yet although natural gas combustion generates half the emissions of coal, it produces at least 50 times more than nuclear power or wind power (around 640 g CO2/kWh for single-cycle plants or 420 g CO2/kWh for combined-cycle plants); and this does not include extraction emissions, which, in the case of shale gas, are very high, or liquefaction and regasification emissions in the case of LPG.

⁵ The Minister-President of Saxony has proposed that the question of nuclear power be raised again in the future.



A new coal-fired power plant was brought into operation in Datteln, western Germany, on 30 May. This 1100 MW plant has been greeted with incomprehension by environmental organisations, considering that, at the start of this year, Germany announced its plans to "phase out coal" by 2038.

The latest trend is to promote hydrogen... However, while some pilot plants have been built, no-one wants to invest in the infrastructure that would be needed to store wind energy surplus for the production of hydrogen using electrolysis and methanation. Given the economic issues, the German government is applying for subsidies; however, in light of the current crisis it should reconsider the role played by nuclear plants.

Anna Veronika WENDLAND

Researcher at the Herder Institute

Verbatims

Jacques Laebens, Schneider Electric –

So, Anna, in your opinion Germany will inevitably fall short of the decarbonisation target?

Stanislas Pommeret, GIFEN –

The nuclear countries are asking the European Union to leave it up to Member States to freely choose their electricity mix. Shouldn't Germany and Austria be left to their own energy choices and the European Union remain neutral? Isn't the debate on taxonomy a prime example of the Union's bias?

Serge Dauby, Belgian Nuclear Forum –

We are the victims of misinformation from the anti-nuclear lobby... We absolutely must act TOGETHER (the whole sector at the international level) and AT THE SAME TIME in each country, and exert counter-pressure on our opponents!

Daniel Calvignac, consultant –

Has the exchange of electric power between France and Germany been assessed? Might I remind you that fossil fuels currently account for over 80% of worldwide electricity generation.

The renewal of the nuclear fleet The basis of a low-carbon economy

Ensuring 24/7 access to electricity, thanks to nuclear energy



Independent analyses - that are among the most authoritative carried out in the energy sector - have confirmed that nuclear energy offers exactly the kind of comple-

mentarity that the renewable sector needs to achieve a successful energy transition. The European Commission's "Green Deal" aims to make Europe the first carbon-neutral continent in the world, with 80% renewables and 15% nuclear by 2050, and 100% renewables by 2100. "This projection should set alarm bells ringing" says Bernard Dereeper, Chairman of the Belgian Nuclear Forum, "as it pushes states to change the sector in line with a future energy landscape that is by no means certain to come about".

There are two opposing arguments about nuclear energy. Pro-nuclear countries emphasise the carbon-free nature of nuclear generation, while anti-nuclear countries focus on waste management and safety issues. These issues are being used to ratchet up the pressure and, ultimately, shut down the nuclear industry, even while it is taking active and innovative steps to overcome its weaknesses and improve its poor public reputation. We have specialist manufacturers and cutting-edge technologies to address these matters; for example, the MYRRHA project has been set up to explore ground-breaking options for managing highly radioactive waste. The European Commission has added MYRRHA to the list of Europe's biggest and most important research projects.

Extending the life of power plants and investing in new technologies

How can we provide EU industries with guaranteed, 24/7 access to a carbon-free electricity source? This is one of the major advantages of nuclear energy, which the European Commission itself recognises in its long-term vision "A Clean Planet for All". We must therefore continue to invest in the maintenance of existing power plants and the construction of new nuclear reactors. Extending the life of power plants to 60 years is becoming an international benchmark, and two units in the United States

have obtained a licence to operate for 80 years. Where do things stand in Europe? This extension of the operating life of our plants must go hand in glove with investment in innovation and new technologies, such as small modular reactors (SMRs). These small and medium-sized reactors allow for more incremental investment, as their integrated functionality complies with the most stringent of standards. Other innovative technologies, which can be better integrated into the energy production mix and effectively address the waste management issue, will be more easily adaptable to a wide range of industrial applications, such as hydrogen production, urban heating systems, etc. Let's prove this by investing in these technologies and turning the figures, the forecasts and the marketing messages into facts!

Uncertainty in Belgium detrimental to the European nuclear industry.

The Belgian government has confirmed that nuclear energy will be phased out by 2025, in accordance with the legislation passed in 2003. Depending on the alternative solutions put in place, it will reassess the impacts on supply security and electricity prices at the end of November 2021, and will introduce measures accordingly. These measures may include adjusting the period of time during which Belgium can legally maintain a nuclear capacity of up to 2 GW, corresponding to two of its existing nuclear units. But this uncertainty is penalising the operator, which explains that the political agenda is out of step with the industrial agenda. If the decision is not taken now and an extension were to prove necessary in 2025, it would be very complicated - perhaps even impossible - to put in place. Yet Belgium does not have sufficient renewable resource deposits to cover all of its needs. Once nuclear energy has been phased out, which will mean replacing 6 GW of existing capacity (50% of our country's electricity generation), Belgium will find it very challenging to meet carbon neutrality objectives. It is not by investing massively in gas, which produces 40 times more CO₂ than nuclear, that Belgium will be able to achieve its long-term climate goals. This political decision is all the more regrettable because, in Belgium, we have a state-of-the-art nuclear industry built on 60 years

of experience. In addition, more and more EU Member States, including countries like Estonia with no previous nuclear experience, are proclaiming their nuclear ambitions and announcing investments in nuclear projects. We need ambitious projects on European soil, as well as more European funds for research and innovation. By actively supporting European industrial projects and assembling the very best talent, we will be able to prove to detractors that nuclear revival will enable us not only to meet energy transition goals and the growing need for carbon-free electricity, but also to safeguard the one million jobs provided by the industry in Europe.

Bernard DEREOPER

Chairman of the Belgian Nuclear Forum

CfD and RAB: nuclear reactor funding mechanisms in the United Kingdom

In the United Kingdom, two EPRs are being built at Hinkley Point C (Somerset). There are plans to build two more EPRs at Sizewell (Sussex), and the British Nuclear Safety Authority is in the process of certifying Chinese HPR1000 reactors (also known as "Hualong-1" reactors).

To protect taxpayers from the risk of construction budget overspends at Hinkley Point C, the British government has introduced the "Contract for Difference" (CfD) scheme. Under this scheme, the electricity generated by Hinkley Point C will be sold for £92.50/Mwh for 35 years, irrespective of market prices (this will be reduced to £89.50 if the Sizewell project goes ahead).

A different scheme ("Regulated Asset Base" or RAB) has been devised to finance infrastructure at Sizewell by sharing some of the risks with the community, which would reduce borrowing rates and therefore the cost of the electricity produced. Under this model, investor remuneration is spread over the entire life of the project (increasing from the start of construction and then decreasing after commissioning, in line with the amortisation of the plant).

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Combining nuclear and renewable energies: the only low-carbon solution that ensures long-term security of supply and competitiveness



STUDY BY PWC ENTERPRISE ADVISORY REGARDING THE TRANSITION OF THE BELGIAN ELECTRICITY MARKET BETWEEN NOW AND 2050

Results of a study by independent consultant PwC Enterprise Advisory on the Belgian energy transition within the time horizons of 2030 and 2050 demonstrate that only a nuclear + renewable energy mix will make it possible to attain the European climate objectives as well as the required growth of renewable energy as was adopted by the Federal Planning Bureau for the evolution of the Belgian energy system until 2050. By contrast, without nuclear energy Belgium will see a considerable worsening of its carbon balance by 2050, and this despite the massive deployment of renewable energy sources.

Moreover, the presence of nuclear energy ensures a competitive production cost and guarantees stable electricity prices. In the absence of nuclear capacity, the cost of electricity, security of supply and CO₂ parameters will worsen.

It would therefore be necessary to call upon imports and the construction of more costly power stations.

Finally, the study unequivocally confirms that nuclear and renewables are not conflicting energy sources, but rather complementary. The electricity storage capacities will further strengthen this synergy to ensure reliable, affordable and sustainable energy, in accordance with the European energy strategy.

The results of the study demonstrate that:

- Only a renewable + nuclear mix makes it possible to attain climate goals
- Without nuclear Belgium electricity production will not meet the national demand
- The presence of nuclear will ensure a competitive cost of production
- Renewables and nuclear are complementary
- Storage is the go-between for nuclear + renewable

The + nuclear + nps study performed by PwC Enterprise Advisory and ordered by Belgian Nuclear Forum stresses three aspects that constitute an identical, significant and ambitious growth of renewable energy between 2018 and 2050 as established by the Federal Planning Bureau as significant increase from 33.7% of the total electricity capacity

currently from renewable sources at 44.2% in 2030 and 57.4% in 2050. The study is based primarily on official quantitative data supplied by the International Energy Agency (IEA), the Energy Technology Research Institute (ETI) and the Federal Planning Bureau.

More information: www.forumnucleaire.be



Clefs CEA is a scientific and technical journal which takes stock of major themes CEA research or on transversal themes to its various activities.



Questions de temps - N°71 - Parution : November 2020

From the vastness of the universe to the strictest intimacy of matter, be it in terms of climate or environmental change, nuclear or digital, time plays a central role in all areas of research.

Czech Republic: the nuclear option supported by government and society

The Czech Republic is a landlocked country at the heart of Europe: too little sunshine, no offshore wind potential, no gas or oil deposits. Our only sources of low-carbon energy are a small hydroelectric capacity and a few nuclear power plants: four units at the Dukovany plant (4 x 500 MW) and two units at the Temelín plant (2 x 1 000 MW).

Our energy mix relies primarily on coal (45-50%). To uphold our commitment to a climate-neutral Europe by 2050, we will have to replace our fossil-fired power plants and renew our ageing nuclear plants, which produce over 40% of the energy we use! Investing in renewable sources and energy-saving solutions would cost €25 billion and rob us of our electricity export capacity. Worse still, we would have to import twice as much gas to provide heat for cogeneration plants, to the detriment of our energy security... and our international obligations. Furthermore, according to the Czech TSO, our transmission system stability obligations based on the LOLE indicator will be breached over 20 times. Not to mention the risks of social instability that such a situation would cause.

Thus, the Czech Republic has no alternative but to promote nuclear generation through the construction of new plants, in accordance with the objectives of the Euratom Treaty. The government – which is planning to extend the life of existing units at the Temelín site to 60 years, and is considering the use of small modular reactors within the next ten years – has therefore decided to support the construction of a new 1200 MWe reactor at the Dukovany plant.



Mechanisms to support the construction of the reactor

The first part of the support mechanism consists of state financing. Investment aid covering 70% of the total capital requirements for the project, which have been

estimated at €5.8 billion, will be provided in the form of a government loan to “Elektrárna Dukovany II”. This loan will be repayable interest free during the development and construction phase, and then at an expected rate of 2% per year once the plant has been commissioned. The remaining 30% will be financed with the own resources of Czech energy company CEZ, which will purchase shares via its subsidiary.

The second part of the support mechanism consists of pre-notified financial assistance in accordance with the power purchasing agreement, also known as the procurement contract. This will take the form of a PPA¹ between “Elektrárna Dukovany” and a 100% state-owned corporation.

The third part consists of two types of contract between the state, CEZ and its subsidiary Dukovany II: a framework agreement setting out the principles and objectives of cooperation, and an implementation agreement establishing the legally binding obligations for the first phase of the project (acquisition of a building permit and completion of tender procedures for the selection of the supplier).

Considering the true cost of sources and offering them identical market conditions

It is a well-known fact that, owing to market failures and the availability of capital, the majority of the cost of nuclear energy is related to the funding of plants, which accounts for up to 60%. That is why we have opted for state financing, as PPAs seem to be a more appropriate and straightforward solution than the CfD or the RAB². There is no reason for the Commission to object to our choice. Indeed, the European Union supports renewable energy, so why not nuclear? Having a significant share of renewable energy in the electrical system considerably increases the need for ancillary services, which will be paid for by all consumers – households and industry. For example, the Czech Republic and Poland have had to install phase shifters on interconnections with Germany to ensure supply stability and security in their own countries. Consumers in the Czech Republic cannot be expected to pay the same high electricity rates as their counterparts in Germany. European market regulations must be amended so that all carbon-free sources benefit from the same conditions of competition. The most important criterion

should not be the cost of building the plant but the final cost for consumers, taking into consideration subsidies and special taxes, as well as the ancillary services needed to eliminate instability in transmission and distribution systems.

According to information provided in the integrated National Energy and Climate Plans, at a time when all the Member States are striving to meet ambitious emission reduction targets, there is no certainty that the single market, the interconnection system and the solidarity mechanism adopted by the European Union will guarantee energy security. It is urgent that we stop all the ideological posturing and that we reconsider the role of nuclear energy, which is the key to decarbonisation and already accounts for more than 50% of the low-carbon electricity supply in the EU.

Jaroslav MIL

Czech government commissioner for nuclear energy



Verbatim

Hervé Fischer - Neither the spot nor futures electricity markets are able to give a long-term price at which investment projects in electricity supply may converge. Auction bidding mechanisms for offshore wind power in particular are an attempt by public authorities to establish a market and long-term price, and given the dramatic drop in the prices offered by competitors this is effective. It shows the potential benefits of making steering of long-term prices by public authorities (or even a pool of private investors) common practice, in the same vein as what the English CfD and the Finnish Mankala have authorised for nuclear power.

¹ PPA: In increasing use all over the world, PPAs (Power Purchase Agreements) are private agreements between electricity producers and corporate consumers.

² See the box on page 7

Industry, economy, climate, a winning combination with nuclear

GIFEN, which was created two years ago, is the French nuclear industry's trade association. It is a nationwide organisation comprised of operators and suppliers, which aims to deliver consistently higher standards and more services.

The construction of new plants is a tremendous challenge for the sector, and a major asset for industry, the economy and the climate.

An asset for industry: nuclear energy is the third biggest industrial sector in France after the aeronautical and automotive industries, comprising 3,200 companies and employing 220,000 people. It acts as an interface with other industries, such as engineering and metalworking, which devote 20% of their activities to the nuclear sector. Each industry benefits from the technologies used by the others.

An asset for the economy: the sector is highly competitive. Energy-intensive industries, such as steel and aluminium manufacturing, demand low electricity prices, as electricity is often their biggest budget item. It guarantees energy independence and sovereignty for our country, and strengthens its performance in the export market¹. Furthermore, during the first lockdown, it showed the same strength of resilience as its American counterpart, providing a continuous supply of electricity and making sure that all needs were met. It never failed to perform, despite

¹ The share of different energy sources in France's energy bill varies considerably: oil product imports accounted for 76%, gas imports accounted for 21%, and coal accounted for 3%. Electricity is the only form of energy with a positive export balance (two billion in 2013), reducing France's overall energy bill by around 2%.

² Electricity represents 25% of the energy mix. Share of carbon-free energies in electricity production: nuclear, 70.6%; hydroelectricity, 10.3%; wind power, 6.3%; solar, 2.2%; bioenergy, 1.4%.

the health measures put in place.

An asset for the climate: industrialists in the sector know that nuclear power does not produce any CO₂. They use this argument with pride, in a context where it is more difficult to sway others than it was twenty years ago. There is no longer a consensus about nuclear power, and the lack of information is a real problem: 70% of people in France think that nuclear power contributes to greenhouse gas emissions!

GIFEN plans to help educate the public, and we are putting together a file for the government on the skills, the innovations and the digital technology that prove the sector's readiness for the future population of EPRs. In this way, we hope to participate in the decision-making process, which is not only necessary but is becoming urgent.

In fact, with the electrification of our lifestyles and production processes, nuclear energy is more than ever in the general interest! Going forward, we will have to produce much more

carbon-free electricity at the risk of driving up pollution levels². We have already established links with organisations that work with hydrogen, and the automotive, digital, construction and heating sectors are certainly starting to work with us to decarbonise industry and the economy.

Cécile ARBOUILLE

Director General of
GIFEN
du GIFEN



The "Grand Carénage" in France

Launched in 2014 by EDF, the Grand Carénage is an industrial programme to renovate and modernise existing nuclear power plants, which comprises three categories of activities: renovate or replace major components approaching the end of their technical life; make any changes necessary to improve safety; ensure the long-term qualification of equipment beyond 40 years. The programme relies on cooperation between all the partner companies.



A revised cost of €49.44 billion

In 2015, the estimated cost of the programme was €55 billion. This was optimised in 2018 to €45 billion, i.e., 48.2 billion current euro. It has now been revised upwards to 49.4 billion current euro. This takes account of changes to the estimated duration of planned maintenance shut-downs (ten-yearly and partial inspections), based on information from previous years, as well as the impact of the health crisis over the period 2020-2022.

A well-advanced programme

24 ten-yearly inspections have been carried out on 900 MW, 1300 MW and 1450 MW reactors. 52 of 56 diesel standby generators have been brought into service.

Verbatim

Anna Veronika Wendland - The German press continues to harp on about "dinosaurs" and "elephants" when it comes to nuclear power plants, said to be too slow and too inflexible to constitute a backup for renewables, which is not true. During the Covid-19 pandemic, for example, nuclear power proved to be the most resilient industry in Germany. Sophisticated tests and controls were carried out in just days, and 1,500 subcontracted workers were deployed during a 6-week "extendable" maintenance shutdown without one case of Covid.

France has the second largest nuclear sector in the world, behind the United States

- With 56 reactors spread across 18 sites, it has an installed capacity of almost 61.4 GW.
- In 2019, it generated 379.5 TWh, i.e. 70.6% of total electricity production in mainland France. One of the sector's most noteworthy features is its standardisation: all the nuclear reactors currently in operation are pressurised water reactors.
- 6gCO₂ / Kwh: this is what nuclear energy releases into the atmosphere against 14.1 for onshore wind power, 15.6 for offshore wind, 56 for photovoltaic, 443 for gas, 778 for petroleum, 1050 for coal.
- EDF is planning to extend the operating life of its reactors to 50 or 60 years, as part of the Grand Carénage project.
- Two reactors in Fessenheim were shut down in February and June 2020 (14 have already been decommissioned previously).
- France's first EPR is now being built in Flamanville, and EDF is hoping to start building six new EPRs to replace the 14 reactors that are scheduled for decommissioning by 2035.
- Act no. 2019-1147 dated 8 November 2019 on energy and climate provides for a 50% reduction in the share of nuclear power by 2035.
- This reduction would have an impact on the 3,200 companies in the sector, which currently represents 220,000 workers (direct and indirect jobs).

The recovery plans and taxonomy: the financing of nuclear investments

The leverage provided by state support



In his article, Vakiasai Ramany discusses EDF's strategy and its ambition to contribute to the development of nuclear energy in France and Europe alongside renewable sources, which is crucial if we are to meet our carbon neutrality targets. He emphasises the financing challenges.

Pending the advent of SMRs, we must invest in building power reactors for periods of 5 to 10 years. This requires a very high level of capital investment at the start of the project, but a finished plant is an asset for over 60 years (perhaps 80 if its life can be extended), offering low operating costs, predictability, stability and reliable production costs. These are the main characteristics of nuclear energy.

Clearly, therefore, the challenge lies in financing the project during the preparatory and construction phases, and the associated risk. How to attract funding and investment?

Investment decisions rely on three main factors: a stable environment, long-term visibility and risk allocation

A stable environment. This is a sovereign responsibility. It is up to national governments and their agencies to create an environment with no long-term surprises, a transparent energy mix, and a stable energy policy that inspires confidence. The inclusion of nuclear energy in the taxonomy¹ is absolutely key to demonstrating its role in meeting carbon neutrality targets, and to building confidence and a sense of stability over the long term.

Long-term visibility. This is necessary to help investors calculate their cash flow over the full life of the asset. It is important to be able to accurately forecast both operating costs (EDF has over 2,000 reactor years of experience!) and construction costs. This requires expe-

rience, as well as operators/developers who know how to reliably estimate development and construction costs, which is the responsibility of technology developers and industrialists.

As for earnings visibility, the government has to get involved². Several approaches may be considered: EDF has trialled the "contract for difference" (CfD) in the United Kingdom with the Hinkley Point C project. We are now urging the British government to consider a model called the "Regulated Asset Base", which allows for the proper remuneration of investments involving a fair and reasonable level of risk, thanks to regulated government action that helps to increase earnings visibility³.

The final aspect regarding visibility: financing the project itself. It is important to be able to anticipate the cost of the project, and governments have huge leverage to reduce it mechanically. We must bear in mind that financing can account for more than 20% of the cost of a project of this nature, given its duration.

Reduction and proper allocation of risks. This allows investors to reduce their investment costs or their risk premiums. Risk reduction relies on industrial factors, namely a tried-and-tested technology. EDF is promoting EPR technology in Europe, which is tried and tested and is already in operation at Taishan in China. It will also be implemented at Flamanville in France and Olkiluoto in Finland. Although some difficulties were encountered with the first EPRs, the whole industrial chain associated with them is now being organised. It is a European chain, which considerably reduces the industrial risk.

Developing a fleet of EPRs with the support of a European industrial chain

China is performing remarkably well, but there is no magic solution: with EDF's support, they have developed a series of projects over the last 30 years. We must have the same ambition for Europe, drawing on the experience of a European industrial chain to build a European fleet of EPRs. This will enable it to plan its investments, and will also help to cut costs. A number of projects are already under way. In addition to Flamanville and

Olkiluoto, there is Hinkley Point C and Sizewell C in the United Kingdom, a medium-capacity EPR in the Czech Republic, projects in Poland, and hopefully, the Dutch programme, as well as the programme to build six EPRs in France. The latter is currently under investigation. The French government has asked EDF to submit a dossier by mid-2021. The programme would consist in building three pairs of EPRs, and we expect a decision to be taken after the 2022 presidential elections. We are making preparations and organising our response to the programme, following the democratic process that gives everyone a voice. We are confident in our ability to develop a programme that makes industrial, economic and societal sense, and that will offer a solution to all these issues.

Vakiasai RAMANY

Senior Vice President
Engineering and New Nuclear Projects
Development, EDF

The nuclear industry is investing in digital technology



In 2019, Orano invested €20 million, of which 10% for cybersecurity, and Framatome invested €35 million, notably in knowledge management. As for EDF, it has promised to create a digital twin for all of its plants. It has also launched the Switch programme to transition from a "document-centric" to a "data-centric" engineering approach.

¹ See box on page 27

² See Jaroslav Mil's presentation on the Czech Republic, and the request submitted to the Dutch government regarding earnings visibility.

³ See box on page 7.

Sending the right signals to investors

Between now and 2050, Europe is going to have to invest massively to decarbonise its economy, despite the weak growth in electricity demand¹.

- Massive investment to increase the production of renewable electricity, and to renew the first wind farms and photovoltaic capacity

- Extension of the life of nuclear plants, which still produce the most low-carbon electricity in Europe

- Investment in nuclear revival in countries that wish to maintain or develop their nuclear capacity (UK, Finland, France, Czech Republic, Hungary, Romania, Bulgaria, Poland, the Netherlands)

- Investment in gas-fired power plants to replace coal or nuclear in some countries – which is not compatible with climate neutrality goals

- Investment in storage resources, including pumped storage, batteries, etc.

- Investment in electricity grids (€400 billion up to 2030)

- Investment in the hydrogen option since decarbonising electricity production will not be enough – thus raising the issue of how to produce hydrogen without CO₂ emissions.

Today, with market prices falling, utility companies (especially in the private sector) do not have the means to finance a large proportion of these investments. Public support will be required, with state guarantees, financial packages with risk sharing between the public and private sectors, or even subsidies via guaranteed prices, etc.

Including all carbon-free electricity sources in the taxonomy and recovery plans

The question of which technologies are eligible for public financing is vital when it comes to attracting investors, hence the importance of the taxonomy. According to the International Energy Agency, all low-carbon technologies play a necessary role, and we cannot afford to dispense with any of them.

The Member States and the European Union have drawn up recovery plans for the period up to 2030, and aim to achieve net zero carbon emissions by 2050. It would be very helpful if the nuclear industry were to receive financing to invest in extending the life of existing plants and building new ones. Unfortunately, where nuclear energy is concerned, it is striking how often political considerations override scientific facts, which could unfortunately have a negative impact on the decarbonisation of our energy systems.

Win-win investments for the nuclear industry, the climate and Europe

Yet the long-term operation (LTO) of amortised plants would enable the production of low-cost nuclear electricity for 20 years. This solution, which is quick and easy to put into place, would have a beneficial impact on employment and industry (supply chains), and would save money on new, renewable resources that are both costly and intermittent.

Moreover, Europe's photovoltaic and battery sectors are not competitive, unlike the nuclear sector which provides it with considerable economic returns. Investments in new nuclear plants, third-generation reactors (EPRs and SMRs), materials R&D and innovation, construction techniques, digital technology, expertise and Gen 4, etc. will enable it to maintain its competitive advantage over other countries. Lastly, nuclear electricity, the load factors of which are higher than those of intermittent technologies, is a stable source for the production of low-carbon hydrogen. Win-win investments for the nuclear industry, the climate and Europe.

Henri PAILLÈRE

Head of the Planning and Economic Studies Section
IAEA



Austria non-suited again by the Court of Justice!

The European Court of Justice has just non-suited Austria, which was challenging the subsidies awarded by London for the construction of two EPRs at Hinkley Point by NNB Generation, a subsidiary of EDF Energy. At the end of 2014, the European Commission approved the aid package that the United Kingdom was preparing for the Hinkley Point project (amounting to £19.6 billion, or around €22.2 billion) in order to promote the creation of new nuclear energy production capacity. Austria had already requested that this decision be cancelled at first instance before the European Court of Justice, which had already dismissed this action in a ruling dated 12 July 2018.

A nuclear plant is eligible for state aid

In its ruling on 22 September 2020, the Court of Justice confirmed that, in the EU, a nuclear plant is eligible for state aid: "a Member State can choose the conditions for exploiting its energy resources, between different energy sources (...) and which does not preclude that choice from being nuclear energy". The Court pointed out that, to be approved, state aid must meet two conditions: it must facilitate the development of certain economic activities or regions, and it must not "adversely affect trading conditions to an extent contrary to the common interest". However, it stressed that this provision "does not require planned aid to pursue an objective of common interest". Furthermore, it held that the Commission is under no obligation, when examining the legality of state aid, to consider "the extent to which those measures are detrimental to the implementation of the principle of protection of the environment, the precautionary principle, the 'polluter pays' principle and the principle of sustainability relied on by the Republic of Austria". Provided that the activity supported complies with the EU's environmental rules, the European Commission's competition directorate should only consider the "effects of the state aid on competition and trade between Member States", said the Court of Justice.

¹ Annual per capita electricity consumption in Europe – which amounted to 6,046 kWh in 2018, 85% above the global average – has increased by 35 to 150% depending on the country, compared with 2018. In France, electricity consumption – which has dropped 15% in the industrial sector owing to the national lockdown – has reportedly risen by 40 to 50% in the digital sector, driven by remote working. This would partly offset declining electricity demand in other sectors. See <https://www.revolution-energetique.com/crise-du-covid-19-la-consommation-delectricite-en-baisse-de-15/>

Nuclear safety in contrast to gas-related risks in the Netherlands



The Netherlands is amicably debating plans to build between three and ten nuclear power plants, says Bart Groothuis. A situation that is less paradoxical than it seems!

The Netherlands discovered the world's largest natural gas fields in 1995, enabling it to connect 98% of homes to the gas heating network. But in recent years, earthquakes induced by gas extraction have become a matter of public concern, and the government has decided to stop extracting gas in 2022¹. In light of these new circumstances, it has just published its roadmap for achieving carbon neutrality by 2050 and updating an energy mix that consists primarily of fossil fuels, with gas accounting for 51% and coal 29%.

Why nuclear energy?

The Netherlands is a small country with a population of 18 million, which values its independence and its freedom of choice.

Norwegian and British gas reserves in the North Sea are gradually running out², and the Netherlands does not want to be reliant on gas imports from Qatar, the United States or Russia (even if they come via Germany!). As far as renewables are concerned, although prices have fallen substantially, the development of wind power in our country would be a blight on our entire landscape, and solar power is probably not the best solution in a northern country like ours!



As part of our effort to reduce carbon emissions, we opted for nuclear energy after the IPCC and the IAEA concluded that we would otherwise fail to meet our targets.

Furthermore, nuclear energy is safe compared to gas. Today, the Netherlands has just one 500 Wh nuclear power station at Borssele in Zeeland, which should reach the end of its life in 2033. A study has been conducted³ that supports the governing party's strategy to build between three and ten reactors.

A unifying choice

This plan, which was put forward by the Christian Democrats, is backed by the Social Democrats; not even the Greens have objected to it. There is an emerging public consensus too, with 54% in favour of the plan. This percentage could increase thanks to the involvement of our scientists and their proven arguments. Of course, nuclear energy is still expensive. The government says it is willing to support investment, and even to facilitate nuclear exports. At European level, Dutch MEPs have signed the petition to include nuclear energy in the taxonomy⁴, as we need a regulatory framework that promotes or guarantees investment.

It is urgent that we take the right decisions, as stormy waters lie ahead!

Bart GROOTHUIS
MEP – The Netherlands

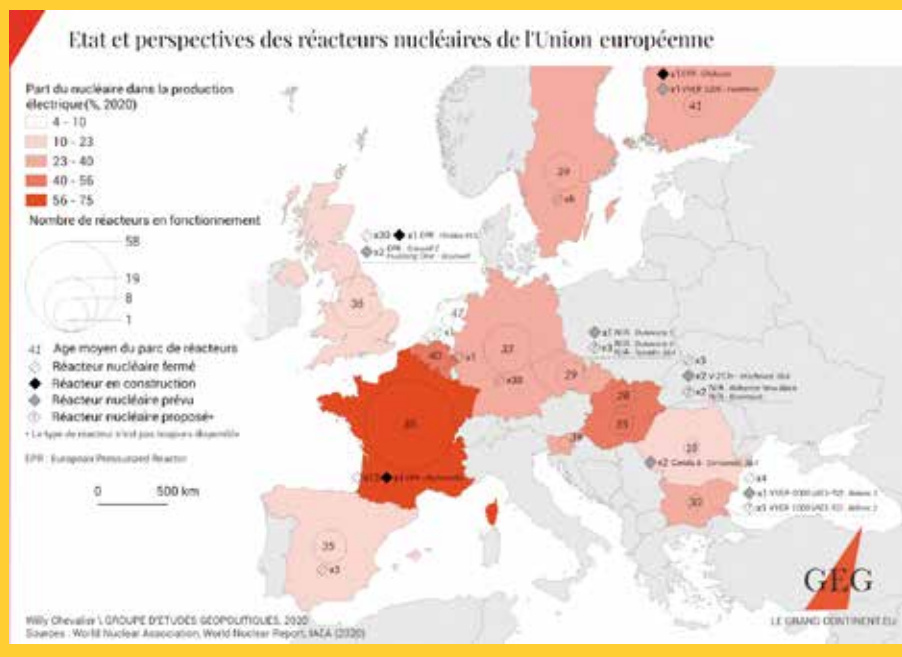
¹ The closure of the Groningen field, which was originally scheduled for 2030, will be brought forward eight years to the middle of 2022. Five years ago, it still produced more than 50 billion cubic metres of gas, i.e. a fifth of European production and around 10% of the Union's total consumption.

² UBS forecasts that gas production in Europe (excluding Russia) will decline rapidly in the next few years, falling from 230 billion cubic metres today to less than 170 by 2025.

³ Cf. 'A role for nuclear in the future Dutch energy mix' by Bojan Tomic, Principal Consultant, and Mario van den Borst, Senior Consultant, with preliminary remarks from the OECD-NEA (TBC)

⁴ 'Nuclear energy in taxonomy regulation', a petition signed by 60 MEPs and addressed to Mr Valdis Dombrovskis, European Commissioner Executive vice-president – 27 May 2020.

Reality and perspective of reactors in the European Union



Verbatims

Pierre Audigier, SLC – How will the load factor of new nuclear plants – and of what remains of existing plants – evolve, considering the ongoing development of intermittent sources? Won't it mainly be up to the nuclear industry to "make room" for intermittent energy sources? If it does so, its load factor can only decline, thus undermining its economic performance and, as a result, its ability to attract external investors.

Isabelle Leboucher, EDF – This decisive issue is addressed by considering the roles and responsibilities of those involved in the project, namely: - the project owner, who must be protected from this risk by regulation. - the community, for which the "Ku risk" is a matter of energy mix policy. It is not connected with any particular component of that mix, especially the controllable resource in question. Therefore, it should be handled by the power system manager – which has a full picture of the issues related to its mix – and by the community via regulation.

Yup, the climate matters to us.



The Proof: according to IPCC figures, the production of electricity using nuclear power emits on average as little CO₂ equivalent as wind power and 40 times less than that produced using natural gas.



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Source: Intergovernmental Panel on Climate Change. Median data - 2014.

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October 18th, 2018 - Paris

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Supplement La Lettre des Entretiens Européens - February 2019

La Lettre des Entretiens Européens October 2018 - 4e

The scientific challenges of spent fuel and nuclear waste management

Approcher - Débattre - Protéger

October 18th, 2018 - Paris

Insigma 2020

Management of spent fuel and nuclear waste: solutions for each technology and at each stage

Launching CIGEO to ensure security in the present without pre-empting the future



The process of establishing the public utility of the CIGEO project is under way. In view of this, Pierre-Marie Abadie, Managing Director of ANDRA (France's radioactive waste management agency) wished to convey three essential messages to add to the debate on the taxonomy¹.

Recognised scientific maturity

Storage is a mature technology recognised in France under the PNGMDR (National Plan for the Management of Radioactive Materials and Waste), as well as internationally. The controversy is centred more on ethical and socio-political aspects. The maturity of the technology is evidenced by 30 years of research in the underground laboratory in Bure, assessments carried out by international scientific journals, and the safety review conducted by the French Institute for Radiological Protection and Nuclear Safety (IRSN) and the ASN (French Nuclear Safety Authority), a precondition for obtaining permission to open the facility. France is not alone in this. Sweden and Finland are going to open a storage facility, and several countries in the IAEA and the NEA are launching new projects based on the experience and knowledge of countries that are already well advanced in the area²...

A progressive project that will span 120 years

Maturity is not a panacea. There are still things that will have to be done, and for a very long time: the project will develop gradually over a period of 120 years.

Construction work will continue after the facility has come into operation: a pilot phase will be conducted in the 2030s and 2040s, with four chambers for intermediate-level waste and a small pilot site for high-level waste. By the end of the 2050s, we will have filled the intermediate-level waste chambers without extending the HLW storage site. In 2080, work will begin on extending the HLW site, and after 140 years, the



High-level waste (HLW) will be buried in a bed of clay, 500 metres below ground.

construction and operation of the storage facility will come to an end.

A project that is adaptable to change over time

The progressive implementation process allows for greater flexibility, which is precisely what makes the project reversible and adaptable to new scientific and technical developments in management practices, to feedback, and to changes in energy policy itself and in technological innovations: the reprocessing (or not) of spent nuclear fuel, the implementation (or not) of Gen 4 technology, etc. A wealth of studies show that the CIGEO project can be adapted for all new developments related to the nuclear cycle, the life of power plants, and so on. All possibilities will be taken into consideration, as we are going to demonstrate.

Do nothing? The worst possible option in a time of uncertainty.

Given the prevailing geopolitical and climate instability, the health and economic crises, and the uncertain future of nuclear energy itself, is it best to do nothing or to engage in the CIGEO project? Doing nothing would lead to a loss of skills; it would disrupt the momentum of the past 30 years and expose us to the risks inherent in more chaotic societies.

Engaging in CIGEO will, on the contrary, secure a certain degree of certainty without pre-empting the future. It is the responsible thing to do. Waste is already being produced. It must be processed without closing the door to other scientific and

technical solutions that may be developed in the future.

Regardless of what the future holds for nuclear energy, waste management will evolve in line with new decisions, technical progress, and feedback. We are not talking about a blank cheque. The opening of CIGEO will be subject to consultations throughout the project: regular technical meetings with the ASN, and more political meetings with wider society.

Pierre-Marie ABADIE
Managing Director of ANDRA

Verbatims

Georges Sapy – Some ministers in France are weighing the major threat to humanity posed by global warming against the extremely small risk arising from rigorously processed nuclear waste buried 500 m underground, which will never kill anyone. These people are not only incompetent but foolish as well. How can they be so blind?

Jean-Louis Tison – I agree with ANDRA that the technology is mature. On the other hand, we must allow ourselves plenty of time to detail the specifics of the project, considering the outlook for nuclear energy in France and the changes that are happening in Europe. So, we should not rush headlong into a 15-billion-euro project right now!

Claude Fischer Herzog – France enjoys a good debate, even if it means flouting its own laws! As for the third consultation on nuclear waste management, it took five months, cost XX million, and culminated in the conclusion that “We don’t all agree”! We knew that already. The debate was pointless.

¹ Waste as a pretext for excluding nuclear energy from the taxonomy – See the box page 27.

² L’Andra shares its experiences with countries that are looking for solutions: see the speech by Thilo von Berlepsch, Director of International Relations BGE Technologies GmbH: How Germany manages its waste and cooperate with others? In Les Cahiers des Entretiens Européens 2018 in Paris : « Spent fuel and nuclear waste management. They must be implemented » www.entretiens-europeens.org

Involving citizens at every stage of the development of Cigeo



Who should be involved in decision making? When? How? Under what conditions and with what resources? Each of these questions will be discussed with the public in early 2021, at the consultation on the governance of the Cigeo project. The governance process will begin when the decree authorising the creation of Cigeo is issued and will continue throughout the project.

Decisions regarding every major step – including construction, commissioning, reception and storage of the first delivery, the further expansion of storage space, and final closure – will be made jointly with the public as part of the Cigeo governance process.

We must collectively find a way of doing this that ensures transparency of information, the relevance and quality of this information, recognition of knowledge and of each individual contribution, the widest possible participation, and the creation of a sustained dynamic of public participation.

Integral to the principle of reversibility, the governance of Cigeo is also consistent with Andra's stated priorities: because decisions related to the Cigeo project will affect the whole of society for a very long time, they cannot be taken by Andra, the state and expert assessors alone. They must result from a collective decision-making process. Moreover, this requirement for public participation is one of the main takeaways from the 2019 public debate on the National Plan for the Management of Radioactive Materials and Waste (PNGMDR), and from the follow-up measures taken in February 2020 by the Ministry of Ecological Transition and the Nuclear Safety Authority.

Mathieu DENIS-VIENOT

Head of Institutional Relations
Department of Communication and Public Liaison

After 30 years of discussion, Sweden opts for geological storage



In her presentation, Saïda Engström¹ told us how Sweden addressed and resolved the nuclear waste management issue. The discussions went on for 30 years and have just come to a positive conclusion.

Nuclear waste management solutions do exist. They vary from country to country, but everyone agrees that deep geological storage is the best option for final waste, which is the most radioactive. Unlike France, Sweden plans to follow in Finland's footsteps by burying final waste without reprocessing it first.

This question should be considered in the context of nuclear generation. In Sweden and elsewhere, opponents of nuclear energy argue that the industry does not have a solution for waste, and therefore that it should stop producing it.

Local community confidence

I have been working in the sector for 30 years and, 10 years ago, local communities were still calling for a citizens' vote. On 12 October 2020, they decided that there would no longer be a vote for or against nuclear waste burial. They are now willing to accommodate the storage facility, and say they can do so safely.

Sweden's waste management agency, SKB, has spent a lot of time and energy on this. It has gained the confidence of local residents, and the Nuclear Safety Authority has given its stamp of approval.

We are expecting to get the go-ahead from the government within the next six months, and then we will be able to open our storage facility – like Finland, which should be opening its own facility in 2021².



The Entretiens Européens organised a roundtable meeting with Pasi Tuohima, director of Communication in TO and Posiva, Frederic Launeau, director of Cigeo Project, and Vesa Lakaniemi, mayor of Eurajoki, who represented Posiva at the 17th edition in Helsinki in November 2019 (see their contribution in Les Cahiers at www.entretiens.europeens.org), as well as a tour of the POSIVA facility in Olkiluoto.

Sweden does not wish to open its future storage facility to other countries, which must – as stipulated in the Commission's directive² – develop their own national management plans. Some may consider regional storage facilities, and the Commission is open to that option. If three or four countries agree to share a storage facility, they will need to decide where it will be built. But let's face it – each will hope it will be on another country's soil.

It has taken us 30 years to solve our own problems and to win the acceptance of the Swedish people, and we need to work even more closely with the general public. We are all engineers and, too often, we tend to work in our own little bubbles; but we need politicians, and even ecologists, who have understood the importance of nuclear energy for the climate.

Saïda LAAROUCHI ENGSTRÖM

Strategy Advisor
VATTENFALL

¹ Saïda is coordinating the selection of a site for the deep storage of spent fuel in Sweden, on behalf of SKB. She led discussions with candidate municipalities, local and national decision makers, and citizens. She was also in charge of the programme to assess the environmental impact of deep geological storage. Since 2018, she has served as advisor to the management of Vattenfall on managing core competencies on production sites.

² Directive 2011/70 / Euratom - Revised in 2018.

Verbatims

Claude Fischer Herzog – Yes, it's important to involve politicians, but they need to be educated first! In France, we have seen ministers question decisions due to a lack of knowledge and interest! As for educating the public, CLIs (local information committees) by themselves are not enough!! Children should learn about these things at school. Learning to read and write is good, but understanding science and industry is important too.

Pierre-Marie Abadie – Let me be perfectly clear. There is no question of France importing waste from other countries! Any suggestion that countries with highly developed solutions could open up their facilities to others would seriously undermine their position! However, for small countries, building a shared storage facility clearly makes sense, and is something that should be considered with the support of international agencies like the IAEA or the NEA.

The multi-recycling of MOX: a technology for future EPRs?

Claude Fischer Herzog - France produces MOX from spent fuel. How important is recycling?



Bertrand Morel - France has opted for the closed cycle approach as a key factor in the sustainability of the nuclear cycle (processing and mono-recycling). The recycling sector employs 5,000 people and Orano holds this expertise, with its La Hague facility. Orano is now interested in multi-recycling in pressurised water reactors: it is a way of buying time until the advent of GEN 4, which will reveal the true value of Pu. Ultimately, we intend to adopt a much more flexible approach: a dual-strata operating system could be envisaged, with: i) the EPR technology constituting the main fleet and ii) fast reactors to manage the plutonium (Pu) and the minor actinides, thereby improving the long-term waste situation.

CFH - Thanks to technical progress in France's nuclear fleet, MOX could be used several times in third-generation EPRs: this would, in a way, constitute a multi-recycling strategy for EPRs, involving MOX 1, MOX 2, MOX 3, and so on. Is that why Astrid was scrapped?

BM - No, the multi-recycling of plutonium in PWRs is absolutely not incompatible with fast neutron reactors (FNRs). Moreover, the true value of processing and plutonium comes to the fore in an FNR. The production of MOX currently serves to reduce the volume of waste. Ultimately, multi-recycling should stabilise spent fuel inventories and give us more time to lay the groundwork for fast reactors reactors. I should add that Orano is investing massively in R&D on new technologies like molten salt reactors, which have many synergies with our processing technologies. Orano is also exploring ways to decategorize outer packaging and thus substantially reduce the volume of waste.

CFH - Why do you think nuclear energy has been excluded from the taxonomy" and from European funding?

BM - It is absurd that nuclear energy is not regarded as a sustainable

solution, considering that it contributes to the fight against climate change and meets the taxonomy criteria with geological storage. In France, recycling was introduced very quickly: it is an excellent example of a circular economy which, as it accounts for less than 1% of natural radioactivity, has only a very small impact on the population.

CFH - If the project is approved, the construction of 6 EPRs will begin in 2024: will we be ready for the first MOX trials by then? What will happen to the 350,000 metric tonnes of depleted uranium if the project is not approved?

BM - Under the current scenarios, MOX fuel will start to be used in some EPRs in about 2040, and multi-recycling in PWRs will begin in about 2050 if the associated R&D is successful. Everything is going according to plan. Research into fast reactors must continue in parallel, and multi-recycling in PWRs will allow ample time for it. Several fast reactor projects are currently being implemented worldwide, notably in the USA. As for depleted uranium, we believe that it can be recycled. It is easy to store, and several R&D programmes are under way with a view to optimising its use.

CFH - How can we improve European cooperation in multi-recycling? And is the future of La Hague secure, both in Europe and worldwide?

BM - MOX fuel and FNRs are of particular interest to countries that wish to develop their nuclear capacity and require large numbers of reactors. This is true, for instance, of China. In Europe, opportunities can be created by pooling the needs of different customers.

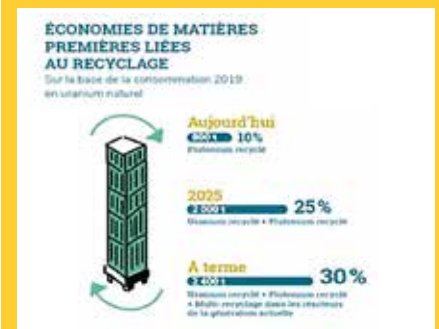
CFH - Resolving the issue of waste processing is crucial to the acceptability of nuclear energy, but some countries are lagging behind. How can we help them?

BM - At Orano, we are putting a lot of money into R&D to reduce waste in preparation for the future fleet of reactors. We have two flagship projects: the actinide converter for molten salt reactors, and the decategorisation of outer packaging. More cooperation between interested States is vital.

What is MOX fuel?

MOX fuel is a mixture of uranium and plutonium oxides, which is used to manufacture nuclear fuels. It offers a means of recycling the plutonium recovered from spent fuel, which is reprocessed beforehand in La Hague. The plutonium is recycled at Orano Melox's Marcoule site in the South of France.

The nuclear industry was among the first to start recycling spent fuel more than 50 years ago, in order to reduce waste and conserve raw materials. Thanks to Orano's world-leading technological expertise and technical capabilities, almost 96% of the spent fuel used in nuclear reactors for power generation or research purposes can be recycled.



The two advantages of recycling

- **It reduces the volume and radiotoxicity of waste:** at Orano, the recycling of spent waste reduces waste volumes fivefold and radiotoxicity tenfold.
- **It reduces the consumption of raw materials:**

- 10% of nuclear electricity comes from recycled materials

- Today, recycling has cut raw materials consumption by 10%. From 2023 onwards, EDF's strategy to recycle the uranium in spent fuel will reduce it by up to 25%. This figure may rise to 30% with the "multi-recycling" of nuclear fuels in pressurised water reactors.

- By recycling spent fuel, France now saves more than 800 metric tonnes of natural uranium – a mineral resource – every year.

Since 1972, 44 reactors across the world have produced nuclear electricity using MOX fuel: Germany (1972), Switzerland (1984), France (1987), Belgium (1995), the USA (2005), Japan (2009), the Netherlands (2014).

How to sustain your low-carbon growth thanks to nuclear energy

NPP New Build
Research Reactors
Small Modular Reactors

Plant Operation Support
Long Term Operation

Decommissioning &
Radwaste Management

Medical Applications

ENGIE, a global Nuclear Operator with local engineering and services

Verbatims

Claude Fischer Herzog – Africa needs all of its energy sources in order to meet its development requirements and the needs of its populations. Cooperation has never been more important to decarbonise its energy mix as much as possible, 92% of which relies on fossil fuels, and to develop other solutions such as solar and nuclear energy. But beware of those advocating 100% solar energy, they are being irresponsible! The sun has never produced solar energy alone – you need panels (made in China), and a lot of water. Those refusing nuclear power to Africans are equally so! There are 34 countries equipped with uranium, which will of course need to create the political stability, security and safety conditions indispensable for developing the technology. Europe came out of the war in 1958 with a Euratom treaty that allowed it to resolve its differences and achieve prosperity for Europeans. Why deny this to Africans? On the contrary, Europe could give Africa the benefit of its experience and transfer technology and skills for public acceptance of nuclear power in countries like Kenya and Mozambique which, like South Africa, wish to develop this source of energy. If Europe doesn't help, it will be left to Russia or China!

Bernard Mairy, European Society for Engineers and Industrialists (SEII) – I greatly appreciated your very open position on these energy issues ("we need all energy sources") and your interest in Africa. I have personally committed – together with Georges Van Goethem – to preparing an international academic conference dedicated to **Sustainable Energy for Africa, SE4A 2021, set to take place in Benin from 8 to 11 November 2021**. It is being co-organised with Belgium's Royal Academy for Overseas Sciences (RAOS) and the Benin National Academy of Science and Art (ANSALB). Like you, we are approaching the issue of energy development in Africa from the perspective of all energies, "without taboo". Solutions will vary according to the specific local and regional needs of this large, high-potential continent, also taking into account of course other societal, economic and environmental aspects. The aim is to provide our African friends with objective information on technical developments and on current research in the field of energy. We want them to be able to talk with experts, and form an opinion on the energy solutions they might consider based on their own needs and resources. I was not aware of *Les Entretiens Européens & Eurafricains* before, but I'm looking forward to seeing you in Cotonou.

L'énergie nucléaire, Une source décarbonée pour le développement durable de l'Afrique ?

Après le Sommet Russie/Afrique de Sochi et les Entretiens Européens d'Helsinki, **Claude Fischer Herzog** répond aux questions de **Christine H. Gueye**.



Écoutez les arguments de Claude Fischer Herzog en cliquant sur le lien de la vidéo :

https://www.youtube.com/watch?v=1hyI9gdf_s&feature=youtu.be

Cooperations and competition with neighbouring countries and internationally

The international dimension of the nuclear industry



According to Yves Brechet, former High Commissioner for Atomic Energy, the international dimension of the nuclear industry is integral to its nature. Whether for geostrategic reasons present from the outset in the form of issues related to deterrence and nuclear weapons, for geopolitical reasons related to industrial and energy sovereignty, or for geoclimatic reasons that have only more recently become apparent with the need to decarbonise our economy to combat climate change.

Whether for geostrategic reasons present from the outset in the form of issues related to deterrence and nuclear weapons, for geopolitical reasons related to industrial and energy sovereignty, or for geoclimatic reasons that have only more recently become apparent with the need to decarbonise our economy to combat climate change.

A "sovereign" industrial sector that requires international cooperation

Nuclear generation is both a manufacturing and commercial sector and, as such, is subject to competition throughout the cycle, from fuel supply to plant construction and downstream management. However, it is also a sovereign sector since its purpose is to supply electricity for all of a country's business activities. To be viable, nuclear generation must be profitable and sustainable. It must also be safe everywhere, as a nuclear accident affects the industry worldwide, irrespective of its magnitude. Consequently, there is an almost structural need for international cooperation regarding both the safety of second- and third-generation reactors, and the management of final waste. I have always been fascinated by the suggestion that an issue that will last around 20 times longer than the most ancient human civilisation (100,000 years for deep geological storage) could be managed nationally. And with respect to the fundamental issue of cycle closure, it is worth noting that at the very time when France is shutting down its fast breeder reactor programme¹, China, India, Russia and the USA are ramping up their activities in this area.

Stepping up cooperation in an unprecedented global context

Cooperation may take several forms, for example resource sharing (research

reactors, critical mock-ups), skills sharing (especially in terms of simulation tools), and the internationalisation of training. It can also take the form of pre-competitive research (safety, Gen 4) or post-competitive research (plant ageing studies). In France, which has a strong Colbertist tradition, the nuclear industry has developed under state leadership, in close collaboration with electricity producers and distributors. The CEA has been a key component of this strategy. Major international collaborations have been developed with the USA, the United Kingdom, China, Russia and Japan, while more science-oriented partnerships have been built with Belgium, Germany, Poland and Israel, all of which support our manufacturers and reinforce our foreign policy. They should be expanded because the problem before us is a global problem. However, this will require a continuing high level of involvement and a strong focus on maintaining and developing our skills. Yet given its inability to adhere to a clear nuclear strategy for the past several years, France's credibility is considerably diminished, as is the willingness of other countries to work with us.

The state's legitimate role in safeguarding nuclear generation

Nuclear power requires long-term commitment, substantial investment and, therefore, a stable policy that far outlives election periods and fluctuations in the CAC 40. It is no coincidence that major electro-nuclear policies are currently being implemented in countries with a strong state. The liberalisation of the energy market in Europe and the penalisation of long-term investments have considerably undermined the possibility of a well-balanced energy policy. The state has abandoned its role as energy policy coordinator, and more broadly speaking, the prevailing ideology has cleared it of all responsibility and narrowed its scope of action. Yet it continues to have a legitimate role in areas essential to the public good, such as defence, internal security, justice, healthcare, education, and access to electricity for all citizens and industries. It is

therefore by nature a key player in the nuclear industry, in terms of ensuring its safety and the stability of the decisions taken.

Freeing Europe from the influence of anti-nuclear movements

The urgency of the climate crisis calls for action at the European level. However, this would require stronger European-level leadership. Europe's energy policy is hampered by the fact that "anti-nuclear" states are able to block joint initiatives in the sector. It is under political pressure from Germany, which is exporting the problems it has created for itself. We need look no further for the true reason behind the new commitments to the hydrogen economy, which are as colossal as they are ill-reasoned. Any policy, regardless of its purpose, must be grounded in rationality and democratic legitimacy; it must be based on a sense of the public good, and on objective, long-term analyses. Yet, while we can optimistically hope that European decision-makers still have a sense of the public good, and that Europe has ample time ahead of it, the objectivity of analyses is questionable. For example, one can only wonder why nuclear energy is excluded from the taxonomy on the grounds of the waste it produces, when natural gas is included.

Industrial consortia should be established on a European scale. But as long as Europe is a political dwarf, shackled to an ideology that claims to be green but is mainly "degrowthist", agreements must be reached between individual states and industrialists to enable us to move forward and to seriously address the issue of global warming, as the IPCC has very clearly explained.

Yves BRECHET

Former High Commissioner
for Atomic Energy
Member of Sauvons Le Climat



¹ On Friday 30 August, 2019, the Atomic Energy Commission (CEA) confirmed that plans to build a fourth-generation fast breeder reactor prototype (ASTRID) had been scrapped.



ROSATOM



75 YEARS OF NUCLEAR INDUSTRY

The year 2020 marks the 75th anniversary of the Russian nuclear industry.

Each new Rosatom-designed unit represents a potential opportunity of up to 1 billion euros worth of orders for our European partners.

Russia and the European Union: cooperation in mutual interest to open up new horizons



For Rosatom, nuclear energy must play an essential role in the modern and sustainable energy mix. A potential exists, very promising. For Andrey Rozhdestvin, the key to maximizing this potential is to engage in collaborative innovation.

It takes years to become a nuclear player, it is a long-term collaborative commitment. After Fukushima, Russia has decided to continue its nuclear development on a national and international basis, and we see serial production as one of the keys to our success. We have built 80 VVER reactors in the world, and in the past 15 years, we have connected 17 units to the grid.

Our VVER technology was born in Russia, but it has grown up in Europe with the involvement of our partners. It is certain that the opening of the European market influenced our strategy, even if we were already in Germany in 1966 with our first VVER reactor overseas. Now we have 18 VVER reactors in European countries, and today we are fundamentally part of Europe. Currently, two new construction projects are underway in the EU: the Paks-2 nuclear power plant in Hungary and the Hanhikivi-1 nuclear power plant in Finland.



We have a commercial approach, but we are all part of a chain. We bought 11 large Arabelle steam turbines (more than what General Electric has signed in the rest of the world). Framatome is also an important par-

ner in the field of digitization. It has been selected as an I&C supplier for our Finnish and Hungarian projects, as well as for several nuclear power plants in Russia.



We cooperate in many areas with many European countries, such as ENUSA and Synatom in the supply of enriched uranium, Vattenfall and Fortum in the delivery of fuel, Framatome and Orano in the area of the fuel cycle. We have partners in the nuclear industry in Bulgaria, the Czech Republic, Slovakia and Hungary. We believe in all green energy technologies, which is why we are also developing wind projects in Russia with our Dutch partner Lagerwey. These are just a few examples.

Innovation cannot and does not thrive in isolation

More generally, it is mutual interest that guides collaboration, and the common objectives of the Paris Agreement. As the necessity for more flexible low-carbon power generation solution increases amidst the climate crisis, the nuclear sector has already proven it has the capacity to respond by adapting and tailoring solutions that address specific local demands, but more needs to be done. Thus, SMRs will be able to provide heat to industrial sites and homes in isolated and decentralized areas¹. It is impossible to meet the challenges of sustainable development alone, and cooperation is needed on all technologies with our European partners: new build, SMR, fast neutron reactors², renewable energy, but also hydrogen, CO2 capture and storage (CCS).

Cooperation covering the entire cycle

We have been developing cooperation for decades with Europe in research and innovation, and in particular for the new fuel cycle. Scientific cooperation is essential, as with the CEA and EDF. For example, our joint efforts in NFC projects date back to 1971, when Tenex and CEA signed their first uranium enrichment services contract.



With our European partners, we have been implementing projects across the entire spectrum of nuclear solutions and services. Let's take ITER as another example – one of the most ambitious mega-science endeavors in the world that seeks to simulate the Sun on Earth. The project brings together concerted efforts from 35 nations, including EU member states and Russia, and is designed to prove the feasibility of fusion as a large-scale and carbon-free source of energy. As the initiative progresses, the collaborative thought propelling it also contributes to breakthroughs that can be applied in aerospace, health-care, material studies, and so on.

The challenges the nuclear industry is currently facing cannot be tackled alone. Joint efforts are needed to overcome the challenges of investment (CAPEX) and waste management, and it is only by pooling resources and expertise that we can move forward towards a closed cycle of fuel, and thus open up unlimited horizons for the nuclear industry in Europe and the world.

Andrey ROZHDESTVIN
Director
ROSATOM Western Europe

¹ Russia was the first in the world to launch an «Akademik Lomonosov» floating center based in the Far East.

² The first commercially operated rapid neutron reactor is located in Beloiarsk.

A global revival... except in Europe?



The future of nuclear energy worldwide has never been as promising as it is in 2020. The latest industrial developments in the sector are creating some very interesting opportunities,

especially in parts of the world that have poor electricity access or will have to cut back on fossil fuels. While China has made huge progress in the past 20 years, to the extent that the entire country has been electrified, this is far from being the case in many Asian and African countries. In India, 350 million people do not have access to electricity, and the same applies to half of Sub-Saharan Africa where the electricity supply is completely unreliable and intermittent¹.

Rising electricity demand

However, enabling large areas of the world to catch up economically is not the only reason to ramp up electricity production. Electricity demand is set to rise significantly, be it because of the rapid and inevitable digitisation of our society with the arrival of 5G, the digitisation of farming, the electrification of vehicles, or building heating systems. And intermittent sources such as wind and solar power will not be enough to meet these growing needs. In 2018, after 40 years of hard work and research, these accounted for just 14.8% of electrical energy production, despite generous financial support. The truth about their inhibitory cost – as well as growing public opposition – should put paid to any illusions, and it would seem that their development is levelling off.

People in Europe hear only negative things about nuclear energy, although extraordinary technological progress is being made. Research centres in Europe and worldwide are working actively together, and some amazing innovations are being made in terms of improving existing systems and building small modular reactors (SMRs) and Gen-4 reactors. And while the decision to shut down the Tihange and Doel nuclear plants is a terrible step backwards for Belgium (which was a leader in the field) and for Europe, other countries have decided to maintain and develop their nuclear facilities or, like Poland, create new ones.

Russia, China and the USA engaged in a geopolitical race without the European Union

Today, Russia is building more reactors than any other country. These reactors are just as safe as those in OECD countries, and the business model adopted by Rosatom, the state-run nuclear energy corporation,

is formidably efficient. Besides the plant, it provides expertise and enriched uranium, recycles spent fuel, and manages waste. VVER reactors are currently being built at Paks II in Hungary and in Belarus, at the borders of the Baltic states. In addition, the Russians are forging ahead in the development of small modular reactors, and have launched the world's first mobile, floating nuclear power plant – the Akademik Lomonosov – in the Arctic region of Siberia. A feat of technology that is under-estimated and criticised by Greenpeace (“nuclear Titanic”, “Chernobyl on ice”) despite the huge commercial potential it represents for North European countries, and for some countries in Africa or elsewhere.

But the Chinese are not to be outdone. Their first “Hualong” reactor (“Hualong” means dragon, a symbol of vital energy, peace and prosperity) was connected to the national grid in November 2020. Having broken away from western technology, China aims to generate 10 TWh of nuclear energy per year at home, thereby reducing carbon emissions by 8.16 million tonnes. Already present in the United Kingdom, where it is working with EDF Energy on the Sizewell and Hinkley Point projects, it has set its sights on selling its reactors all over the world.

The United States have realised that the time has come to act, and have introduced bipartite legislation to keep existing American reactors in operation – in some cases for up to 80 years – and to lay the groundwork for the deployment of advanced nuclear technologies². They are developing a needs-based strategy and focusing on the private sector, which is continuing to invest in the industry. The first SMR is expected to be commissioned in 2025 in Utah, and they have just dealt the EU a slap in the face by entering into a bilateral agreement with Romania to develop CANDU technology there.

The EU must snap out of its green stupor!

The EU has chosen to push ahead with de-industrialisation and to focus exclusively on wind and solar power to reduce its carbon footprint. This policy is suicidal. The EU is at the forefront of nuclear expertise and is in danger of weakening its skills and assets, and losing its competitive edge. For example, France is lagging behind Russia and China when it comes to small modular reactors. In 2019, the CEA, EDF, Naval Group and TechnicAtome launched the Nuward, an SMR developed in partnership with the USA; however, if it is not backed by the European Union, we will lose market shares in our own space and worldwide.

Today, the European Commission is embarking on an ill-considered “hydrogen strategy”

based on wind or solar power. This is absurd³, as the only way to produce large quantities of hydrogen in a cost-effective, carbon-free manner is to use high-temperature gas-cooled reactors (HTGRs). The public, the media and politicians do not understand the complex scientific and technical data relating to nuclear energy. We must put a stop to the simplistic narrative, and indeed the lies intended to undermine a flourishing industry. Politicians must urgently pull themselves together and try, if it is still possible, to put an end to this mess.

Samuele FURFARI

Professor of Geopolitics of Energy at the Université Libre de Bruxelles
President of the European Society of Engineers and Industrialists

¹ FURFARI, Samuele. “The Urgency of Electrifying Africa”. *L'Harmattan*, 2019. See also Sputnik's interview with Claude Fischer Herzog following the Sochi Summit on nuclear energy in Africa.

² See the bipartite legislation put forward by American senators in November 2020: <https://www.epw.senate.gov/public/index.cfm/2020/11/senators-introduce-bipartisan-legislation-to-revitalize-america-s-nuclear-infrastructure>

³ FURFARI, Samuele. *L'utopie hydrogène*. ebook, 2020.

The United States in Romania



The United States and Romania have entered into an inter-governmental cooperation agreement in Washington for the construction of two nuclear units at the Cernavoda site in south-east Romania. American company AECOM will manage the 8-billion-dollar project, which will be implemented with the support of Romanian, Canadian and French organisations. In June, Bucharest terminated an agreement with China General Nuclear Power Corporation (CGN), the only organisation to respond to its 2014 tender to extend and modernise the Cernavoda site. Nuclearelectrica, which is predominantly owned by the Romanian state, agreed to look for new investors after the United States accused China of trying to steal its technologies for military purposes (!). It is worth pointing out that CGN is a partner of EDF in China... and in the United Kingdom, where it is involved in the Hinkley Point C project.

SF

Investing without delay in the nuclear technology of the future

The Commission recognizes the essential role of nuclear power



In his intervention during the Conference "Entretiens Européens" (European Interviews), Saïd Abou-sahl returned on the responsibility of the Commission and that

of the States in the financing of the investments necessary for the renewal of the nuclear fleet in Europe, and the development of research for the nuclear power of the future. A good opportunity to make the point, for the representative of the nuclear scientific group for taxonomy, set up by the JRC.

With its Communication of May 2017¹, the European Commission underlined the importance of nuclear power in the energy mix and the amount of investments, estimated at 800 billion euros by 2050. Funding is a big challenge to replace the existing power plants, which are capital intensive, and the Commission recognizes the need for guarantees to attract investors. If we do not invest, we will not be able to implement the zero-carbon strategy.

Renewable energy and nuclear power to reduce greenhouse gas emissions

In its Communication of November 2018², the Commission confirmed its strategy: nuclear and renewable energies will be essential for success! This is based on scientific evidence and refers to the governmental panels on climate change and the urgency to reduce greenhouse gas emissions. A whole chapter concerns the financial sector and its key role in making the transition a success and financing sustainable investments. Within this framework, the Commission proposed the taxonomy³. Its objective is to send a message to investors by defining projects and objectives for sustainable development. A technical group of experts has been set-up to examine sustainable activities. In its report of March 2020, the group was

unable to draw conclusions on whether or not to include nuclear in the taxonomy. What causes the debate is not nuclear technology, but the issue of nuclear waste! Nuclear waste management is a process, storage solutions have been proposed, but the expert group wishes to clarify this point by asking the Commission to appoint another group of experts with a recognized competence in the nuclear field. The Commission asked its scientific arm, the JRC, to carry out a technical assessment of the fuel cycle against the taxonomy criteria, with a focus on the downstream phase of the cycle, concerning waste management. The work is in progress.

Do not expect everything from the Commission

With regard to the Generation 4, in 2006, Euratom joined the GIF³ and invested in research on the 6 systems of GEN4 on the aspects of safety, waste management, security and non-proliferation.

Indeed, the amount of Euratom's budget (which is still the subject of difficult negotiation) can be discussed. Nevertheless, it allows the financing of many R&D projects which cover also the safety of fast neutron or molten salt reactors, the coordination of the SET-Plan created by the Commission⁴, or the support the research programmes of the Member States for the peaceful civilian use of nuclear fission and fusion energy⁵. Not to mention the ITER project, established in Cadarache (FR), which



represents a substantial share of around 5.5 billion euros for the next 7 years.

The European Commission is not there to replace States, and it must be recognized that when it comes to the contribution to GIF, apart from Euratom and France, the contributions of other Member States remain very limited. States and actors must work together, cooperate and pool their efforts ... The role of the European Commission is to encourage them to do so. Platforms already exist, working groups are in progress⁶, but the Commission cannot do everything. Not all the States share the nuclear choice, and there are blockages within Euratom that must be overcome! That being said, let's not confuse the Commission and the Union! There is a balance of power within the Council itself, and even when the Commission proposes, the decision ultimately lies with the States.

Saïd ABOUSAHL

Head of the Euratom Coordination Unit
Joint Research Center
European Commission

Verbatims

Laetitia Canou - Skills development is a major issue in this industry and it must be structured in terms of initial and continuing training, at least at the European level. It will be more difficult to harmonise the safety authorities (ASN, etc.), unless we can coordinate expectations and scope of action.

Claude Fischer Herzog - It goes without saying that the Commission can't do everything. But it must better fulfil its role of creating incentives. When the Commission makes proposals dictated by pressure from the anti-nuclear camp, it is in fact forcing itself on Member States, with the kind of damaging effects it will be difficult for us to recover from. The Commission should rely more on Les Entretiens Européens, because we are allies in EURATOM's fight for a proper budget. Austria is the enemy, not us.

¹ Nuclear Illustrative Programme presented under Article 40 of the Euratom Treaty-Final (after opinion of EESC)- {SWD(2017) 158 final}

² A Clean Planet for all, A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy- COM(2018) 773 final

³ See frame at page 27

⁴ SET-Plan: the strategic plan for energy technologies adopted by the EU in 2008 is intended to give a strong impetus to European research

⁵ see projects PREDIS and A-CINCH in the frame below

⁶ EUROTRANS projects of FP6, EVOL, CP-ESFR and ADRIANA projects of FP7, GEMINI +, SAMOFAR and SAMOSAFER projects of the Horizon 2020 programme, as well as national programmes in France, such as PACEN and NEEDS...

Generations 3 and 4 are not to be set against each other: each has its own future

It is now well-established that fast-breeder reactors are the best equipped to make optimal use of available uranium resources, and perhaps to further reduce the potential long-term toxicity of residual waste. This explains the major research effort made by numerous teams worldwide over the past few decades, particularly within the framework of the Generation IV International Forum (GIF).

However, the deployment of fast-breeder reactors seems to be hampered today by two stumbling blocks: firstly, a feeling that there is no great urgency (we have several decades of easily accessible uranium ahead of us); secondly, the fact that the technology can and must mature, and that research will produce more sophisticated fast-breeder reactors (which are safer, less costly, and also perhaps better adapted to new needs, such as less centralised uses, heat production, etc.).

At the same time, water reactor technology has been tried and tested extensively, and the third generation is remarkably safe. Of course, as far as use of raw materials is concerned, they cannot compete with fast-breeder reactors and must, in the long term, give way to a new generation (assuming that nuclear energy has a sustainable future). But they can still continue to benefit from innovation and progress, and adapt to new and changing needs; and research is currently being carried out into the "multi-recycling" of uranium and plutonium, which could bring significant benefits in terms of materials use.

Generations of reactors that are complementary over time

Therefore, we should not be comparing generation three with generation four. Each has a role to play, each has its own

deployment timeline: within the next few decades for water reactors like EPRs and later for fast-breeder reactors. And recycling in water reactors could effectively set the stage for future recycling in fast-breeder reactors, thus producing systems that are increasingly compliant with "circular economy" principles.

One point seems worthy of note today: by thinking about fast-breeder reactors from a longer-term perspective, we are giving ourselves the opportunity to explore more options, and therefore to try and address certain issues – such as cost, safety, flexibility and the new needs mentioned above – as effectively as possible. At present, several concepts are being studied or investigated further. Following the termination of the ASTRID programme, the CEA is also conducting research into small sodium reactors, or molten salt reactors, and in the United States a profusion of new concepts are emerging, again from a variety of new sources; this newly burgeoning research is very exciting. It could bring a whole new dynamic to nuclear research! Generation 4 may be the ideal springboard for international cooperation. It should be approached with a level of ambition commensurate with the tremendous promise it holds; with an open mind, but also with caution and realism (especially regarding the prospects and schedule for industrial implementation), to guard against more disappointment further down the line.

Bernard BOULLIS

Advisor to the High Commissioner for Atomic Energy



Nuclear power in the European Union in figures

- 129 nuclear reactors in operation in 14 Member States (including the UK)
- 120 GWe of total installed power
- The average age of a reactor is 30 years
- 6 reactors under construction in France, Romania, Slovakia and Finland
- 12 projects planned in the United Kingdom, Czech Republic, Poland, Hungary, Romania, Bulgaria, Finland, Sweden and Slovenia
- 3 to 10 reactors by 2030 under discussion in the Netherlands
- 6 EPRs planned in France
- If these projects come to fruition, the European nuclear industry, which already represents 780,000 jobs, could create up to 350,000 additional jobs

IMT Atlantique in Nantes involved in two Euratom projects

The SUBATECH laboratory (CNRS/IN2P3 – IMT Atlantique – University of Nantes) is participating in the PREDIS and A-CINCH projects under the Euratom programme, which is dedicated to nuclear research and training in the European Union. The latter is part of Horizon 2020, the European Union's programme for funding research and innovation.

With a budget of €79 billion, Horizon 2020 is tasked with supporting academic and industrial research according to three priorities: scientific excellence, industrial leadership and societal challenges.



PREDIS is a research project on radioactive waste management, and A-CINCH is designed to encourage student interest in nuclear chemistry and radiochemistry. "Our participation in these two European projects underlines the excellence of the research and training carried out at IMT Atlantique through SUBATECH's radiochemistry group", says Abdesselam Abdelouas, a professor and researcher at IMT Atlantique, who is managing the two projects.

Verbatim

Michel Belakhovsky, G2E-TERE - We suggest a "For the survival of humanity" task force, with the aim of eliminating fossil fuels by 2050. Can it be done? Yes, if we immediately launch a technological BREAKTHROUGH plan with the development in 10 years of safe, renewable and virtually waste-free nuclear power at an acceptable cost. Freeman Dyson analysed why civil nuclear power was not socially acceptable in his day. The solution is now at hand, China and the United States are actively working on it and should achieve their goal within this decade. Europe has the skills, but lacks the political will.

The molten salt reactor

Claude Fischer Herzog - You are working on a molten salt reactor (MSFR) project. What are the advantages of this type of reactor?



Elsa Merle - The MSFR is a liquid fuel reactor, in which the fuel circulates as a coolant. Its main advantage is its operational flexibility. In fact, these reactors can operate with

any type of fuel. The power output can be controlled using the heat extracted from the reactor core, and according to grid demand across a very broad power range; this compensates for the fluctuating output of renewable energy sources. It is also worth mentioning its design (large-core SMR, modularity, geometry, etc.) and the fact that it can be used as a regenerator in both fuel cycles (the U-Pu cycle and the thorium cycle), as a waste incinerator, in spatial propulsion, in the production of radioisotopes, etc. Like all regenerator reactors in the U-Pu cycle, it can use the depleted uranium stored at La Hague. It should also be pointed out that it is intrinsically safe, thanks to the reactor's considerable neutronic stability.

CFH - Isn't the liquid fuel more difficult to confine?

EM - Fuel confinement is only a concern in the liquid phase, i.e. when the fuel temperature is above around 450 °C. When the fuel cools down, it solidifies and stays in place. However, as in any fission reactor, it is vital to be able to cool it down in the event of an emergency. In this respect, liquid fuels are no different to solid fuels. Except that they are easier to move passively by means of a straightforward gravitational draining process. The real difference is that

solid-fuel reactors can be compacted, unlike the majority of liquid-fuel reactors.

CFH - Will the reactors have to be built in a SEVESO area owing to the risk of chlorine evaporation in the event that the reactor has to be cooled down?

EM - So far, we haven't found any risk of chlorine gas compound production. The chlorides used are certainly radioactive, but they are no more chemically hazardous than table salt or the salt used to de-ice roads! A large quantity of chloride could become chemically hazardous as a result of chemical reactions that produce toxic chlorinated gases, such as chlorine (Cl₂ gas) or phosgene (COCl₂). However, chlorine gas would have to be produced first. The only way of doing this would be to react fluorine gas with the salt. We don't see why there would be any fluorine gas on the site, as it is more chemically hazardous than chlorine gas and would alone call for classification under the SEVESO Directive.

CFH - You talk about 10 years until the MSFR is used in industry. Isn't that a little optimistic?

EM - Fifteen years is a reasonable timeframe for building a demonstrator. It's a question of resources, and therefore political (and social) decision-making. It has been 15 years since we developed the MSFR concept, and 12 years since the GIF¹ adopted it. The Chinese launched their project in 2011 and the reactor is now being built. But Europe is asking for handouts to keep the project alive. We could wait another 15 years but, by then, China, Russia and the startup sector will have done all the work; the ship will have sailed, and we will have to buy a licence, as we did from Westinghouse when we first started building PWRs in France.

CFH - Will it be more cost-effective than Gen-3 or Gen-4 reactors, bearing in mind their complexity?

EM - The MSR being studied in France is geometrically very simple (a compact core surrounded by reflectors, with modular and changeable circulation/cooling loops inserted into it). As it is also neutronicly very stable, it does not require several extra layers of safety. Combine all this with a less complex fuel manufacturing process, and it is promising in terms of cost. Anyway, we shouldn't set one technology

against another! For example, the researchers working on the MSFR at the CNRS are also supervising doctoral theses on other types of reactor, which encourages knowledge sharing and ensures that everyone gets to know each other – and so works together – well. Hence the idea of a French network comprising the CNRS, the CEA, Framatome, Orano, EDF and, if possible, the IRSN.

CFH - The CNRS has suggested a European R&D centre, the CEA wants a European hot laboratory: why not consider creating dedicated clusters where cooperation could flourish?

EM - Specific resources are needed to actually develop the MSFR, and equipment such as the CEA's hot laboratory are very important. Yes, we need a French coordination network connected to a European network. It would also be good if the MSR concept were included in Europe's SNETP² platform. Any country able to prove that it has at least two R&D organisations and a relatively low number of researchers can ask for it to be included. France could do it. International coordination is efficiently managed by the IAEA and the GIF. In this regard, the IAEA can only set up dedicated working groups at the specific request of Member States. Again, France could put in a request with the support of other countries interested in this technology – and there are plenty of them! In 2016, the IAEA organised a meeting to discuss MSR technologies, involving around 15 countries.

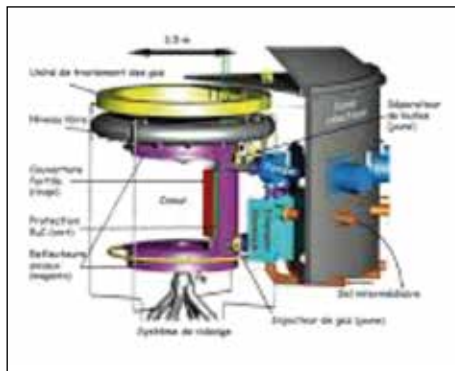
¹ GIF: The Generation IV International Forum is an initiative created by the United States Energy Department in 2010, with the aim of building international cooperation in the development of 'fourth-generation' nuclear systems.

² SNETP is a platform created in 2007 to support and promote the safe, reliable and efficient operation of Generation II, III and IV civilian nuclear systems. Since May 2019, the SNETP operates as an international non-profit association under Belgian law pursuing networking and scientific objectives. It is recognized as a European platform for technology and innovation by the European Commission.

Verbatim

John Laurie, consultant - China is building a prototype of the molten salt reactor. Start-up is scheduled for March 2021.

Here is their project: <https://fissionliquide.files.wordpress.com/2020/11/tmsr-site-plan-fr.pdf>



Giving states the possibility to choose a nuclear future in full independence and with cooperation

From a Nuclear Schengen Area to permanent structured cooperation... how can we help Europe's nuclear states to move forward?

In 2009 and 2010, the *Entretiens Européens* organised a whole series of conferences to explore the feasibility of setting up a "Nuclear Schengen Area", within which the Member States would be able to build a cooperative network, work together on R&D and training projects, and share their costs without being hampered in their ambitions and their activities by the need for unanimity (and especially by anti-nuclear neighbours). This idea was put forward by Anne Lauvergeon when she was CEO of Areva. We took it up again with Dominique Ristori when he was in charge of nuclear energy policy, and put it into the public debate.

It turned out to be a complicated idea, as a new treaty would have to be created and the Schengen Agreement was not necessarily the right blueprint for it. Permanent structured cooperation (PESCO) is another idea, which is all the more interesting because it is already part of the Treaties. But it is designed for the defence sector alone. Could it be transferable? We asked General Jacques Favin Lévêque, member of the EuroDefense network, to clarify the matter for us. **CFH**

The Defence blueprint



The creation of an intergovernmental framework has mitigated the extreme difficulty of establishing a common Defence policy at the community level. And it wasn't an easy task: it would take 15 years - from 2002 to 2017 - to convince people of the value of creating permanent structured cooperation, which, although a resounding success - as General Jacques Favin Lévêque explains - represents a "departure" from the initial goal.

The Permanent Structured Cooperation (PESCO) concept dates back to the Giscard Convention in 2002. Michel Barnier has demonstrated a keen interest in it.

The idea - which was to create a core common defence policy within the intergovernmental framework - was explored through numerous studies, and in particular by the EuroDefense network. The aim was to include the policy in the draft Constitution of 2005, then in the Lisbon Treaty in 2008.

In June 2017 - after President Trump called NATO into question (verbally) and the Brexit vote weakened Europe's defence capability - the European Council decided to push ahead with common defence plans and suggested establishing Permanent Structured Cooperation. "Those Member States whose military capabilities fulfil higher criteria, and which have made more binding commitments to one another in this area with a view to the most demanding missions shall establish permanent structured cooperation (PESCO) within the Union framework". The PESCO

initiative is aimed at countries that are willing and able to move faster and further towards common defence and industry policies. It is open to all countries that are prepared to make a substantial effort in this area¹.

France and Germany behind the initiative, with two different visions

The initiative could be launched by at least two Member States, and it had to be agreed by qualified majority: France and Germany referred it to the European Council at its meeting on 15 December 2016... On 7 July 2017, the Franco-German Ministerial Council discussed an ambitious and inclusive cooperation structure for Member States participating in PESCO. The proposal was that they would increase their defence budgets to 2% of GDP (20% of which would be earmarked for investment), harmonise their capability requirements, increase the interoperability of their forces, and develop joint programmes within the European Defence Agency.

But this ambitious proposal was hampered by two contradictory visions. France gave priority to operational engagement and wanted tougher PESCO participation criteria. Germany gave priority to solidarity and diplomacy, so as to bring as many Member States as possible on board. On 13 November 2017, the High Representative announced that 23+2 Member States had notified the European Council of their agreement to participate in PESCO and sign up to 20 legally binding commitments. The European Council officially established PESCO on 14 December 2017. A tremendous diplomatic success, but a departure from the original goal.

PESCO created a flurry of projects... but few were operational

Once PESCO had been approved and its scope had been defined, much remained to be done in terms of setting up and

implementing joint operational and capability projects. It sparked a flurry of joint defence projects: a first raft of 17 projects was followed by a second and a third, bringing the total number of joint projects to 47. Some were broadly inclusive. Most were capability or institutional projects, few were operational².

The PESCO structure is composed of the Defence Ministers of the 25 participating Member States³. It is a virtual structure, which benefits from the support and the hosting capacities of the European External Action Service (EEAS) and the European Defence Agency (EDA). Decisions regarding the 20 basic commitments and the entry of new members are taken unanimously. Decisions in other areas are taken by qualified majority. Unanimous agreement is required on the objectives and management of each project, and the High Representative and the EEAS (technical arbitration panel) coordinate projects with the EDF (European Defence Fund).

One question is still being discussed: will third countries (such as the UK and the USA) be able to participate in PESCO projects?

PESCO is specific to the defence sector. Strictly speaking, only the enhanced cooperation aspect would be applicable to civil nuclear energy, with a mandatory minimum of nine participants. Will it be transferable to the nuclear energy sector? The answer lies in the hands of the Member States interested in coordinating their activities and progressing towards a common strategy.

Général Jacques FAVIN LEVÊQUE
Member of the EuroDefense network

¹ The core common defence policy is based on Article 42-6 of the Treaty on European Union (TEU), supplemented and clarified by Article 46 and Protocol 10.

² Some of the projects: Mobility «the military Schengen»: 24 partners. Rapid reaction to cyber attacks: 7 partners. European medical commander: 9 partners. Male drones: 5 partners.

³ All the Member States except two: Denmark and Malta.

Remaining within the framework of the Euratom Treaty and preserving energy neutrality for all

If we boil down the European Union to its mere essence - It is a club that shares common goals and commits to working together in achieving them. As EU Member States we indeed share many goals - at least at the most basic level - and this is a very good start. However, we sometimes vary as to the path leading to their accomplishment. Diversity is the essence of life, and as such - it is also the essence of the European Union. A club whose diversified members pursue common goals is not a contradiction in terms if we go about it wisely, keeping our eyes on the goal, while accepting and respecting inevitable divergences.

One of our common goals - a goal of the utmost importance I should say - is climate change mitigation. We all commit to this goal with our joint efforts. It is, however, in the nature of these efforts that we may vary, which is best pictured by the disagreement on the role of nuclear power. I will not insist, although it stems from the Euratom Treaty, that building nuclear power plants is a goal shared by all Member States. However, at the level where nuclear power serves climate change mitigation (to which it is indispensable according to major international organisations) it becomes such a common goal. Its contribution to fighting climate change serves to the benefit of all Member States and cannot be limited to just a few operating nuclear power plants.

Closer cooperation of interested Member States in the nuclear field and, what is important - rooted in the EU institutional framework, would definitely enhance the visibility of both nuclear power and interests of states developing it. It will not solve all the problems we are wrestling with. It is about creating a true level-playing field for everybody in the market we are all participating in.

Structural cooperation or any form of enhanced cooperation is definitely a worthwhile option, especially towards common facilities underpinning the development of nuclear power, like research centers or material testing facilities. This is also a great perspective for regulatory cooperation, including design standardisation. But first and foremost - it is a great opportunity for building human resources, with the help of joint training centers, personnel exchange programmes, and countless other opportunities that are out there. All these areas are vital for

reestablishing the hard-earned European excellence in nuclear technologies and increase the sector's competitiveness in the difficult market and regulatory conditions we are facing.

It is quite humorous that structural cooperation modeled on the defense sector could serve as a means of self-defense of the nuclear sector, but I do not like to foster a siege mentality. I would, however, like to finish by stressing two takeaways: - the development of nuclear power is supported by the Euratom Treaty all Member States adhered to and decided to keep in force. And, even more importantly - it serves our common goal of fighting climate change. - As the second takeaway I would like to point to the need to keep on advocating for technology neutrality and the level-playing field within the European Union, which should not be sidelined by the structural cooperation developments.

Michal KURTYKA

Minister of Climate and Environment
Poland



Verbatims

Henri Prévot - A joint reflection with the defence sector is certainly a good idea. But even if permanent structured cooperation is not legally possible (since it is applicable only to defence matters), we could use the "major projects of European interest" option.

Véronique Parente - Why not use all this intelligence and all these means for the benefit of solar energy? Nuclear power breeds "mistrust", and in a world where people have no faith in politicians nature appears as a possible solution. Admittedly, it kills whereas science heals, but nature is considered more transparent and honest.

Jean-Pierre Lowys - Ecole des Mines - Thank you and well done for organising such a rich, instructive and high-quality conference.

Jacques Delarosière, BNP PARIBAS - Bravo! I've read the Entretiens reports. The message is direct and courageous.

TAXONOMY: Nuclear power awaits a decision

European Taxonomy is an EU-wide classification system for sustainable investments. The agreement reached between the European Parliament and the Council for the creation of the first "green list" in December 2019 should come into effect from 2021. Which activities will be chosen? The answer is not without consequence given that the taxonomy will serve as a reference for investors and companies, a basis for creating green European standards in the definition of financial products.

Despite nuclear energy being a major contributor to the reduction in greenhouse gas emissions and to the transition to a green and climate-neutral economy, the Commission has been asked to reconsider its place in the taxonomy, in view of the radioactive waste that it produces. Under pressure from Germany, for which nuclear has become a red line, the Commission entrusted the Joint Research Centre (JRC) with the task of conducting "a more in-depth technical analysis" to examine the environmental impact of nuclear energy. A particularly puzzling decision because the Commission is well aware of the current geological storage solutions proposed by the scientific community¹ and of those planned in certain Member States, and is monitoring the national plans of States required under guidelines it has itself proposed. Moreover, technological advances are raising a lot of hope that today's waste will become tomorrow's resources, as we heard again during the Entretiens Européens².

Scientific arguments in the face of ideological attacks

The results are expected to be published in a report early this year. Depending on the conclusions drawn, the Commission will be issuing delegated acts by the end of 2021 to establish concrete criteria for taxonomy. But Germany has not given up the fight. In a letter addressed to the institutions, MP Kotting-Uhl, who has challenged the Commission's decision to task the JRC on the basis that it is both "the fruit of the Euratom programme" and financed by it, has already set the tone: the JRC is biased and is not therefore in a position to "give an objective analysis".

Here's hoping that the JRC, which describes itself as a neutral scientific group, will take into account the sustainable solutions proposed by the industry for the responsible management of its waste and promote their implementation through support for those countries lagging behind (like Germany!), and prevent the nuclear sector from being excluded from the taxonomy. For if the aim of the taxonomy is to arrive at a new economic model renouncing fossil fuels and refocusing on low-carbon energies, then it must encourage the world of finance to direct funds towards sustainable investments such as nuclear power. The taxonomy of green finance would then become "a short-term effort for a great long-term benefit"³. **CFH**

¹ V1. Cf. The December 2019 agreement between the European Parliament European and the Council.

² Cf. The intervention of Maria Betti, Director of Security and Nuclear Safety, DG Joint Research Center, European Commission, in La Lettre des Entretiens Européens of Paris - September 2018.

³ The French Banking Federation took position in favour of introduction of the nuclear industry in taxonomy during the public consultation organized by the European Commission in April 2020.

A new electric aera with the new nuclear



Ask

**The Helsinki «Entretiens Européens» Letter
its supplement with recommendations for a review
of the European energy strategy
The Notebooks with the acts of the 17th edition**



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Published in "SCIENCE & VIE"

CO2 emissions: European targets are unrealistic

On the surface, it seems there is every reason to cry victory: on Tuesday 6 October, the European Parliament agreed a target to cut greenhouse gas emissions by at least 60% by 2030. A tremendous and very beneficial step forward... Which is, in fact, rather puzzling. Do the members fully understand what this colossal figure implies?



A 60% reduction will mean cutting waste at a ruthless pace of 6.7% per year, worldwide; a reduction greater than any of those triggered occasionally by economic crises, oil crises or world wars. Such a performance would be comparable only to the impact of the Covid-19 lockdown (-8.8% for the first six months of 2020), but it would have to be repeated every year! Even the most fervent of technophiles must face the facts: technical progress will not be enough to halve emissions from energy production, transport, agriculture, housing and so on in less than a decade. Meeting this ambitious target will mean impinging radically on the way people live their lives, for example by rationing air travel and the consumption of meat or petrol, or by requiring individuals to invest considerable amounts of money in things such as insulation and electric vehicles. Enough to spark more than one revolt... Let's be clear: it is no doubt the only way to prevent global warming from reaching catastrophic levels. But are the politicians who voted for the -60% target prepared to defend such measures? Do they have a plan to spread the burden fairly? Unless they have simply bought into the fantastical idea that all they have to do is vote for a target to reach it...

The S&V editorial office

*352 votes for, 326 against, and 18 abstentions

Verbatims

Eric Maucourt, SLC - If Europe's future so clearly lies with nuclear energy and renewables, then the Commission should condemn any Member State that, like Germany and France (Fessenheim), decommissions a plant without first replacing it with an equivalent continuous, carbon-free energy source

Anna Veronika Wendland - I agree with Eric Maucourt. The Commission should take measures, but that would mean standing up against one of the most influential Member States! The German government is unlikely to reconsider its decision to phase out nuclear energy: it boasts that it has "replaced nuclear power with renewables" while, in fact, we have replaced reliable nuclear with reliable lignite and natural gas, not with unreliable renewables.

Elizabeth Neau, CFE-CGC Energies - The first group of experts announced that it was not competent to make decisions about nuclear energy. Why did the Commission take a year and a half to set up a new group? It is preparing to publish the delegated acts. Why not postpone their publication, apply technological neutrality, and treat all

carbon-free energy sources equally? The present situation looks very much like procrastination, which is sending a negative signal to investors and creating concern among workers about the future of their industry!

Gérard Bonhomme, Professor emeritus - This article illustrates the ambiguities in the debate on the hydrogen industry: <https://theconversation.com/debat-lhydrogene-produit-par-les-seules-renouvelables-ni-possible-ni-durable-148663>

Georges Sapy, SLC - As it went well underlined, the big question is to coalesce all nuclear-friendly countries for stop getting dragged into politics German, which leads straight to disaster: last proof, contained in the last version published today of a study carried out by Agora Energiewende, Agora Verkehrswende and the Stiftung Klimaneutralität with the support of Prognos AG, Öko-Institut and the Wuppertal Institute, which in 2050 plans to use 432 TWh / year of hydrogen or fuel synthetics derived from it, including 348 TWh or 80% will be imported !!! From where ??? This is where the irrational fear of nuclear and associated ideology.

Finland, extending cooperation with Nordic countries to the whole of Europe



At the Entretiens Européens in Helsinki in 2019, Liisa Heikinheimo explained that the prospective development of nuclear power in Finland had the public's backing'.

Although climate change does come into the equation, it is vital to understand the role that the nuclear industry itself has played in bringing the public onside. Today, she is stressing the importance of the cooperation that has developed in Finland at all levels between private sector players and with the public sector, and within the Nordic countries. She is calling for more Europe-wide cooperation.

Nuclear energy must play a key role if we are to reach our targets in Finland and the European Union. Our country has decided to increase the share of nuclear in the energy mix from 32% to 40%. This figure is high. It takes into account future industrial requirements, as well as changes in transport modes and urban heating systems.

To reach it, we have put extensive plans into place, including extending the life of our power plants, commissioning the EPR plant Olkiluoto 3, and launching new projects such as Hanhikivi1.

And why not, in the future, use SMRs to power urban heating networks? Finland works with partners all over the world. It takes part in forums hosted by leading organisations like the IAEA, the NEA and, as a member of the European Union, the ENEF. We have made some very good contacts, and it is important that the Ministry participate in forums like these where ideas and experiences are exchanged.



Should we build permanent structured cooperation at the EU level, between all consenting Member States? We all know that the nuclear industry is no ordinary one and that the responsibility for safety must be shared. There can be no accidents in a nuclear power plant, from the moment it comes into operation to the day it is decommissioned. This means that, even before we start to build it, we must think about the long term. The experience and knowledge of others are invaluable in this respect, so a great deal of cooperation is required. Even if every plant is unique. In Finland, license holders and the national regulator have developed the KELPO project to establish a standardised licensing process². Cooperation comes almost naturally to the Nordic countries. We have entered into bilateral cooperation agreements according to reactor type. For example, we have an agreement with France on EPRs and with Russia on VVERs. We also have an agreement with Sweden, whereby we exchange any relevant information about a reactor with a view to extending its life. We have entered into numerous cooperative research arrangements and are now ready to forge ahead with SMRs. We must put all our efforts into training the younger generations, which will mean developing a joint funding strategy.

In Finland, nuclear energy companies are privately owned: they must bear all the costs themselves. The Finnish industry has a long tradition of working within a collaborative system. So-called Mankala companies are owned by various shareholders, who use the energy produced. But the projects require more substantial investments over a longer period of time, and nuclear energy should be treated in the same way as other carbon-free technologies. In particular, it should be included in the EU taxonomy for sustainable finance.

Liisa HEIKINHEIMO
Deputy Director General, Department

KELPO, a cooperative project conducted by the Finnish nuclear industry



The project was carried out by three companies: TVO, Fortum and Fennovoima. STUK, the Finnish nuclear safety authority, participated as an observer. The objectives: implement a phased approach; ensure the use of standard, high-quality industrial equipment; establish a comprehensive supplier network; make sure that high-quality equipment is available; strengthen cooperation between license holders in Finland, and within the Nordic countries and Europe.

At the ENEF¹ conference on 7 June 2019, Maria Palo – a project manager at ÅF-Consult and leader of the KELPO project – advocated a dialogue between license holders in different countries, sharing of best practices and harmonisation across Europe: "ENSREG should put harmonisation and use of industrially-compliant equipment on the agenda. Let's work together to create a future where Europe's nuclear industry can attract the very best suppliers."

¹ European group of nuclear safety authorities created in 2007.

Verbatim

Roberto Passalacqua, European Commission – In Sweden and in Finland, confidence in decision-makers is relatively high. This is not the case in many other EU countries. As engineers and scientists, we should be doing more to convince decision-makers and the public, and to show that an incident occurring in a nuclear power plant today will cause no damage (improved safety has already eliminated the need to evacuate the public) and that, in terms of nuclear waste, a circular economy has already been partially implemented.

¹ See her article: "Nuclear power in the Finnish energetic mix" - In La Lettre des Entretiens Européens of Helsinki, "A new electric era with new nuclear" - October 2019

² See the box opposite.

Engaging the European Parliament in a dialogue with the civil society



The instigator of the petition on the taxonomy¹, Christophe Grudler – MEP and member of the European Parliament's defence and energy committees – supports nuclear

power, without which it will be "impossible to deliver the Green Deal successfully". To do this, he suggests setting up an informal intergroup.

France has a major responsibility for raising the status of nuclear energy in Europe. It should not be ashamed of nuclear energy, but should assume its role more assertively. Being proactive does not mean mindlessly promoting the nuclear industry, which would be detrimental to the general public.

We must work closely with other interested countries. We are part of a group of ten natural allies in the Parliament, including Poland, and there is no reason why we should not create something more structured.

That said, the Green Deal has reaffirmed the role of nuclear energy as one of its overall components: it proposes to include 80 GW of nuclear power in the mix to meet net zero carbon objectives. The Commission acknowledges that it will be impossible to meet our 2050 decarbonisation targets without nuclear energy.

The pragmatic action I am taking should be seen in this context: I believe in the Green Deal, which is why I want nuclear energy. And I am trying to win a majority in Parliament over "anti-nuclear opponents": so, at the COP 25 conference when we were voting on a climate resolution, I tabled an amendment² with the MEPs to ensure that nuclear energy is recognised as a component in achieving our targets, despite the reservations of some.

Last March, appalled by the conclusions of the anti-nuclear rapporteur, who unravelled the agreement between the Parliament and the Council on the taxonomy,

I organised a petition that was signed by sixty MEPs. Experts from every sector were brought in to draw up the list of eligible activities, with the exception of nuclear energy, which was dealt with separately! We are waiting for the new delegated act, and I am prepared to refer the matter to the European Parliament again if necessary!

What's more, I am shocked by the Just Transition Fund³! It isn't "just"!! This fund should be financing the phase-out of coal... We are going to support gas but not nuclear. If that isn't dogma, I don't know what is!

How can we move forward? We are thinking about creating an intergroup⁴, but perhaps in a "more confidential" form so that we can act with efficiency and finesse, and avoid labels! This intergroup would work actively with the Community institutions and all national governments.

Furthermore, I believe in European alliances. We have created one on hydrogen, where Germany's vision of producing hydrogen from gas (or from renewables when we find a way to store electricity) contrasts with France's vision of generating carbon-free hydrogen from nuclear power. We also created one on SMRs after a group of US market players visited former Energy Commissioner Canete in Brussels to talk up their technology, when we have our own prototypes in Europe. A few million euros have been earmarked for this technology, which isn't very much. We are still waiting for funds.

Civil society should work much more with the European Parliament, which is a more reliable ally than the European Commission. The Commission is an executive body! It does what the Council asks it to do, and the European Parliament can object or vote against its proposals. The Parliament responds to every regulatory text and has more leverage to raise objections or put forward proposals.

Christophe GRUDLER

Member of the European Parliament
France



Verbatims

Serge Dauby – Perhaps the European Parliament should try to connect more closely with society! It is guided by the same logic as the Belgian government, where a single party has been able to swing the majority by dogmatic means. As we know, the Parliament has its own "ayatollahs"!

Claude Fischer Herzog – National divisions run very deep in the European Parliament! Even deeper than divisions along party lines. It's hard to get it on our side. It's easier with the Commission, which has the European general interest at heart. The Commission makes proposals, and when those proposals are good, they really make a difference! Of course, when it is influenced by outside pressure, everything changes too: the proposed target of 80% renewables by 2050 is leading us to a brick wall. There are other ways to reach net zero carbon emissions!

The Entretiens Européens – Everyone agrees on hydrogen and SMRs! It's just a matter of time! We must fight as hard as we possibly can! At a meeting in Cherbourg, we suggested creating a competitive cluster specialised in nuclear energy! The CCI wanted it to specialise in healthcare... which wasn't an issue! It was energy that was the problem. We must not back down from the fight! Because it is a fight, and if we want to win it, we must get both industry stakeholders and civil society on our side.

Question/answer – How is Pascal Canfin behaving in the Parliament? He voted for the "just transition" and for investing 27 billion in gas! He argued that gas "pollutes less than carbon"! Which didn't stop him from voting against nuclear! Or from claiming "a major victory" on 9 December, when an agreement was reached to exclude fossil fuels from structural fund support by 2025. Hypocrisy in all its glory!

¹ "Nuclear energy in taxonomy regulation", a petition addressed to Mr Valdis Dombrovskis, Executive Vice President of the European Commission – 27 May 2020.

² "[The European Parliament] believes that nuclear energy can play a role in meeting climate objectives because it does not emit greenhouse gases, and can also ensure a significant share of electricity production in Europe; considers nevertheless that, because of the waste it produces, this energy requires a medium- and long-term strategy that takes into account technological advances (laser, fusion, etc) aimed at improving the sustainability of the entire sector." This paragraph was adopted by a slim majority on 28 November (323 for, 298 against and 44 abstentions). Following this amendment, the majority of the ecologist group voted against the entire resolution.

³ See box on page 27

⁴ There are twenty-seven intergroups within the European Parliament. They are composed of MEPs from all the political groups and parliamentary committees. Their role is to conduct informal discussions on specific topics and to promote dialogue between MEPs and civil society. As a rapporteur on the SGI (Services of General Interest) directive in 2004, Philippe Herzog created an intergroup that organised over one hundred meetings to improve public services in Europe.

The outlook for nuclear energy and its public service role



The European Commission has supported Les Entretiens Européens since their creation in 2002¹. In his conclusions, Massimo Garribba, the Deputy Director-General of

DG Energy, welcomed the richness of this 18th edition. The debates provided a new opportunity to share experiences and expertise, to consider different views and opinions, and thus to have a consolidated perspective on the trends and developments of the European nuclear sector in the future electricity mix and European energy policy.

Prospects for nuclear power that has played a public service role

The first issue that can be noticed is that the prospects for nuclear have changed in the discussions on energy transition. Nuclear energy will have a role to play in the fight against global warming and in our ambition of decarbonisation until 2050, and will remain an important energy option for those Member States wishing to use it in their energy mix.

Electricity is an essential public service. During the Covid outbreak, nuclear power has fulfilled its full role in ensuring safe access to and supply of electricity; therefore, making it possible to discuss now its positive role in the energy mix with regulators and operators.

'Federating' all low-carbon sources to reduce greenhouse gas emissions

We are perfectly aware that we will need to unite all low-carbon energy sources to achieve our 2030 greenhouse gas emission reduction targets, and the complementarity of nuclear and RES will be essential in the energy mix of the future. While recognising that the electricity system will be largely based on RES, the new EU energy system integration strategy does not exclude the contribution of nuclear power. In all Commission documents, for example the so-called 'A Clean Planet for All' or "2050 long-term strategy"², nuclear generation

capacity by 2050 is estimated to remain at levels similar to the present capacity. This will represent an enormous industrial effort in order to maintain the same production capacity since, despite the long-term operation of nuclear power plants, investments will still be needed to replace the oldest plants... In the PINC³, we have estimated these investments at around EUR 400 billion.

New perspectives emerging with SMRs

New reactor technologies offer a number of improved features (increased safety, reduced radioactive waste, greater operational flexibility, etc.), thus opening up new opportunities for nuclear energy. It is worth mentioning here the SMRs, which have become quite a popular topic, as they could be complementary to traditional reactors and could play an important role in the future.

Some companies have noted the need to invest in the existing nuclear fleet as well as in new technologies, and to accelerate the development of SMRs in Europe. International players (such as the US) are targeting the EU market. The response of the EU nuclear industry should be more visible in this context and this requires a coherent EU strategy.

A first step in this direction could be an EU event on SMRs, bringing together the EU nuclear industry, nuclear regulators and public authorities in the first part of 2021. Discussions among European stakeholders will allow determining the perspectives on the development of a European supply chain for SMRs and on EU regulatory cooperation to streamline licensing procedures, and identifying areas of synergies between these different bodies.

Creating a different image of nuclear power and reducing its costs

Let me highlight our European policy that ensures a high level of safety: we should be proud of it, because safety is a business card for our industry. And we need to do more! It is a question of giving nuclear power another image and at the same time reducing its costs.

The operation of nuclear power plants is not expensive, but the construction of new plants is. All the more so because too often there are budget and time overruns!

What are the scenarios envisaged for 2030? After the adoption of the European Green Deal⁵, the EU Member States defined their energy and climate plans by 2030, without any obstacle to the development of nuclear power for those Member States who wish to do so, as long as this is in line with the new EU requirements and overall plan. Member States such as Finland, Slovakia, Hungary and Bulgaria have indicated the future use of nuclear energy as part of their plans. Poland, Czech Republic or Romania have concrete projects which are already well advanced.

Working on closing the nuclear fuel cycle

The nuclear industry and Member States need to pay greater attention to the taxonomy. The difficulties are linked to the fact that possibly not enough efforts were devoted to the back-end of the nuclear fuel cycle in order to ensure that spent fuel can be used as an energy source⁵, opening the door to critics and criticisms. But this has not been yet concluded. The expert group will deliver its report early next year, which will allow the Commission to review the inclusion or not of nuclear power, and the related conditions, in the delegated acts and the taxonomy.

As regards the research into the nuclear technologies of the future, there is a budget dedicated for such research, but it is limited just as the overall budget of the European Union, which, despite its increase in the context of the crisis, represents less than 2% of the Member States' gross national income! We need to think about what each of the partners can do to avoid dispersing the available funds and create added value. I would like to recall that the largest research project financed is ITER. It is a project for the future (like Generation 4) while its budget allocation is for the present: EUR 5, 61 billion in the 2021-2027 budget. ITER also offers opportunities for companies with expertise in the traditional nuclear field, for which this budget can be attractive.

Massimo GARRIBBA

Deputy Director-General responsible for the coordination of Euratom policies
DG ENER, European Commission

¹ The 1st edition was organised in October 2003 in Nogent en Haute-Marne with the support of Loyola de Palacio, then Commissioner for Energy, and the participation of François Lamoureux, Director-General of DG Energy, on: "The scientific challenges of nuclear waste management in Europe" — See the list of events organised since 2003 on page XX.

² COMMISSION COMMUNICATION 'A Clean Planet for All' - 28 November 2020 - A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy.

³ Commission Communication on a Nuclear Illustrative Programme, 12 May 2017.

⁴ <https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal>

⁵ Les Entretiens Européens organised several editions on this issue. In 2018, an edition devoted to 'the management of spent fuel and nuclear waste' prompted several recommendations, which were sent to the EU Member States and the European Commission. Again this year, a panel discussion enabled Andra, Orano and Vattenfall to share their experiences and solutions.

Attracting investors to European projects

Fourteen countries are interested in developing their nuclear power plants and some projects are already underway, for example in Finland, France, the United Kingdom, Hungary, the Czech Republic, Romania and the Netherlands, which prefer nuclear safety to the risks of gas. Each country is facing the issue of construction costs. Because building nuclear power plants is costly. But, once built, operating costs are low in relation to profits. How can we attract investors and give them long-term guarantees? Examples of financing arrangements between partners do exist, as in Finland, and in other countries open to international investors and offering government guarantees, for example the United Kingdom and the Czech Republic. Hence the international dimension of nuclear power. Europe must not make the same mistake as it did with other high added-value industries, by surrendering the nuclear lead to countries like China, Russia and the United States, highly aggressive in the world market where needs are massive (renewal of nuclear infrastructure, electrification of uses, development of regions in Asia and Africa, etc.)

Creating a European nuclear industry

Nuclear electricity is a long-term solution. It requires a clear vision and careful planning of investments to lay the groundwork for the future. It benefits from government policies and support everywhere, everywhere except in Europe, which puts it at a disadvantage. However, it is a service of general interest (and not only for the countries that produce it!) and a European public good, for which the Commission must provide guarantees and incentives. On what grounds can those Member States who do not want it in their own country (even if it means buying it from us when they run out) object? And, beyond the necessary market reform and public incentives and guarantees, how can we circumvent the anti-nuclear States and work together in the European market to create a real industry, efficient both nationally and abroad? Euratom was born of the desire to organise European cooperation and build a flourishing civil nuclear industry to ensure the energy self-sufficiency of our continent, but institutional bottlenecks and the relatively limited means implemented are preventing it from serving its purpose.

An energy solidarity pact and greater cooperation

We have examined the feasibility of the sort of permanent structured cooperation between nuclear states that exists in the defence sector. A particularly complex venture given the highly institutionalised nature of PESCO and the fact that Poland is not on board, preferring to maintain the technological neutrality and diversity of the 27 Member States. To achieve this, the States would need an energy solidarity pact that respects everyone's choices. We could also do as the Polish Climate Minister himself has suggested and think about increased cooperation, based on sharing upstream costs of investment in public goods, particularly training and research, and even downstream costs relating to grids.

Asset classes for cooperation projects in a European bond market

That said, it should also be possible to share the high costs associated with long-term investment in power plant construction through cooperation or consortiums (Philippe Herzog suggests "mutual societies"), involving both manufacturers and States (this already exists in various models). They must also be guaranteed in order to attract investors. Companies and Member States are "competitors", even rivals, and the Commission could help in that respect by making it easier for them to share their costs. The creation of asset classes for cooperation projects could be financed through a European bond market. We have an innovative European recovery plan based on mutualised debt to support national macro-economic policies and efforts to build a common public good: health. Why not develop a similar industrial plan to support nuclear power? For this we will need investors: market investors, asset managers, sovereign funds, banks (especially development banks) and insurance companies. Some, such as BNP Paribas in France, are now involved in green investments, and if the nuclear industry is included in the taxonomy, they would hopefully get involved in that too. The idea being to invest not so much in "labels" but in general interest projects, based on their value as a public good.

A 19th edition promoting nuclear projects

The 2021 Entretiens Européens will be in line with this perspective and we intend to propose a new edition with that in mind: "The promotion of nuclear projects in Europe and their financing in a regulated market". We will draw comparisons between the countries of the European Union, and with the major countries of the world (Russia, China, the United States, etc.). So we look forward to seeing you at this 19th edition expected to take place in September, in the hope that we will be able to meet again in Brussels or another European country.

ASCPE LES ENTRETIENS EUROPEENS since 2003

- November 2020 by zoom: **Nuclear and its innovations for a sustainable recovery in Europe?**
- November 2019 in Helsinki: **New Nuclear: a response to the electrical changes in our society in Europe?**
- Octobre 2018, Paris: **The management of spent fuel and nuclear waste in Europe. Solutions existe, they must be implemented.**
- October 2017, Brussels: **The issues of competitiveness of nuclear energy in Europe**
- October 2016, les Entretiens Européens in Brussels: **Building a long-term framework to allow the upgrading and financing of projects**
- April 2016, les Entretiens Européens in Brussels: **Energy security in Europe. Which interdependencies with third countries?**
- October 2015, les Entretiens Européens in Brussels: **The social ownership of nuclear waste management in Europe, a safety issue**
- November 2014, les Entretiens Européens in Paris: **Towards societal ownership of nuclear waste management**
- October 2014, les Entretiens européens in Brussels: **How to finance the move towards carbon-free and competitive electricity on the European market?**
- October 2013, les Entretiens Européens in Warsaw and Krokowa: **A civil society initiative for nuclear in Poland**
- April 2013, les Entretiens Européens in Brussels: **EU/Russia Dialogue. Nuclear sector: competition and cooperation**
- April 2012, Brussels: **For a European energetic pact in Europe**
- June 2011, les Entretiens Européens at the University Foundation of Brussels: **Bulgaria, Hungary, Lithuania and the Czech Republic... The economic challenges of sharing European safety**
- 2011 in Brussels: **Sustainable agriculture (4 lunchtime-debates)**
- 2010 in Budapest: **Nuclear energy in Europe, from acceptability to social ownership**
- 2010 in Paris: **Sustainable mobility and clean cars (after 8 lunchtime-debates on biofuels)**
- 2009 in Brussels: **Food and public health**
- 2008 in Brussels: **Nuclear energy, a global public good**
- 2008 in Paris: **The revival of nuclear energy in Europe and worldwide**
- 2006 in Berlin: **Europe invests again in nuclear energy**
- 2006 in Paris: **The legislative issues in France and in Europe for nuclear waste management**
- 2005 in Reims: **Ethical and democratic issues in nuclear waste management**
- 2004 in Bar-le-Duc: **Financial and economic issues in nuclear waste management**
- 2003 in Nogent: **Scientific issues in nuclear waste management**

Minutes and summaries are available on www.entretiens.europeens.org

CFH

A big THANK YOU to all our partners who agreed to speak during this 18th edition of Les Entretiens Européens, and to our friends Laurent Daniel, president of X-Sursaut and Jean-Philippe Brette, member of SLC, for their friendly and reassuring help in handling computer tips. Thanks also to Romuald Rochetta and Yvan Fischer for the video editing of the debates and their circulation on youtube and the networks.

Director of publication and Editor in chief: **Claude Fischer Herzog**
Design: **Christophe Le Nours** 
Publiée par ASCPE
9 rue des Larris, 93800 Epinay sur Seine
Tél. : 00 33 (0)6 72 84 13 59
contact@entretiens-europeens.org