October 2019

La Lettre des Entretiens Européens

Special New Nuclear

Rapprocher - Débattre - Fraterniser

Édito

A new electric era with nuclear

Claude Fischer Herzog
Director of ASCPE Les Entretiens Européens

Les Entretiens Européens form part of a long-term strategy. We want to clarify the contradictions posed by growth in electricity demand and reducing greenhouse gases, and anticipate, even plan, policies and strategies capable of resolving this challenge. Indeed, Europe and the world are being "electrified". The electrification of cars, housing, agriculture, health, space, digital… is growing at a very fast pace. Companies and local authorities will have to invest and innovate. How can we articulate the climate emergency and the European economic challenges, where efficiency will become a new type of industrial policy and where the energy sector will have to produce and at the same time provide adequate services, and this in a more affordable way?

What will be the right energy mix which is both affordable and low-carbon? Short-term strategies that seek better cost-benefit ratios often run counter to CO2 zero targets in 2050: how do they fit in a long-term strategy?

Decarbonised sources raise competitiveness concerns, and new nuclear energy - which is an ally for climate goals - will have to be able to spread its costs and pool them to mobilize resources in order to innovate. More diverse and flexible, it will be able to adapt to the diverse needs and demands of industry and territories. Beyond proposals for more responsible governance between Member States and the European Commission for the implementation of public policies, we will discuss the option of creating a European planning agency in consultation with users and energy producers, responsible for contributing to the creation of a coherent network system at European level, with enhanced skills and intelligent services.

These issues and options will be discussed during Les Entretiens Européens in Helsinki, organised by ASCPE with FinNuclear and GMF, the Group of European Municipalities with Nuclear Facilities, the support of the European Commission, and the partnership and participation of many industrial and territorial actors from Europe.

summary

See the programme on page 32

From Paris to Taiwan, an international stand up for nuclear power

On Sunday 20 October 2019, several environmental organisations held simultaneous public gatherings in 32 cities across the world to talk about the importance of nuclear power to human development, health and the climate.

As climate protests swept the globe, eco-modernists – who argue that science and progress can be harnessed to protect the environment – were organising a mass demonstration to highlight the role of the atom in fighting climate change.

From California to Taiwan, via Paris and Berlin, volunteers were on the streets to answer the questions of passers-by. Banners, stalls, mascots and music set the tone and pace of a day that was deliberately peaceful and good-natured. The initiative came from Environmental Progress, an American organisation that is striving to lift humankind out of poverty and safeguard the environment. It works closely with Nuclear Pride Coalition, which comprises pro-nuclear environmental NGOs including Saving Our Planet, the Association of Ecologists for Nuclear Power, and Voices of Nuclear.

The Entretiens Européens team at the Nuclear Pride Fest in Munich

On 21 October 2018, we spent the whole day talking to the people of Munich, which had become the "green capital of Germany" since the "Green" party achieved its highest score there at the start of the month, with 42.5% of the vote. We joined people from the Netherlands, Taiwan, Poland, Slovakia, Russia, France and other countries at the Marienplatz, the busiest public square in the city, to shine a spotlight on nuclear power. Accompanied by our mascot, a polar bear called "Melty", we ran information stalls and sang "The Change of Climate" to the tune of Simon and Garfunkel's "The Sound of Silence". I have a doubt

CHF

COP24: The Katowice Partnership for Electromobility

The Katowice conference in December 2018 adopted the "Rulebook", a global system for assessing and analysing efforts to combat climate change, which should make the 2015 Paris agreement more operational. The adoption of the "Rulebook" was accompanied by dialogue and solidarity between the Member States, which is unusual enough to deserve a mention. In our efforts to create an Energy Union, we cannot disregard the differences between Member States and the diversity of what they bring to the table. Changing energy mixes is a long-term process that requires much innovation and very substantial investment. An energy solidarity pact would foster cooperation in Europe and encourage the wealthiest countries to support less developed countries as they embark on their energy transition. This argument is even more pertinent at the global level, where solidarity should underpin all our relationships so that the poorest countries and regions can access sustainable development and new technologies. We should also welcome the declarations on inclusive development and social change in the energy sector, CO_2 absorption by forests, and the development of e-mobility and zero-emission vehicles, which were supported by dozens of countries, 1,500 towns and cities and 1,200 businesses.

Is the growth of the electrical demand climate-friendly?

An assertion that today's global population is so dependent on electricity that it would not be able to function without it for more than 24 hours is misplaced. Indeed those who have steady access to electricity would be paralyzed after just a few hours. But close to 1 billion people continue to lack any steady access at all.

According to the International Energy Agency [World Energy Outlook 2018], electricity accounts today for nearly 20% of the world's total energy demand. A figure like any other, but what does it mean in practice? Well, here we go: electricity production is responsible for some 64% of global coal use and 40% of that of natural gas. Further, electricity production can be blamed for 42% of global CO2 emissions and 48% of total SO2 emissions. In addition, electricity accounts for almost half of all investments in the energy sector while an average household's energy bill in 39% comprises of electricity cost. Electricity demand surpassed 22 thousand TWh and there is no peak in sight. Assuming current trends continue electricity consumption will increase by another 70% by 2040. Even if deep changes in energy systems take place, this increase will still be more than 60%. Such is the big picture with electricity question at its center.

New, more competitive and cleaner technologies

If we consider this data in isolation from the broader context it leads us to some grim conclusions: each increase in the share of electricity in the economy is another additional ton of CO2 and SO2 in the atmosphere, moving us further away from the already elusive 2 degrees Celsius goal of the Paris Agreement. But this thinking is erroneous. The fundamental expectation from electricity markets is not only that they develop in a climate-friendly way. Modern electrification is indeed the only way to bring us closer to the achievement of the climate targets. New solar installations are more competitive than the new coal installations almost all over the world, but they are not competitive with existing installations without clear and steady support from national policies.

There is no way to reverse the upward trend in electricity demand. But there is no need to do it either, at least in view of climate goals. IEA tells us that in 2040 as much as 40% of the world's electricity generation may come from renewable energy sources. This alone is already a climate-friendly information (today it isn't more than 25%). But let us make a step further in our deliberations.

Growing demand for electricity, a godsend for the climate

In fact only thanks to – rather than in spite of – increasing demand for electricity can we have the chance to have cleaner energy, ergo – a cleaner and safer life. Let us consider what could be the result of a sudden slowdown in the growth of demand for electricity. I should think we would stall at the present, less than technologically and environmentally perfect state of power generation. Full stop. It is thanks to the growing demand that the technologies are developing, while the old and less efficient generation methods are being decommissioned with new investments progressing. Perhaps most importantly: the drive for development is led by innovative thinking, which has an enormous impact not only on energy sector but it spills over to all the areas of economy.

Zero emissions or 100% REn: setting the right objective

Technologies are key to clean electricity in the future. Given that the energy sector as a whole is responsible for 2/3 of the world's emissions, technologies are key to climate protection too. Over the last 20 years wind and solar PV added some 580 GW of electricity generation in advanced economies. In that context clean electricity generation must also include nuclear zero-emission energy, without which keeping up with clean energy transition in power generation may be very hindered: if announced policies across the world to decommission even 40% of current nuclear capacities by 2040 are implemented, as much as close to 3 thousand GW of new wind and solar PV will have to be added over next 20 years only to compensate for this loss. Therefore, no clean technology should be abandoned unless it can add to quicker energy transition. It is better to target zero emissions rather than 100% renewables.

Opportunities created by growth

Is then the growth of the electrical demand climate-friendly? By far it is. It may also contribute hugely to clean energy transition in general. The new pushes us towards the better. The better then gives us new opportunities and, as a result, the increase in demand for energy – in the first reflex considered to be catastrophic – gives us hope of achieving ambitious climate targets. Eventually, as a result, the aforementioned billion people without access to electricity today will finally gain it. And with it access to opportunities. Electricity is much more than only an artificial light. It brings along education, better health care, exchange of good practices and equal opportunities. If all that comes along with higher shares of electricity – most certainly we should not miss this chance.

Michal Kurtyka
Deputy Minister of Environnement in Polish Government
COP24 Chairman

Les Entretiens Européens & Eurafricains

Rapprocher - Débattre - Fraterniser

Nuclear energy for sustainable development

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The global impacts of an energy transition in a context of growth in electricity consumption

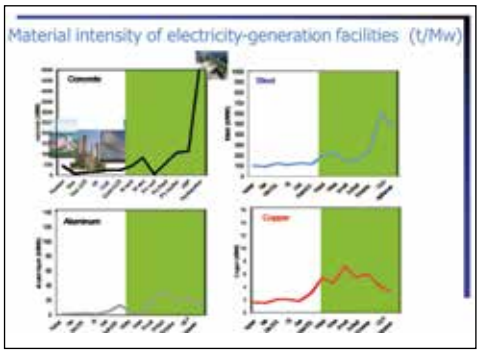
Meeting energy demand while reducing GHG emissions is a crucial 21st-century challenge. Europe aims to achieve a minimum of 27% renewable energy by 2030 and the Paris agreements provide for global carbon neutrality by 2050. To achieve these objectives, all existing energy transition scenarios anticipate a reduction in global energy consumption combined with a massive incorporation of carbon-free electricity from renewable and nuclear sources.

Scenarios in contradiction with the heavy trends

Both of these developments present a major challenge, as the anticipated reduction in global energy consumption stands in contradiction with historical trends and past economic development patterns. It requires a significant decoupling of trends in economic activity from trends in energy consumption. This is feasible in wealthy countries marked by declining industrialisation, which import raw materials and semi-finished and finished products. These countries have the capacity to improve their energy efficiency and shift their industrial energy consumption to the countries that produce the resources they consume. On the other hand, it is much more difficult to decouple energy consumption from economic growth in emerging and exporting countries. In these countries, all past experience shows that increases in economic activity, overall and urban population, average income and the standard of living lead to exponential growth in energy and raw material needs, and it is difficult to imagine that future global trends may be radically different.

No decarbonation without overconsumption of raw materials

Furthermore, transforming our energy production, storage and consumption infrastructure over the course of around 40 years also raises some very important issues. Apart from the technological difficulties and socio-economic constraints (transition costs and energy prices) associated with the transition from concentrated and easily storable fossil energy sources to diluted and difficult to store flow energies, the raw material needs and environmental costs involved in such a change should not be ignored. Building a new, decarbonised energy generation infrastructure based massively on electricity requires significant quantities of primary raw materials. This is true both for the nuclear sector and for the production, storage and distribution of electricity generated from renewable sources. In any case, new infrastructure must be built using "structural" raw materials, such as steel, aluminium or copper, but also rarer substances: neodymium, praseodymium and dysprosium in the super magnets of some wind turbines, tellurium, indium, gallium, selenium, some thin-film technologies for photovoltaic panels, lithium, cobalt and graphite for hybrid or electric vehicle batteries, etc.



Energy-intensive production of raw materials at the expense of sustainable development in the producing countries

It takes a lot of energy to produce all these raw materials: currently, 10 to 15% of the energy consumed by industry worldwide is used to produce metals and minerals. It is therefore foreseeable that the energy transition will lead to excessive consumption of metals and fossil fuels. This over-consumption is the price to pay for significantly reducing our dependence on fossil fuels and the pollution associated with their use. However, it raises questions about the availability of the metals used in many technologies, adding to the tensions already caused by rapidly growing global consumption and Europe's strong dependence on imported raw materials (Europe consumes about 20% of global metal production while producing about 3%). The environmental and social impacts in non-European countries that produce mineral resources and equipment for Europe's energy sector should also be taken into consideration. These exporting countries are not necessarily politically stable, the income from their resources may be distributed unequally or even used to finance armed conflicts, and/or they may not have the means to carry out effective monitoring of good practices and hence ensure minimal environmental impacts.

Reduce the overall impacts of the ecological transition without giving up the development

The need for raw materials and other resources (including water), and the overall environmental impacts vary for different energy mixes combining renewable and nuclear energy, because the material intensity (quantity per MWh produced), efficiency and lifespan of the different technologies are different. An analysis of energy consumption and transition scenarios must be carried out to assess these different aspects, and should do more than simply define the optimum technical and economic conditions needed to minimise our GHG emissions. This assessment is not only desirable, it is necessary to determine the best energy options and mixes to minimise negative impacts at the global level, while maintaining economic activity, meeting energy demand and reducing GHG emissions.

Olivier Vidal
Research director
CNRS-IS Terre Grenoble

Electric vehicles will be the key driver to decarbonize the road transport sector

Studies show that the there is no additional energy production expected due to increase of electric vehicles, and the existing generation capacity in Europe is enough to deal with the growth of EVs. However, the significant growth of EV will place a high demand on the power system and the additional peak demand due to uncontrolled charging might stress the grid. Smart charging EVs has the potential to resolve these problems.

An opportunity for the power grid

In addition, the expected benefits of electric vehicles development are not limited to the transportation sector. Indeed, the multiplication of batteries is also a true opportunity for the energy sector. It will enable to foster the energy transition towards CO2 free energy, thanks to the flexibility that such devices will bring to the system.

Smart Charging and Vehicle to Grid, will also bring services to the grid. In the first place, charging can be shifted based on grid loads and in accordance to the vehicle owner's needs. For instance, at times of high prices customers shall be induced to reduce charging and at times of low prices customers shall be induced to increase charging.

Towards a bidirectional exchange

Moreover, charging can be bi-directional, by providing two types of ancillary services to the grid. Charging power can be decreased in times of scarcity or electricity can be returned back to the electrical grid by utilising bi-directional charging solutions. The utility offers electric vehicle owners monetary benefits (i.e. lower prices) in exchange for enrolment in a program that permits controlled charging at the times when curtailment capacity is needed for the grid

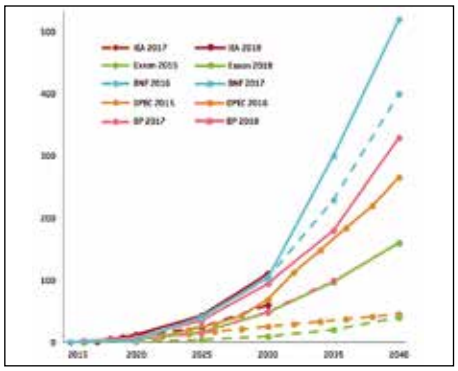
In the long run the question is not if electric vehicles need to be integrated in a smart manner but rather which is the best way to integrate them in a cost-efficient and system-friendly way.

Groupe Renault, as leader of Electric Vehicles in Europe, is very active in the field of Smart Charging and more generally in Vehicle to Grid Integration, in order to facilitate the integration of EV, in the most customer centric way.

Yasmine Assef

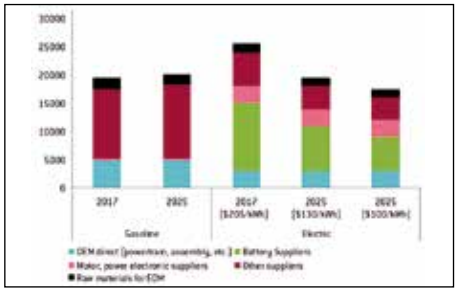
Program Director,
New Energy Businesses
Electric Vehicle
Business Unit

Electric Vehicle Deployment Forecast in the world by 2040



Source : Bloomberg New Energy Finance, in Bruegel (Fredriksson Gustav et alii, op. cit.).

Breakdown of manufacturing costs of internal combustion engine vehicles and electric vehicles (in US dollars), 2017-2025



Source : UBS, 2017, in Bruegel (Fredriksson Gustav et alii, op. cit.).

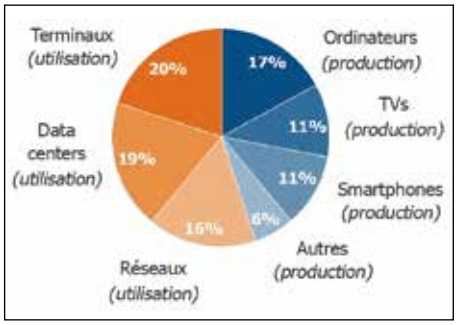
Towards digital sobriety

Think tank The Shift Project has studied the environmental impact of producing and using digital equipment, and therefore the energy (particularly electricity) consumption connected with such equipment. In 2018, it published a report entitled "Lean ICT: towards digital sobriety"; in 2019, it published a second report entitled "Climate: the unsustainable use of online video». Below is a summary of the two reports.

Digital everywhere for everyone

Digital technology is now regarded as the primary lever for economic and social development by public policymakers and companies around the world. Today in fact, there can be no major strategy that does not make use of digital technology, including the UN's 17 Sustainable Development Goals (SDGs).

At the same time, digital technologies are having a growing impact on our lifestyles and consumption patterns: adults in France spend four hours a day on their digital devices (excluding television); one out of two smartphone users never turn their device off, and the typical family home has almost ten screens.



Distribution of energy consumption per item for the production and use of digital equipment in 2017
Source: "Lean ICT: towards digital sobriety" (The Shift Project, 2018)

Given their ability to dematerialise physical flows and facilitate access to products and services, these technologies seem to intrinsically facilitate environmental transition. However, this instinctive trust in connected objects and in so-called "smart" innovation should be tempered by some very real physical observations.

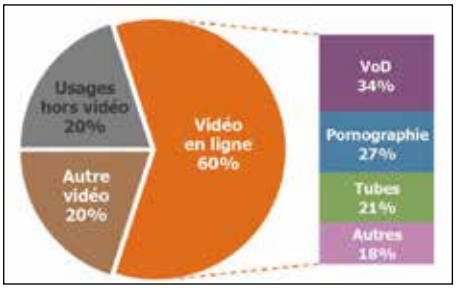
The environmental footprint: the dark, hidden side of the digital era

Although it lies hidden behind our screens and interfaces, the material footprint of digital technology is significant: worldwide digital energy consumption is increasing by around 9% per year and reached 3000 TWh in 2018, equal to the energy consumption of France and the Benelux countries combined. As progress in energy efficiency is tending to slow, this consumption could more than double by 2025.

Right now, the total amount of wind and solar energy available (less than 5000 TWh) would be insufficient to "green" the electricity used by digital technology. The share of carbon emissions from fossil fuel use and attributable to digital technology is thus expected to rise from 5% in 2017 to 15% in 2025, unless the energy mix is changed (for example by increasing nuclear power at the expense of coal).

Towards digital sobriety

Online video is one of the most illustrative examples of the unbridled development, in recent decades, of resource-intensive applications and innovations for the entertainment industry. It accounts for more than 40% of the growth and energy consumption of digital technology.



Distribution of data flows between uses of digital t echnologies and of online video in 2018
Source: "Climate crisis: the unsustainable use of online video", The Shift Project (July 2019)

It is therefore possible – and necessary – to regain control over the way we use our digital systems in order to make the most of what they have to offer. It is urgent that we stop basing our technological and strategic choices on consumerist logic alone, and that we build a European digital ecosystem compatible with 21st-century challenges.
Sobriety does not mean stifling the digital transition, quite the contrary: it means tapping into its true potential by using it **intelligently** to address the challenges arising from the planet's limitations.

Hugues Ferreboeuf
Director of the "Lean ICT" working group at The Shift Project

Maxime Efoui-Hess
Digital Project Manager at The Shift Project

[1] The figures and findings presented come from the report «For digital sobriety» published by the think-tank The Shift Project in October 2018. Unless otherwise stated, the figures cited for energy consumption and emissions of CO2 are world-wide and encompass the production of equipment and use of products and digital services.

[2] International Energy Agency, World Energy Outlook 2018

Google invests in its European Data Centers

In September, Google announced an investment of more than €3 billion in its European data centres. The aim being not only to extend its presence on the old continent, but also to reduce the environmental impact of its infrastructures.

As of next year, an additional €600 million will be invested in the centre at Hamina, Finland. In total, Google will have invested €2 billion in this Nordic data centre, which was once a paper mill. The centre will play a key part in the company's Cloud strategy. It offers numerous opportunities for economic growth, and will also serve as a model for all other data centres in terms of energy efficiency. Located near the Russian border, this centre uses seawater from the Gulf of Finland to reduce the energy required for cooling.

Google wants to use renewables as a source of power for its European data centres

Data centres consume a lot of energy. They are where the data transferred to Cloud-based services are stored and processed. According to Greenpeace estimates, Chinese data centres alone will soon consume more energy than all of Australia. However, Google also plans to invest heavily to reduce the environmental impact of its data centres. Half of the 1,600 MW of renewable energy purchased recently by the firm will thus be

used to launch 10 projects in Europe. In total, Google plans to create the equivalent of €1 billion in infrastructure for the European Union. The remaining funds invested will be distributed among the other European centres located in the Netherlands, Ireland and Belgium.

France: making the right choice

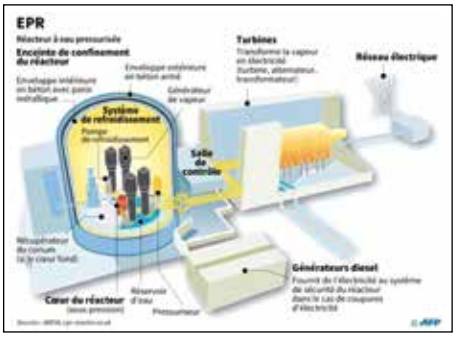
Some of France's 58 nuclear reactors are reaching the end of their operating lives and are scheduled to be gradually dismantled. When, and with what, should they be replaced? According to French government policy, 14 of the 58 reactors currently in operation should be shut down by 2035.

Replacing France's existing nuclear plants with Pressurised Water Reactors (PWRs)

Under the French government's energy roadmap (*Programmation Pluriannuelle de l'Énergie or PPE*), the nuclear sector has until 2021 to draw up an "industrial programme" enabling the construction of new PWRs at an acceptable cost. This summer, Les Échos published a report commissioned by the Ministries of Energy and the Economy; it was written by two long-established nuclear operators and recommended building six PWRs starting in 2025.

According to CEO Jean-Bernard Lévy, if several new PWRs were built, EDF could achieve a cost ranging from €60 to €70 per megawatt hour. The group would have liked the first reactor to be up and running by around 2030. However, given the time required to complete all the preliminary technical and regulatory work, this timeframe does not seem very plausible, even if the EPR project in Flamanville – which has been plagued by delays and soaring costs[1] – is used as blueprint to build the new plants.

Pending the decision, EDF is making its preparations. It has been working for several years on developing simplified PWRs that are cheaper and quicker to build. It is



buying up land close to its industrial sites to accommodate potential new projects.

France needs political will

It is time for the government to show some political will. It has embarked on a green (and inclusive) transition of France's economy, but can it succeed without nuclear energy? Centring our energy policy on emerging French technologies and renewables is a perilous route to take. Ambitious objectives regarding electricity storage, mobility, construction and hydrogen do not really seem achievable, and renewables will only ever provide a partial solution to our reliance on fossil energy… Worse, they may have many negative repercussions. Germany is a perfect example of this, having reopened its coal and lignite mines to offset the intermittency of its renewable energy sources.

Working towards public acceptance

If, as the majority of experts have confirmed, nuclear energy is necessary to meet our carbon reduction targets, then the government should be working on increasing public and political acceptance of nuclear technology... and challenging the claims made by all kinds of anti-nuclear lobby groups that it produces greenhouse gases[3] or that the Fukushima accident killed thousands of people. That is simply not true. No-one is denying that nuclear power generates waste, but solutions do exist. They just need to be implemented![4]

The green transition will not succeed unless we extend the operating life of existing plants, build next-generation PWRs, follow the example of Finland and install small nuclear reactors (SMRs) to respond appropriately to the demands of towns, cities and industry, and develop innovative technology for the future[5].

The government must reassert its political will and make the long-term strategic choices needed to consolidate its energy model and preserve its nuclear power industry, which no other country can match.

Claude Fischer Herzog
Director of Entretiens européens

[1] EDF now plans to bring Flamanville into commercial service by 2022, as opposed to 2012 initially.

[3] According to a BVA survey carried out in April, a large majority of French people (69%) think that nuclear power plants cause global warming. Nothing could be further from the truth. This belief is even more prevalent among young people aged 18 to 34 (86%).

[4] The 16th edition of the Entretiens Européens – which took place in October 2018 in Paris – produced 40 recommendations for the sustainable and responsible management of spent fuel and nuclear waste. See pages 30 and 31.

[5] It is regrettable that France's atomic energy agency (CEA) has decided not to build ASTRID, a prototype fourth generation "fast breeder" reactor that could one day have replaced the PWR.

"Grand Carénage": a large-scale industrial project

The purpose of the "Grand Carénage" project is to ensure the long-term sustainability of France's nuclear power plants. It involves upgrading the entire fleet of 900-MW reactors when they reach 40 years old to extend their service life by an initial period of 10 years, as well as conducting regular maintenance of the fleet with ten-yearly inspections of the reactors and mandatory public surveys. In addition, it will ensure that the post-Fukushima measures required by the French nuclear safety authority (ASN) are implemented. The aim of the safety review is to make sure that the fleet complies as closely as possible with PWR safety standards, but the implementation of measures based on feedback from Fukushima has delayed work on extending the fleet's service life. In 2020, the ASN issued a "generic"

assessment covering all the requirements applicable to the 900-MW fleet, before breaking it down reactor by reactor.

A lucrative operation

This operation involves the entire nuclear industry, in other words almost 2,600 companies in France and some 220,000 jobs. Its estimated cost is approximately €45 billion (10 billion less than anticipated, due to the closure of two reactors at Fessenheim and the cost reductions achieved by EDF's project management team). Routine maintenance accounts for approximately €21 billion of this cost. Thus, "Grand Carénage" represents an estimated €1 billion per year based on an annual output of around 400 TWh, i.e. around €2 to €2.5/MWh. Although it is difficult to predict the market price of electricity over the next 10 to 15 years, EDF is expecting a two-figure return on investment from this project by 2025.

CFH

Thermal renovation of buildings
Complexit

The energy renovation of the existing building stock is necessary if France is to achieve the ambitious target it has set itself in the national low-carbon strategy. But however necessary this renovation, it is apparently – all other things being equal – unachievable.

Unattainable objectives

The observation is that the outcome will be well below the objectives, with the exception, at least in part, of commercial buildings (offices and shops) managed by institutional investors. Green value in these segments is a growing reality. The situation is quite different for housing stock and small businesses. Given the price of energy, only a very small number of energy efficiency projects provide acceptable return on investment times. This situation is likely to continue, especially since two other converging causes must also be considered:

- firstly, behaviours and settlement patterns. People struggle to comply with the operating instructions. Furthermore, the final invoice may be higher than expected, especially when the energy-saving work involves the installation of equipment that generates additional maintenance, servicing or subscription costs;
- secondly, in declining areas, the number of vacant buildings is skyrocketing, and this trend looks set to continue permanently. Before they can be put back on the market, such properties require major structural work that is often incompatible with market constraints. The demolition of this out-of-date building stock, including in the affordable housing sector, will therefore gradually become necessary for the first time in France.

Obligations of incentives

Given the situation, it is very tempting to make renovation work mandatory. In this respect, imaginations are so fertile and so strongly inspired by supposedly edifying examples abroad that it would be fair to compare such an approach with the "Lépine competition". However, a study carried out for the CHANUT/CLAUSTRE report showed that no European country has introduced an "outright" or unconditional obligation to carry out renovation work. Most use a variety of incentives, which seems less problematic and more effective.

Another natural and very effective approach would be to increase the price of energy. However, this is all the more hypothetical and questionable because our country has proved incapable of using any of the taxes on energy bills to cover the cost of building work for the most deprived, and/or to develop stable incentive schemes.

Ultimately then, the alternative is to encourage and/or promote electric heating combined with low-carbon electricity. The choice of electric heating for new buildings will be confirmed in the 2020 Heating Regulation. As for the widespread use of low-carbon electricity in the existing building stock, that's another story!

Bernard Coloos
Vice-president de la FFB

[1] *« Explore the obligation of energy renovation in the residential sector », by Jacques CHANUT and Raphaël CLAUSTRE, June 2013, working group «Obligation to works «as part of the Sustainable Building Plan.*

Reduced CO2 emissions from buildings

This year's SLC summer university was held at Domaine de Chalès in Nouan-le-Fuzelier on 19, 20 & 21 September. It has been led by the new President, Eric Maucort. ASCPE followed the discussions.

Quality input, people committed to their work, a proactive atmosphere for reflection and action – all in all, two rich, exciting, friendly and instructive days devoted to meetings and discussion!

We all know the figures: buildings in France represent 45% of our energy consumption and 25% of GHG emissions (1). The sector has been the subject of numerous public policies, in particular because taking action in this field seemed easier than implementing measures in other energy-intensive areas such as transport and agriculture. However, all the policies implemented over the past ten years have failed, from the Grenelle Law to the sustainable construction plan.

Reducing energy bills was not the right way to go. A carbon-based approach would have been smarter and more economical. Many billions have been spent on renovation work that has had little effect on public buildings and industrial facilities, i.e. the places that consume the most. As for private housing stock, priority should have gone to the poor. Instead, the tax credit proved to be a windfall for the more affluent. Worse still, we began incurring costs despite a lack of qualified professionals. In the renovation of the buildings, the artisans are majority in France, but they did not receive training, for lack of time and means. The results are particularly disappointing, since CO2 emissions actually increased between 2012 and 2017.

CFH

See the Jean-Pierre Pervès study: La consommation d'énérgie dans le bâtiment en 2017. Les questions que pose le poids des énergies fossiles dans l'existant comme dans la construction neuve. [Energy consumption of buildings in 2017. Questions raised by use of fossil fuels in both existing and new buildings.

See also the summer university presentations and videos: *https://www.sauvonsleclimat.org/fr/base-documentaire/2019-orleans-nouan-le-fuzelier-12eme-ue-reduire-les-emissions-de-co2-du-batimenttations-et-videos*

(1)The equivalent of 120 million tonnes of CO2 per year.

The true costs of decarbonising the electricity supply

The deployment of energy technologies renewable variable (ERV) can entail costs for the system energetic in addition to those created by the central. Jan Horst Keppler and Marco Cometto from the Energy Agency Nuclear Policy, OECD, summarize for us the NEA study on the costs of decarbonisation.

Such system costs are mostly due to the variability and unpredictability of VRE output and their comparatively small unit size. The first demands structural changes in the generation system to ensure the capacity and flexibility needed to accommodate their variable production, the second requires extra investment in transmission and distribution infrastructure. There are four categories of system effects: profile costs, balancing costs, grid costs and connection costs. The most important are the profile costs, which are due to the increase in the generation costs for the entire electricity system in response to the variability of VRE output.

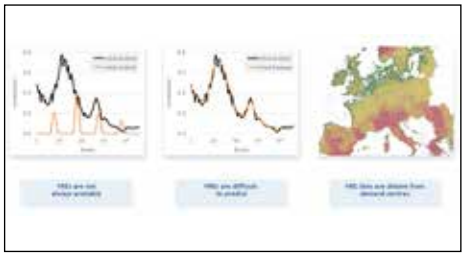


Figure 1. System costs and variable generation
Source: Hirth, 2015

Balancing costs are due to the increasing investments necessary to ensure system stability due to the uncertainty in power generation. Grid costs include building new infrastructure and strengthening the existing infrastructure's capacity. Connection costs are the costs of linking a power plant to the grid.

Need for greater REn capacity to produce less electricity

Combining explicit targets for VRE technologies and a limit on carbon emissions has important impacts on the generation mix, overall capacity and costs. As VRE load factors are lower than conventional power plants, higher

Jan Keppler during Les Entretiens Européens on Nuclear competitiveness (Brussels – 2017)

capacities are needed to produce the same amount of electricity. Concurrently, conventional resources such as nuclear or gas will turn at lower load factors. Other things equal, the total costs of realising a given emission target will increase significantly with higher shares of VRE.

In a least-cost system, VRE also change the long-term structure of the remaining fossil-fuel based capacity with a progressive shift from combined cycle gas turbines towards open cycle gas turbines with lower fixed costs which are better equipped to accommodate reduced load factors. The generation share of nuclear is a function of the overall carbon cap and the amount of exogenously imposed VRE.

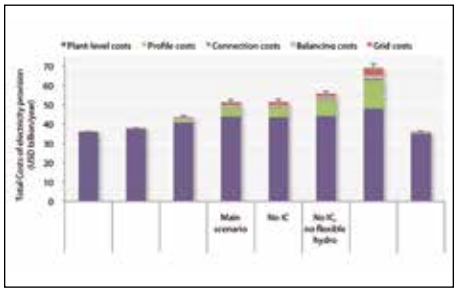


Figure 2. Total cost of electricity provision (billion USD per year)

Figure 2 shows how the overall costs of the system and the different system cost components increase strongly with VRE production share under a 50gCO2/kWh carbon constraint. Taking a base case with only nuclear energy as a low carbon electricity provider, total system costs increase by 42% if half of all electricity generation is from VRE and a 75% VRE target means almost doubling the costs of electricity provision.

Higher overall system costs

High shares of VRE drive up overall costs and change how the electricity system operates. Nuclear or gas plants will operate at reduced load factors and frequently ramp up and down. A striking effect on the electricity market is also the appearance of hours with zero prices. The need for economic viability will ensure that these are compensated by hours with high electricity prices. This implies higher volatility and in the real world, increased investment risk and higher capital costs.

VRE generation is concentrated during a limited number of hours. In combination with their zero short-run marginal costs, this decreases the average price of the electricity generated by VRE as their penetration level increases.

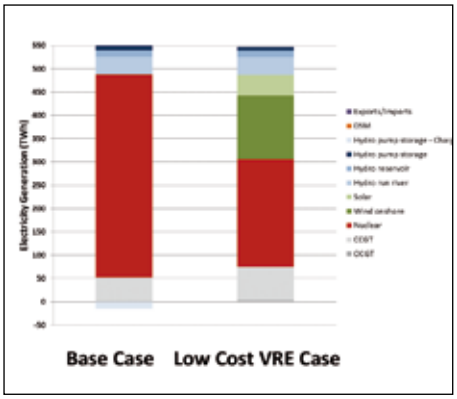


Figure 3. An equilibrium of nuclear and low cost variable renewables

Under current costs, a mix relying substantially on nuclear energy is the most cost-effective option to achieve a target of 50 gCO2/kWh. Further declines in VRE costs would lead to entry on their own merits. Ultimately, there could be a cost-minimising equilibrium between VRE with low plant-level costs but high system costs and nuclear with somewhat higher plant-level costs but low system costs. A realistic vision for a future low carbon electricity mix could be 40% VRE, 40% nuclear and gas and hydroelectricity the rest.

Recommendations for a cost-effective and safe carbon-free system

The task for policymakers is to cost-effectively decarbonise electricity while maintaining security of supply. This means:

1. Implementing carbon pricing to decarbonise the electricity supply.

2. Recognising and fairly allocating the system costs to the technologies that cause them.

3. Encouraging new investment in all low-carbon technologies through frameworks providing stability for investors.

4. Using competitive short-term markets for the cost-efficient dispatch of resources.

5. Ensuring adequate levels of capacity and flexibility, as well as transmission and distribution infrastructure.

These five measures are the basic framework for a low-carbon electricity system with an optimal mix between VREs and clean, dispatchable sources such as hydroelectricity and nuclear energy.

Références :

NEA (2019), The Costs of Decarbonisation: System Costs with High Shares of Nuclear and Renewables, OECD, Paris.

NEA (2018), The Full Costs of Electricity Provision, OECD, Paris.

Europe's low-carbon transition will only succeed if it is fair

Successfully tackling climate change will require more public services, planning, long-term strategy making, regulation and government intervention, explains Alexandre Grillat. It will also mean ensuring that "European workers are not left behind".

The new President of the European Commission has committed to prioritise the climate during her time in office, with plans to increase the CO2 reduction target to 55%, create a European Climate Bank, introduce a carbon tax at the borders, and set up a Green Deal initiative. This commitment should be applauded, as an uncompromising and non-ideological response to the climate emergency and to the need for a low-carbon society must be front and centre of the European project.

But it will take more than just words to make a success of the low-carbon transition. Words must be turned into action, even if that means challenging established dogma. Far from the liberal ideology that has reduced the European energy union to an internal market driven exclusively by competition and short-term interests, the Commission must understand that successfully tackling climate change will require more public services, planning, long-term strategy making, regulation and government intervention. Because low-carbon energy is a long-term commitment, and the fight against climate change – while it must begin right now – is for the long haul.

Developing a low-carbon industrial policy

Beyond competition policy, which must be reviewed in light of the climate emergency, the priority is to lay the groundwork for large-scale investment in low-carbon infrastructure, through appropriate regulation and funding. On condition that European technologies and industries are used, which will require Europe to implement a real industrial policy and an ambitious programme of innovation that gives equal consideration to the climate, industry and jobs. For if Europe relies on Chinese or American equipment, technology and standards, it will achieve neither sovereignty nor full employment. Implementing low-carbon regulation means introducing a carbon tax at Europe's borders to make sure that Europe's decarbonisation efforts are not cancelled out by imported products with a negative carbon balance, and do not put European industries at a disadvantage compared to their competitors. Europe must move to action now, and use single market access as a lever for decarbonisation!

Restructuring through training and employment

Taking action also means effecting a low-carbon transition that takes social issues into consideration, is fair, and resonates with Europeans as both citizens and employees! How can we invest in low-carbon energies and encourage energy efficiency while preventing prices from spiralling upwards, which would affect the purchasing power of Europeans and increase energy insecurity? How can we restructure regions that currently rely on fossil fuels by providing high-quality retraining programmes for affected workers? Clearly, if the European energy transition overlooks the social implications, it will be doomed to failure. Worse still, the very concept of transition leads to major changes: the emergence of new jobs (linked to digital technology, new energy sources, energy efficiency, etc.), the need to consolidate existing jobs in low-carbon technologies like nuclear power, the loss of jobs in the fossil fuels sector, etc. These changes must be accompanied by support measures including human resource planning, initial and continuing training, apprenticeships, and higher education programmes to attract talent, encourage young people to work in industry, and successfully retrain workers.

These measures are essential to ensure that Europe has the skills necessary to transition to a low-carbon economy that is based on European technologies and provides European people with real, skilled jobs throughout the value chain. So, yes, Europe is destined to be a low-carbon continent, provided that European workers are not left behind, and that European construction is no longer confined to a single market that regards Europeans merely as consumers. Social ambition and an industrial strategy really are essential to create a low-carbon Europe!

Alexandre Grillat
National Secretary
CFE CGC

An appeal from the MIT to give nuclear power its rightful place

Can the world still reduce its carbon emissions and slow or even halt the effects of climate change? "Yes", says the MIT in the 8th of a series of reports on the role of technologies in meeting rising energy demand[1]. Especially if nuclear power is included in the array of low-carbon technologies, otherwise the task is likely to be tougher and more costly. But for the industry to deliver its full potential, its new reactors must be more competitive and the regulatory and political framework must be reworked.

Towards deep decarbonisation

Given the predominant role played by fossil fuels in electricity generation, the electricity sector is still a high emitter, with average emissions of around 500 g-CO2/kWh. However, it is also the most likely to achieve deep decarbonisation, thanks to technologies that have been tried and tested in numerous countries (nuclear, hydraulic, renewables). These are a real asset considering that global electricity consumption is expected to grow 45% by 2040, driven upwards by demand in emerging countries. To reduce our emissions by 2050, low carbon technologies will have to be complementary rather than competitive. The MIT's scientists underline the fragility of decarbonisation scenarios that do not include nuclear power, deeming them not only unrealistic but also more costly. For the majority of countries around the world, not using nuclear power leaves them with no other solution but storage, which raises its own set of challenges (see the box opposite).

Build faster to cut costs

In the United States and Europe, productivity on construction sites is lower than in Asia. The MIT's scientists invite the nuclear industry to rethink its construction methods, and recommend greater modularity. The mass factory production of standard parts would reduce costs through increased productivity in the manufacturing sector. They also stress the importance of having a robust and experienced supply chain that is familiar with reactor technology.

A revised political and regulatory framework

Study co-chair John Parsons argues that "government officials must create new decarbonization policies that put all low-carbon energy technologies (i.e. renewables, nuclear, fossil fuels with carbon capture) on an equal footing", to avoid risk of discouraging investment, increasing the cost of decarbonisation[2] and hindering progress towards climate change mitigation targets. The premature closure of existing nuclear plants regarded as safe by the safety authority and competitive by the operator would increase the cost of achieving emission reduction targets and compromise efforts to this effect. In the United States, three states (i.e. New York, Illinois and New Jersey) reward electricity producers that do not emit any greenhouse gases (Zero Emission Certificates). Lastly, the authors consider that, despite specific circumstances in some countries, it is feasible and possible at this stage to harmonise regulatory safety requirements to enable the global deployment of commercial reactor designs and ensure a high level of safety worldwide.

Is electricity storage a solution to the intermittency of wind and solar power?

In France alone, it would take 24 million fully charged electric vehicle batteries to provide the equivalent of the energy consumed in one winter's day. Emptying all the dams in France would only provide the equivalent of the energy consumed in one winter's day, and WWTPs alone would be empty in less than two hours. Replacing the 12 billion cubic metres of gas stored in France's natural cavities with compressed air would generate enough electricity for just four hours during peak periods in winter. Storing five hours' worth of wind power in batteries doubles the cost of the wind farm, and halving the price of batteries will not fundamentally change the situation! Hydrogen does not fare much better, since it takes 13 GW of wind and solar capacity to produce the same volume and quality of electricity as a nuclear power plant using hydrogen.

HF

[1] *Massachusetts Institute of Technology / The Future of Nuclear Energy in a Carbon-Constrained World. 2018*

[2] *See article by the OECD's Nuclear Energy Agency (NEA) on page 11.*

Nuclear power must earn its green label

On 8 March 2018, the European Commission published an action plan for financing sustainable growth. It sets out a strategy for developing a European classification system for sustainable activities (taxonomy). The aim is to counter "greenwashing" by harmonising the rules used to determine the sustainability of financial products.

There is fierce debate in the energy production sector: while fossil fuels are logically excluded from this green label scheme, the eligibility of nuclear power – which is carbon free – has still not been decided. The European Parliament and some Member States, such as Germany, are pushing for nuclear power to be excluded from the taxonomy.

As for the Commission, it acknowledges the importance of nuclear power in tackling climate change, while other countries, led by France, are advocating its inclusion. It is still not clear when the taxonomy will be completed. The project was initially scheduled for completion in 2020, but is likely to continue until 2022:

in the meantime, the pro-nuclear forces, led by industry, must do everything they can to earn their green label!

Julien Maison
In charge of studies
Les Entretiens Européens

Renewable electricity
A societal choice that will cost Europe dear

An efficient power generation mix must ensure effective monitoring of demand, emit few greenhouse gases, and be competitively priced. However, renewable energy (RE) is one of the least cost-effective technologies for tackling energy and climate challenges. Indeed, increasing the share of intermittent wind and solar power in the power generation mix will require improvements to the grid, additional flexible (and mainly fossil-fired) production facilities, and a total installed capacity that far exceeds power demand. The collapse in overall supply efficiency will lead to an increase in real costs for consumers and taxpayers and a more unstable, poorer quality power supply.

The perverse effects of too many renewables on the market

The massive and increasing injection of wind and solar power onto the grid at times when consumers do not need it drives prices down, or even creates negative prices. However, RE benefits from priority dispatch and a guaranteed purchase price, the difference between the market price and this guaranteed rate being paid through consumer taxation. As the installed capacity of RE increases, the average wholesale price falls, and taxes and shipping costs rise. Consequently, with constant system service, it is highly likely that RE producers will never be able to finance themselves from the market alone and that they will always be subsidised by the taxpayer, or that they will cease operating due to inadequate profitability! At best, we will maintain their activities artificially by exempting them from all system service obligations, or even by financing their grid connection, which will inevitably weaken the system while increasing the full cost of supply.

Falling wholesale prices are penalising nuclear power

Heavily capital-intensive production systems like nuclear power plants, which require a reasonable market price to finance their investments, are being hit hard by falling wholesale prices. In addition, the absence of a long-term signal from a market that is more sensitive to changing weather conditions than to basic energy needs is not likely to reassure investors! We must be careful not to ruin the economic model and force the only truly carbon-free power plants to close by allowing excessive amounts of intermittent energy to be injected at low market cost,

but at increasing real prices subsidised by the taxpayer. In that case, the grid's continued operation would depend on fossil fuels alone, with their attendant greenhouse gases and other air pollutants.

One-way complementarity between RE and nuclear power

The nuclear industry – which is able to perform load following and carry out system services on behalf of the RE sector – is complementary to RE, which, conversely, is unable to back up or support nuclear power generation. In France in particular, the RE sector is whittling down the load factor of nuclear power plants by slashing their profits by €2 billion per year, while spending around €7 billion in taxes without saving a single gram of CO2! Worse still, lifecycle analysis – including fuel and dismantling – shows that nuclear power in France generates 6g CO2/kWh, while wind power generates 10g at best, and solar power generates 32 g. Nonetheless, France has set itself a target of nearly 40 GW installed wind capacity and 20 GW installed solar capacity in the next ten years. Meanwhile, the load-following capacity of nuclear plants has been clamped at 63 GW, which will barely be able to offset more than 20 GW of power variation in a few hours: does this mean we will be relying on gas (or that we will continue using coal)? As for interconnections, they will only be useful if a country is able to use the surplus controllable capacity of its neighbours. France, which now has only 85 GW controllable capacity (having previously reached a peak of 102 GW), has embarked on a critical path and is relying on its 12 GW of interconnections and wind capacity to meet demand: what will happen when it has closed its coal-fired and Fessenheim (5 GW) plants, Germany has closed 29 GW of capacity, and there is almost no controllable capacity to replace them?

Making new choices

Opting for one hundred percent RE will cost Europe dear: installed wind and solar capacity is four times less useful for producing energy than nuclear power, while requiring additional means of storage (see box below) or production, and improvements to the grid. At constant service, the cost of RE is ultimately 10 to 20 times greater than that of nuclear power. The figures speak for themselves: Germany has the highest domestic electricity prices in Europe, excluding Denmark; they are about twice as high as in France, and the average carbon content of its electricity is six times higher than that of France. To complete nuclear and hydraulic, we would be better advised to focus our efforts on thermal RE, which is 25 times more efficient than electric RE per euro of aid in terms of reducing CO2 emissions, and which accounts for 75% of the sustainable jobs created by the RE market in France. Thermal nuclear power would have its role to play: by recycling the residual heat released by its reactors, it could meet a large proportion of urban and industrial heating requirements. In this respect at least, it should be eligible for funding under Europe's Energy Transition Fund and, as suggested by the Council (see column opposite), it should be included in the "EU sustainable finance toxinomy" project that is currently under discussion in the European Parliament..

Our energy and climate policies should be driven by the cost of a ton of CO2 avoided, which would quickly put wind and solar in their proper place (€1000/t-CO2 avoided, when the market price of CO2 is around €30 and the target tutelary value is €250). To ensure the market functions correctly with regard to the policies adopted, the right investment signals must be provided by internalising connection and back-up costs. Since CO2 knows no boundaries, such a driver would allow CO2 emission reduction solutions to be developed anywhere in the world, wherever they are the most efficient and the least expensive.

Hervé Fischer
ASCPE Consultant
Les Entretiens Européens
President of EuroLorraine SAS

EuroLorraine
Conseils et ingénierie pour l'environnement et le développement

A Finnish sector under development

As the main partner of "Les Entretiens Européens" 2019, FinNuclear brings together industrial companies and promotes the nuclear industry internally and internationally. Its director Marjut Vähänen describes here the main facilities in Finland for the entire sector, production and nuclear waste management capacities.

Nuclear power has an important role as CO2-free energy source mitigating climate change. In Finland's electricity production nuclear energy is the largest single energy source; more than a quarter of the electricity used and over a third of electricity produced in Finland are generated by nuclear power (Fig 1). For decades, Finnish nuclear power plants have operated safely and reliably at stable prices. Plant usability has been consistently top of the world. In Finland questions related to final disposal of spent nuclear fuel have also been resolved.

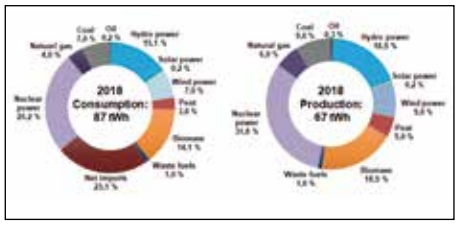


Figure 1 Energy consumption and production in Finland in 2018 ("Energy year 2018 – Electricity" by Finnish Energy).

Nuclear energy production and waste issues

The nuclear sector employs thousands of people in Finland, not only in the nuclear power plants themselves, but also in government organizations, research and life-cycle supporting companies. Indeed, the industry offers sustainable business opportunities for committed professionals. At this moment there are altogether four nuclear reactors in operation; two in Olkiluoto power plant (880 MWe - owned by TVO) and two in Loviisa power plant (502 MW - owned by Fortum). The fifth reactor (Olkiluoto 3, 1600 MWe - owned by TVO) is almost ready for operation; the Finnish government granted the operating license on 7 March 2019 and the power plant is scheduled to begin commercial operation in July 2020. The sixth reactor Hanhikivi 1 at Pyhäjoki (1200 MW - owned by Fennovoima) is at the licensing phase and is scheduled to get the construction licence in 2021 and to begin commercial operation in 2028. The research reactor (owned by VTT Technical Research Centre of Finland) operated over 50 years at Otaniemi and it is now at the decommissioning phase; it was shut down on June 2015 and VTT applied decommissioning license in 2017.

There are already repositories for low and intermediate waste at the operating nuclear power plant sites Olkiluoto and Loviisa. Nuclear waste management organization Posiva (owned by TVO and

Fortum) is taking care of the planning, constructing and operating of the disposal facility of spent nuclear fuel. The excavation work of final disposal facility began on December 2016 at Olkiluoto site and the final disposal of spent nuclear fuel is planned to start in 2020's.

Emissions-free nuclear power will continue to account for a significant part of Finland's carbon neutral energy production. As the share of variable generation based on renewable energy sources increases, stable power generation is needed to ensure the security of the energy system. The future nuclear projects are seen as remarkable opportunities to expand the Finnish industrial competences in the nuclear field in addition to numerous companies already possessing nuclear expertise.

Marjut Vähänen
Director, FinNuclear

FinNuclear, Finnish Nuclear Industry Association

Founded in 2011 by industry organizations, FinNuclear is a contact window for the Finnish nuclear industry network. The Association works to promote Finnish nuclear cooperation and competences in Finland and internationally. The «FinNuclear Directory» presents the member companies (available electronically on the Internet **http://directory.finnuclear.fi/directory.aspx)**

FinNuclear organizes many events, company visits and exhibitions, to promote its members to different stakeholders (authorities, regulators, decision-makers, licensees, etc.)

The Nordic Nuclear Forum (**https://nordicnuclearforum.fi/**) in Helsinki in 2019, organized by FinNuclear, collected more than 600 nuclear professionals, and will hold its 2nd edition in 2021. You can meet FinNuclear at World Nuclear Exhibition 2020 in Paris, as well as in Dubai Expo 2020.

FinNuclear Association is founded by industrial organisations and its purpose is to promote Finnish companies' general preconditions, cooperation, competences and international profile in order to support the safe use of nuclear energy. FinNuclear's field covers the whole lifecycle of nuclear power plants and associated plants, including expert services and equipment within design, licensing, construction, operation, maintenance, modernisation, fuel cycle, waste management and decommissioning as well as related research activities.

For more information and contacts, do not hesitate to contact us via: **https://finnuclear.fi/en/contact/**

Nuclear Energy
as a part of the Finnish Energy Mix

The share of nuclear energy in our Finnish energy mix is about one third of the electricity produced in Finland and less than 30% of the consumption. The acceptance of nuclear energy is higher than ever based on the poll carried out over 30 years measuring the "yes and no" answers in Finland. To the opinion of Liisa Heikinheimo, it is not only the climate change debate yet that can be seen in these results. The change seems to reflect some longer-term actions and processes.

Three keys to understanding

As the first key to this change, I would take the responsibility of the nuclear waste management, especially the efforts and progress to develop the spent nuclear fuel repository in Olkiluoto by Posiva. Posiva is constructing today the underground repository tunnels below -450 meters depth and the encapsulation plant works have started on the site this summer. This facility will be the first in the world that will be taken into operation in the mid 2020´s. The second key for the acceptance to my opinion is that we have a strong and knowledgeable safety authority; the safety assessments take time but the results are verified and reliable. As a third key I would take the good performance and high load factors of the existing nuclear fleet, both in Ikiluoto and in Loviisa.

It has been possible to renew the operating licenses due to the facts that the units fullfill all the present safety requirements and the aging management programmes provide good operability. Today the units Olkiluoto 1 and 2, owned by TVO, have operating licenses until the end of year 2038. The Loviisa site licenses will expire in 2027 and 2030 for units 1 and 2, we will soon learn how the owner of Loviisa nuclear power plants, Fortum, will see the future of these units.

Private companies serving the public good

In Finland, it is also a sign to the public that the private power companies are building new nuclear units, there needs to be a real business case for these. The fact that Finland is importing electricity is well understood and this means that there is still space for new capacity. Although it is very challenging to start a new project and take all the responsibilities for financing and realising the project, Olkiluoto 3 unit is close to the start of operation now and Hanhikivi 1 unit, owned by Fennovoima, makes progress towards the construction license. In Finland there is also ongoing a public dabate on new nuclear technologies such as SMR`s since they could be built faster, provide high safety and be used for cogeneration of power and heat too. The future will show how these benefits could be realised.

A diversified mix with more and more nuclear to meet needs

Finnish energy mix is diverse, a substantial amount of renewables has already been brought in. In the electricity production, the part of nuclear energy is already about one third and with the Olkiluoto 3 production this will grow close to 40 %. Due to the fact, that the Finnish industry is demanding a big part of our electricity the reliable and well forecasted production is needed. What are going to be the changes in the needs of electricity in the industry if the climate change actions will change the processes towards more energy intensive direction. This is also to be seen in the coming years. The same applies for the changes in the transportation and traffic when we will start using electrical vehicles in a large extent. The crucial question there is to be able to build the power production capacity with the same pace with these changes.

We are today running a nuclear power programme in Finland where the current licenses are valid till the end of 2030's and the operation of new units may last much longer if the 60 years design life is counted. Correspondingly, the activities on the nuclear waste management will last at least a 100 years from now.

Olkiluoto 3

Skills and innovation on the agenda

The human resources capacity building is reported on a national basis, and we have counted the amounts of skills and competencies. This is a basis for both the education and industry to act for the new and future needs. The Finnish Nuclear Energy Research Strategy was published in 2014. It was written by all major nuclear stakeholders in Finland, although coordinated by our ministry. The Finnish idea is that the policies are planned together but the actions for execution of the programs are left to individual stakeholders. The nuclear safety research infrastructure is under a strong development phase. Both the VTT Centre for Nuclear Safety could be funded and at the same time the research infrastructure of Lappeenranta University of Technology will take place. These are needed to provide the necessary resources for our nuclear safety authority and for all the research activities for the capacity building, including industry and its needs.

To continue the safe and reliable electricity production we need a stable environment for the planning and operation. This means a good licensing system that relies on an up-to-date legislation and reflects the international developments as well. On a governmental level the long operation perspective means that we need to work continuously for actions improving the safety and to take care of the capacity building and research activities too, as well as the economics of the activities. As a result of these it is possible to get the electricity in return for the society.

Liisa Heikinheimo
Deputy Director General
Energy department
Finnish Ministry of Economy and Employment

The importance of nuclear long-term operation in fighting climate change

An increasing number of experts recognise that decarbonising the power sector cannot be achieved with renewables alone - nuclear will have to play a role if the world is to reach its CO2 reduction targets by 2050.

The intermediate decarbonisation targets in the transition towards 2050 cannot be achieved without the Long-term operation (LTO) of existing nuclear power plants (NPPs). In fact, if the EU were to invest in maintaining a fully operational nuclear fleet over this period, then 58% of its electricity would come from low-carbon sources by 2030 – making it the global leader on climate change policy. If not, the share will drop to 38%, increasing cumulative emissions by around 1500 million tonnes of CO2 by 2030.

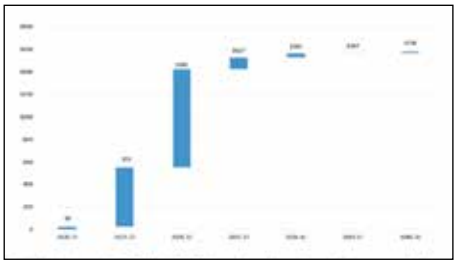


Fig. CO2 emissions (MtCO2) added to the overall budget in the case of an early closure of the nuclear reactors. FORATOM calculations based on FTI-CL Energy results

Sustainable decarbonisation at reduced cost

LTO is unarguably economically advantageous compared to other power sources. For example, when it comes to capital costs, the average LTO investments between 2000 and 2025 are around 630 EUR/kWe and according to PINC , representing the lowest capital cost of all low-carbon technologies. From a technical point of view, the LTO of nuclear reactors provides a great advantage thanks to the "…timely implementation of reasonably practicable safety improvements to existing nuclear installations" which brings older generation reactors to a level of nuclear safety standards in compliance with the amended Nuclear Safety Directive.

LTO reduces the EU's energy import dependency – mainly fossil fuels – and

provides reliability to the grid. The results of a recent study undertaken by FTI-CL Energy Consulting demonstrate that an early closure of nuclear capacity would increase fossil fuel consumption (gas and coal) by 6500TWh.

Low-carbon nuclear generation provides firm capacity to the electricity system. Intermittent renewables cannot replace firm thermal capacity in terms of security of supply. For example, wind generation provides a firm capacity equivalent of less than 10% of its installed capacity. In contrast, thermal and, in particular, nuclear generation provides a firm capacity of more than 90% of its installed capacity.

FORATOM's policy recommendations

- Ensure a coherent, consistent and stable EU policy framework (including Euratom).
- Agree an ambitious net-zero CO2 emissions target for the EU in 2050, in line with the European Commission's long-term vision for a climate neutral economy.
- Develop and implement a strong industrial strategy to ensure that Europe maintains its technological leadership.
- Support human competences development.

FORATOM
THE VOICE OF THE EUROPEAN NUCLEAR INDUSTRY

ABOUT FORATOM

15 European fora and 2 corporate members representing nearly 3,000 companies.

We provide expertise on the role and importance of nuclear energy by:

- Participating in the EU legislative process, particularly regulations which can have an impact on the industry
- Providing feedback to public consultations
- Analysing public opinion
- Raising awareness amongst broader audiences
- Organising regular events to inform key stakeholders about the benefits of nuclear

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Yves Desbazeille
Director General
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For more information on this issue, please refer to FORATOM's position paper entitled "The importance of the long-term operation of the existing EU nuclear fleet", available from our website: www.foratom.org

Nuclear energy, the base of a carbon-free economy

In her article, Liisa Tuomela demonstrates that nuclear will remain the production base energy without which no objective reducing gas to greenhouse effect will only be filled, and that its role will develop in the context of electrification of modes of production.

Based on several recent analyses and reports – IEA, IPCC, EU Commission, as well as those carried out by the industry (Eurelectric and Foratom) – it is clear that nuclear plays an important role in climate change mitigation.

The EU Commission's Clean Planet for All communication states from autumn 2018 that, "By 2050, more than 80% of electricity will be coming from renewable energy sources. Together with a nuclear power share of ca. 15%, this will be the backbone of a carbon-free European power system."

The role of nuclear is significant already today and, it will either grow or at least remain the same. None of the reports suggest that the importance of nuclear would be diminishing.

Nuclear's ability to produce a large amount of CO2-free energy becomes valuable again, as we expect electrification to move ahead in all energy consuming sectors, including heavy industries. Most likely, the word "baseload" will return to the vocabulary of energy policy as quickly as it disappeared a couple of years ago, when "volatility" and "flexibility" took over, even though flexibility would remain a valuable attribute for the market.

How can we exploit the potential of nuclear energy? I think we should look at the full menu: competitiveness of existing nuclear power plants, their long-term operations (LTO), and new builds.

Time to transform the nuclear industry

The past few years have been very challenging for nuclear companies. Wholesale electricity prices have been on the downward trend until recently. In the Nordic countries, the average price in 2017 was 40% lower than that of 2010. The low price level has been driven partly by economic downturn and partly by the oversupply caused by subsidies primarily for renewable energy sources. At the same time the investment money put into the nuclear plants has almost doubled due to increased safety- and refurbishment costs.

Much of the future options are in the hands of the industry itself. We should be more active and open in looking for best practices within the nuclear industry but also from other safety-critical industries. Digitalisation, fresh and modern leadership skills, and change management should find their ways to the nuclear industry too – it is clear that the world has changed and the nuclear industry must change too.

All new nuclear power plants are somewhat unique. Harmonised safety and licensing requirements, standardised designs, equipment and components are lacking. This increases costs and affects negatively on competitiveness. To address this challenge, Finnish nuclear license holders, together with the national regulator, have started a project (KELPO) to develop a standardised licensing and qualification process for safety related systems, structures and components.

This is the start of a long journey. If we want to create real impacts, we must take it to an international level – starting with the EU and the close involvement of the Commission – as well as supply companies and regulators. It is a modest start, but we need to start somewhere because the status quo is not sustainable.

The Commission has assessed that approximately 50 nuclear reactors out of the 126 currently in operation in the EU are at a risk of an early closure over the next ten years or so if the operators do not pursue LTO licenses. This in spite of the fact that IEA estimates nuclear LTOs to be the cheapest option to produce electricity on a levelised cost of electricity basis (LCOE).

In today's world, anything that costs 6, 7, or 10 billion and takes a decade or more to complete – i.e. doesn't generate income before that – is very difficult to finance. Therefore, if we want to see new nuclear plants – in addition to those six currently under construction in the EU – to be built, they would have to become cheaper and faster to build, and safer at the same time. In this regard, developments of small modular reactors (SMRs) would offer interesting outlooks, when moving from R&D projects to reality.

Plea for a level playing field for nuclear in policies and legislation

While there are issues, like standardisation and harmonisation, that are nuclear-specific to a certain extent, many horizontal policies and pieces of legislation have an impact on nuclear and its competitiveness. There, the nuclear industry is asking for equal treatment with other low-carbon technologies: similar treatment in the power market, where the ETS should be the main tool to drive decarbonisation; similar treatment in terms of taxation and abolition of nuclear-specific taxes; similar approach in research, development and innovation policies to develop new nuclear concepts to meet the demands of the future; and similar access to financing as other low-carbon technologies. When it comes to the last point related to financing, the EU package on sustainable financing simply must assess nuclear on equal footing with other climate neutral technologies.

Tiina Tuomela
Deputy Director General
FORTUM

Nuclear New build in Finland: why is more energy needed?

Climate change is upon us and many organizations, such as the IPCC, have alarmed the global community on the urgency to limit our emissions. Climate anxiety has spread widely as a phenomenon lately; people are seemingly very stressed and worried on what will happen to our planet and our societies. So what needs to be done? Do we all need to live in trees and cut practically everything out of our lives? I would say no; nature and modern human societies can coexist, although many changes are urgently needed, the production and use of energy being one of the most important ones.

Energy efficiency is not a solution

When we talk about energy, we often tend to shift the discussion on electricity alone. How is it produced? What is the environmental impact of each production method? How is it consumed and how can we do all this in a manner that decreases the strain on our environment? Extremely important topics, but very often the use itself of electricity is seen as a bad thing; the argument goes that energy efficiency should solve a major part of the problem and the consumption of electricity should decrease.

Here I beg to differ. We need to increase it. What is important is the entire big picture in regards to energy; electricity is a big part of it, but heating, industrial use of energy and especially transport are often put aside as different topics of discussion, if discussed at all, as is the case of the use of energy for heating in many parts of Europe. The point here is, that if we can decrease the total emissions by shifting energy use from e.g. burning petrol and diesel in passenger cars to electricity, the resulting increase in electricity consumption is not a bad thing at all; given of course that it is produced in a more environmentally friendly way than burning oil, preferably with a method with as a low environmental impact as possible.

The same is true for heating; if a household exchanges their gas or oil-burner to a heat pump, often the use of electricity in that household slightly increases, but the total use of energy, and especially emissions, decreases considerably. As a bonus, the use of electricity is a part of the Emissions Trading System, contrary to the use of oil for transport or for heating. This brings the use of energy to a system where it can be controlled and the emissions decreased annually.

Consuming more, but with which energy?

Electrification is needed on many parts of the society and we need to ensure that clean electricity is available for this need. Here comes in nuclear power. With the Fennovoima 1200MW nuclear power plant coming online in 2028, we could electrify every single passenger vehicle in Finland. All 2,6 million of them, with an annual average of 15 000 kilometres per vehicle. Year after year. Or we could replace all coal and gas from electricity production. Or electrify huge areas of industries currently using fossil fuels.

Nuclear power might take time to build, but when it comes online, the impact it has on the use of fossil fuels is like a strike of Thor's hammer on a Giant's head; it smashes it with one blow.

Tuomo Huttunen
VP Manager
Fennovoima

Voimaosakeyhtiö SF
United by a need for stable, reliable and emission-free electricity

Fennovoima is owned by two companies, SF Power Company (66%) and RAOS Voima (34%), a Finnish subsidiary of the Russian group Rosatom.

As the majority shareholder, SF Power Company brings together large companies based in Finland including Outokumpu, SSAB, SRV and Fortum as well as many local energy companies. They will receive a share of the electricity produced by the Hanhikivi 1 plant, which will cover about one-tenth of Finland's electricity needs.

These companies are key players in the local economy, and some are owned by municipalities. Given that they consume more energy than they are able to produce themselves, they buy the difference on the electricity market, which requires a high degree of predictability. Fennovoima, managed according to the Mankala principle, will guarantee both their energy supply and a fixed price for the years to come, allowing them to more effectively manage their investments.

Finland's nuclear safety authority gives EPR a green light

Now that STUK, Finland's nuclear safety authority, has given its green light, Helsinki has issued an operating licence for the third-generation reactor to Finnish operator TVO. Construction of the EPR reactor by Areva in Olkiluoto is nearing its end and commissioning is scheduled for 2020, ten years later than initially planned, at an estimated cost of €8.5 billion, almost three times the €3 billion initially envisaged.

The safety authority must now carry out a final inspection before authorising the loading of nuclear fuel, scheduled for January. This Finnish project is the second to involve commissioning of an EPR, following that of the Taishan plant in China in December. The EDF plant in Flamanville, Manche, is announced for 2022.

The licence will be valid for 20 years, through to 31 December 2038, and a new mid-term inspection is scheduled for 2028. The plant, which will be the most powerful in Scandinavia, will cover 15% of Finland's electricity needs and will reduce imports during peak consumption in the coldest days of winter. With a capacity of 1,600 MW and an estimated service life of more than sixty years, the EPR will help to increase the share of carbon-free electricity, which according to Minister of the Environment and Energy Kimmo Tiilikainen will rise from 80% to 85%.

Small nuclear reactors could heat Finnish cities

Author of a study on heating in Finnish cities by nuclear small reactors, Rauli Partanen rejoices that this option is at the heart of the debate in Finland

Most Finnish cities use district heating networks to heat their houses. It is a pipeline system that heats buildings with hot water produced at a central power plant. These power plants often do Combined heat and power, or CHP, where some of the waste heat from electricity generation is used to deliver hot water. Some smaller plants do only heating, without electricity.

Decarbonising district heating

District heating is a major source of GHG emissions, as it is often done by combustion of fuels such as coal, natural gas, peat and biomass. To decarbonize heating in Finnish cities, the option of using small nuclear reactors has come up during the last couple years on multiple levels. City council members in various larger and smaller cities have written political initiatives to investigate the feasibility of small nuclear reactors for district heating. This, in turn, has led to much interest from the press and other media. To add substance to this discussion, a study was released (prepared by the undersigned) and an international seminar held on the topic in early 2019 by the Ecomodernist Society of Finland. Here are some of the key findings from the "Nuclear District Heating in Finland"-study and the seminar. The study and videos from the presentations and panel discussion can be downloaded from the links below.

Proposals to be ready in 2025

Very simple and small heat-only reactors of various sizes (roughly between 20 to 400 MWt) could be used economically to replace most of the fossil fuels combustion in district heating – even if the demand during winter is much larger than summer demand. By smart timing of annual maintenance breaks to summertime, the load factor of the reactors would be reasonably high and the cost of heat reasonably low. Reactors capable of running in combined heat and power would be able to replace an even bigger share of the combustion, while also providing valuable flexibility to the electricity grid. This could lead to both lower emissions and lower costs.

Small reactors are becoming commercially available much faster than commonly believed – already in the 2020s. The message from both the regulator and the representative of the energy ministry at the conference was that the bottleneck right now is not the technology availability, it is the rest of the society. Legislation and regulation have been designed for large power reactors sited far from population. Now they need to be modified to better accommodate small reactors that are sited near population and industry and reactors doing heat for heating and industrial processes as well as electricity.

This process will take several years, and a political mandate, along with resources, are needed to start the work in earnest. That work needs to start today so we will have it ready by the mid-2020s.

Rauli Partanen

CEO & co-founder of Think Atom
Co-founder of The Ecomodernist Society of Finland

eko-modernistit

Cf. The study: https://thinkatom.net/publications/ and the seminar videos (YouTube playlist): http://tinyurl.com/y6kl4ott

VTT: innovations for cities and industry

Nuclear energy is an essential element of the cost-efficient energy system for the next decades to reduce emissions of greenhouse gases. This conclusion was drawn in the latest energy scenarios of international organisations, such as the International Energy Agency, IEA and the Intergovernmental Panel on Climate Change, IPCC. Also the national energy and climate strategy confirms the important role of nuclear energy in Finland.

In Finland the energy mix is versatile and the power system is low-carbon, one third of electrical power being generated by nuclear energy. The two ongoing new build projects of large reactors will further secure the supply of low-carbon energy. The projects are also in a vital role in the development of nuclear expertise in Finland, and they demonstrate to the young generation that nuclear energy has a future.

Small modular reactors (SMRs) have great potential to be the future of nuclear electricity generation. The total investment will be less than in the case of a large reactor, and due to a shorter delivery time, it will start to pay back sooner. The key factors both pressing the cost and reducing the delivery time are serial production and standardization. If, thanks to standardization, the licensing can be harmonized and even based on international type approval, SMRs will be attractive for new nuclear countries.

New uses of nuclear energy with SMRs

Small reactors enable new uses of nuclear energy, or uses that have been less frequent. Cities are struggling to replace fossil fuels in district heating, and SMRs can provide a zero-emission heat source as a base load for the system. And energy intensive industry could greatly reduce its carbon footprint by using nuclear energy, as electrical power, heat or steam. These uses become much more feasible in case the emergency planning zones (EPZ) can be reduced. That will allow the construction of the reactor at the existing district heating network or next to the industrial plant.

The first small reactors are already being planned with estimated completion years in early 2020's for the Chinese district heating reactor DHR-400 and 2026 - 27 for the US-based NuScale. There is potential for cities and the industry to decarbonize their processes and for supplier companies to find their place in SMR supply chains. The global SMR market is growing fast, and the first adopters of SMR technology will benefit from all international deployment of SMRs through consulting work and supply chain experience.

VTT Technical Research Centre of Finland is working on multiple fronts to study the feasibility of SMRs and possible ways forward. We have analysed the effects on a city energy system when an SMR is introduced. We are building up an ecosystem of Finnish companies who will potentially have a role in some phase along the life span of an SMR. VTT coordinates a EURATOM Program funded project ELSMOR, aiming at confirming the European capability to ensure the safety of SMRs. And we are ready to support both new and established nuclear countries in their SMR programmes.

Matti Paljakka
Solution Sales Lead, VTT

A key partner to the nuclear stakeholders

VTT Technical Research Centre of Finland has been a key partner to all stakeholders in Finland's nuclear sector, and we know the whole life span of a nuclear programme. We operate internationally, offering services for the successful peaceful use of nuclear energy around the world.

VTT is well networked e.g. a founding member of the Nuclear Generation II and III Association (NUGENIA), and an active member of the European Technology Platform on Implementing Geological Disposal (IGD-TP) and the European Technical Safety Organizations' Network (ETSON). In Finland VTT is the coordinator for the national research programs for both nuclear safety (SAFIR2022) and nuclear waste management (KYT2022).

VTT has unique experimental and computational infrastructure, and profound expertise in a wide variety of technologies as well as cognitive sciences. We have more than 200 nuclear energy or radioactive waste management experts, in addition to which we can combine other relevant expertise from within the organization. You are also welcome to discuss new technologies in the nuclear industry like wireless data transfer, artificial intelligence, cyber security or virtual and augmented reality.

MP

New generations with Smarter Reactors

The energy sector is going through one of most transformative periods of his history. No longer limited by their size, their complexity and their distance from cities, a new category of reactors advanced - small, modular and relocated - will be the future of the energy sector.

Managing the transition from current nuclear reactors to these smart reactors of the future, will require innovation and flexibility to adapt to unprecedented ways of conducting business. Framatome, as a leader in the nuclear sector has already mapped out the path with innovative and state-of-the-art solutions, is not content with simply supporting the development for these reactors of the future. We offer solutions to innovate for a smart fleet within and out of the standard-reactor network.

Innovation in motion

Ensuring control and data communication superiority by reducing vulnerability of information with cyber-security systems, remote-controlled maintenance, self-learning instrumentation and control systems, training via virtual/augmented reality, or developing long cycle fuels and Accident Tolerant Fuel, all these topics underpin our vision to provide solutions for nuclear reactors in supplying cheaper, permanent, wide-use and safe smart energies, supporting the development of smart-cities, smart-cars, smart-industries or smart-technologies.

Your performance is our commitment and enhanced safety is in our DNA, both achievable with our constant innovation in accident tolerant fuels, in state-of-the-art computational fluid dynamics codes, in instrumentation and control for full flexible and co-generation operating modes, in energy storage solutions or in very long cycles solutions.

A smart nuclear reactor for a society with a better life without greenhouse gases emissions, this is Framatome's ambition. High-performing people and technologies for safe and competitive nuclear power plants worldwide.

framatome

Nuclear revival and renewable energy
What innovations and complementarity?

Energy issues are directly connected with two major challenges. Firstly, the climate emergency: the IPCC's latest report is very clear that we must achieve carbon neutrality by 2050 if we are to limit global warming to 1.5°C. Secondly, energy consumption, which according to the IEA's forecasts will increase 75% worldwide by 2050.

In an announcement on 28 November 2018, the Commission described the European energy project as "a strategic long-term vision for a prosperous, modern, competitive and carbon-neutral economy", which anticipates that "by 2050, more than 80% of the electricity mix will come from renewable sources. With 15% coming from nuclear power, it will be the backbone of the energy system." Likewise, the MIT report "The Future of Nuclear Energy in a Carbon-Constrained World" shows that all low-carbon energy sources, including nuclear power, will be needed to achieve carbon neutrality.

How much scope is there for complementarity between these sources?

Considering that solar and wind energy are intermittent, nuclear power – as a basically controllable source of production – is able to guarantee supply security at a competitive cost, regardless of the weather conditions. One of the main questions today is how to coordinate these different sources and manage the interactions between them.

Technology and innovation can both be leveraged to tackle this question. Three aspects must be addressed. Production methods, of course (nuclear and renewable energy). But also, systems: flexibility tools such as multi-vector energy storage, smart demand-side management networks and capabilities, and energy conversion systems. The issue of resources must also be addressed: materials, the material cycle and the carbon cycle.

Une exigence d'innovations

One area in which innovation is required is that of small modular reactors (SMRs), which could be an instrument of flexibility.

The CEA and its partners in the French nuclear industry (EDF, Technicatome and Naval Group) are developing an innovative SMR called NUWARD. The project is backed by the French government and will be open to international cooperation. The R&D programme on SMRs (of the CEA?) also focuses on new applications for nuclear energy resulting from disruptive innovations: an SMR system coupled with high-temperature electrolysis to produce very large volumes of hydrogen; a heat-generating SMR system to supply urban heating networks; multi-vector energy reactors (H2, heat, drinking water) to maximize the flexibility of the system. These modular reactors are particularly useful for countries where the power grid is less developed than in France.

Applications in the transport, building and industry

France's energy mix, which is based on a combination of hydraulic, nuclear and renewable sources, is already 97% carbon neutral. Nonetheless, France is resolutely engaged in an energy transition and has set itself some very ambitious targets, particularly with regard to transport, construction and industry. As regards electricity production, which is a crucial factor considering that carbon neutrality will be achieved partly through electrification, France aims to diversify its means of production by increasing the share of renewables, which is expected to rise from 20% of the energy mix today to 40% by 2030.

The CEA is one of the few research organisations to cover most of the technological building blocks involved, including nuclear energy, synthetic fuels, solar energy, hydrogen production and storage, batteries, and materials manufacturing and recycling processes. It now intends to step up its activities in these areas to develop integrated, low-carbon energy systems.

Stéphane Sarrade
Directeur Innovation
Direction Energie Nucléaire,
CEA

[1] *Voir p.12*

The role of the local level and the governance of nuclear energy

As a partner of Entretiens Européens 2019, GMF will be present with over 40 mayors from all over Europe, with the aim of ensuring safety within their borders and promoting cooperation between civil society and institutions for sustainable development.

The Group of European Municipalities with Nuclear Facilities (GMF) was founded in 2000 with the aim to facilitate the exchange of information and experience among municipalities hosting or located near nuclear facilities. The association is composed of elected representatives from 11 European countries. Of primary importance to GMF is the health and safety of the communities in which nuclear facilities are located. GMF also urges the nuclear operators, nuclear regulatory authorities, governments and European level institutions to communicate with and engage local elected officials, communities and other stakeholders in the decision-making process around nuclear issues.

GMF members are legitimated direct representatives of citizens and elected intermediaries who can ensure that the concerns, needs and priorities of the local communities are taken into account. They contribute to facilitate and strengthen relationships among the different stakeholders in the nuclear arena and can improve projects based on their local knowledge and the creation of added value for the community. GMF calls for decision making processes which build confidence and provide for transparency, openness and justice.

For the harmonisation of national practices

The pilot project "*Local Competence Building and Public Information in Nuclear Territories*" promoted by GMF and partly financed by the European Commission (EC) Directorate General on Energy in 2007-2008 had the aim to support the EC in the process of harmonising national practices in the field of governance in nuclear territories. The project identified local good practices at European level with regards to governance in nuclear territories, based on the Aarhus Convention. In the 2009 GMF Annual Assembly, local representatives agreed on the following 10 recommendations for good governance in nuclear territories. These good practices were then the basis for the European Nuclear Energy Forum (ENEF) to propose 22 recommendations to improve practices on information, communication, participation and decision-making in nuclear matters.

In its ambition to promote an open dialogue on energy in the framework of ENEF, GMF also promoted in 2012, with the support of the European Economic and Social Committee, the Spanish Energy Mix Forum (SEMF). This collaboration between the European and the local level had the ambition to develop general guidelines to frame a transversal debate on energy, based on inclusiveness, openness and respect.

Local authorities living with nuclear facilities are willing to promote initiatives to bridge the gap between the political establishment and civil society, but they require other governmental bodies to commit to listen to stakeholders and take decisions to address their concerns into a long-term sustainable development strategy.

Mariano Vila d'Abadal
Secrétaire général du GMF

Meritxell Martell
Consultante GMF

[1] *Group of European Municipalities with Nuclear Facilities*

2009 GMF Annual Meeting
10 recommendations for good regional governance

1. To clearly define the concerned people with special provisions as regards information and participation.

2. To establish an effective legal framework for information provision and public participation.

3. To ensure provision and dissemination of transparent, plural and reliable information by independent experts in lay terms.

4. To create tools for public participation (local information committees, partnerships, etc) around nuclear facilities.

5. To ensure effective communication channels between the different political spheres – national decision-makers and local authorities.

6. To ensure that the know-how of nuclear municipalities is effectively transferred and considered in the decision-making process.

7. To guarantee sufficient resources for nuclear areas to undertake information and participation procedures.

8. To promote training programmes for competence building.

9. To promote mechanisms for the exchange of information on safety, stakeholder involvement and local development at EU level.

10. To ensure that municipal practices on information and participation are independently reviewed and disseminated.

GMF
GROUP OF EUROPEAN MUNICIPALITIES WITH NUCLEAR FACILITIES

The long-term strategy of the European Commission and its implications for investment

A « European Green Deal » for the EU must become the world's first climate-neutral continent: that is the objective announced by Ursula von der Leyen, the President of the European Commission.

In its *European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy*, put forward in November last year, the European Commission already proposed that the EU reach climate neutrality by 2050. This is now being discussed among Member States. Moreover, Ms von der Leyen has expressed her intention to propose a 'European Green Deal', which should enshrine the 2050 climate-neutrality target into law.

Energy plays a central role in the fight against climate change. Ambitious action in this area is needed if we want to fulfil the EU's Paris commitments and become climate neutral. To reach this goal, different pathways – all in line with the Paris Agreement – have been analysed and put on the table.

By 2050, the EU economy could reduce its energy consumption by half (compared to 2005). However, in all the assessed scenarios, electricity consumption increases, by 35% to 150%, compared to 2018. More than 80% of electricity could come from renewable sources and, together with a nuclear power share of about 15%, this should be the backbone of a low-carbon European power system.

Investing heavily to maintain our nuclear production capacity

In recent years, the Commission undertook several outlook analyses in the energy sector. The latest one focused on nuclear energy, the Nuclear Illustrative Programme (PINC), presented in May 2017. It provides an overview of developments and investments needed by 2050 in the EU for the whole nuclear lifecycle. PINC estimates of installed capacity in 2050 have been confirmed by the more recent pathway assessments.

The nuclear sector is facing challenges stemming from ageing power plants: the average age of the EU nuclear fleet is now close to 30 years. Maintaining the nuclear generation capacity requires further investments over the next 35 years. New reactors could represent about 80 GW of new capacity by 2050, with about € 400 billion investments needed.

Significant investments will also be needed for waste management, decommissioning, and long-term operations (LTO). The importance of LTO is expected to increase given that by 2030 the majority of the fleet will be operating beyond its original design

life. The estimated value of investments needed is € 50 billion.

Uncertainties related to costs and state choices

However, in the EU there is limited incentive to invest in new nuclear capacity and nuclear investments remain a challenge due to considerable up-front costs. There is also a high degree of uncertainty: only a small share of investments in new construction or LTO has already been approved by national authorities.

The reliability of the supply chain is an essential element for a competitive nuclear industry. The Commission has already launched several initiatives to facilitate standardisation and better regulation in cooperation with stakeholders from inside and outside the EU.

Another key issue associated with ageing and planned LTO programmes is the question of the obsolescence of components. Operators face a difficult choice: the replacement of obsolete components with identical ones that need to be designed and manufactured again, versus the licensing and use of new nuclear grade components and the potential use of commercial of-the-shelf components in safety-classified applications.

Meeting all safety and security conditions

We are currently examining, in cooperation with relevant stakeholders, what policy options and actions could be considered to optimise the nuclear supply chain for components for new and existing nuclear power plants, including in the field of licensing and cooperation among regulators, in order to ensure enhanced safety.

The future of the European nuclear industry largely depends on the way it will face the current and future technological, industrial, and societal challenges, either by developing new designs or by efficiently upgrading existing facilities for long-term operation. The European Commission does not only focus on how nuclear can be part of the solution to decarbonize the economy but also on the political and societal conditions for it to be able to play this role and, most particularly, on ensuring that the optimum safety and security levels are enacted and implemented.

Massimo Garribba
Acting Deputy Director General responsible for the coordination of Euratom policies
Director of Nuclear energy, safety and ITER
Directorate-General for Energy, European Commission

ENEF PRAGUE 2019 Towards more harmonization

In its conclusions, the Forum recognizes the role of nuclear power in decarbonization of the energy mix. The approach presented in the long-term strategy must be translated into concrete actions.

Investments in all Low-energy energy sources carbon, including nuclear, be sufficient to provide the capacity

planned in the long term. In addition, the capabilitiesshould be adapted needs to. Beyond the projects of R & D in progress, especially on small modular reactors (SMR), it is necessary to harmonize licenses and regulation. National authorities and the industry have to work together as part of an integrated approach of the EU. Coordination of all parties stakeholders is crucial in this regard.

The European Union can lead the way to climate neutrality by investing in realistic technological solutions, guaranteeing the participation of citizens and aligning actions in key areas. Beyond the will expressed, the EU must now prove its ability to meet energy goals and climatic until 2050.

To find out more: https://ec.europa.eu/info/sites/info/files/enef2019conclusions_0.pdf

Nuclear power, at the heart of the Swedish political debate for half a century

Sweden has taken three major political decisions to reduce the uncertainty surrounding the future of nuclear power, but they have all been called into question.

In 1980, Sweden decided to phase out all its reactors by 2010, and in 1997 the Social Democrats finally cancelled this decision in order to guarantee energy supply. In 2010, the centre-right government lifted the 1980 moratorium on the construction of new reactors and launched the SVEA project (the construction of two reactors by the public energy company Vattenfall in Ringhals). However, the Social Democrats and Greens put an end to this project when they came into power in 2014.

In 2016, a historic cross-party energy agreement was signed to phase out nuclear power by 2040. Today, this agreement is controversial.

Towards a non-binding, 100% carbon-free energy mix

The main political centres have adopted the objective of a "100% renewable energy mix by 2040", which is non-binding so the State does not have to compensate operators. The decision to extend the renewable energy support mechanism (green certificates)

until 2045 could be sufficient to replace nuclear power primarily with onshore wind power. Indeed, nuclear power accounted for 42% of electricity production in 2018, ahead of hydropower (38%), wind power (11%) and thermal power plants (mainly biomass, 9%). Wind power is booming and is expected to account for 14% of electricity consumption in 2019 and 24% in 2022. The right-wing opposition wants to review the 2016 agreement and is again supporting the construction of new reactors by Vattenfall. It believes that the real objective should be a "100% carbon-free energy mix by 2040" and that it would not be reasonable to do without nuclear power in the medium term, given the growing energy needs associated with the electrification of transport and industry. The opposition is stressing publicly that, according to the Swedish Energy Agency, national electricity consumption may increase 25% by 2050, and that security of supply during peak consumption periods may be impacted in the event of a dry and windless winter.

Towards a new agreement?

Only six nuclear reactors will still be in operation after 2020 (Ringhals 3 and 4, Forsmark 1-2-3 and Oskarshamn 3), compared to ten in 2015. Vattenfall will shut down the Ringhals 2 reactor at the end of 2019, and Ringhals 1 at the end of 2020. These closures follow the group's decision not to invest in upgrading these reactors to post-Fukushima safety standards. However, the rise of wind power and the currently stagnant levels of electricity consumption enabled Sweden to remain a major exporter of low-carbon electricity in 2018 (17 TWh, or 12% of domestic consumption). In this context, Energy Minister A. Ygeman (Social Democrat) is relatively confident in the country's ability to phase out nuclear power by 2040. However, he has stressed in the press that he "would not really be opposed to the principle of opening new negotiations for a 2.0 agreement", but Deputy Prime Minister I. Lövin (Greens) firmly refuses to reopen negotiations at this stage. Everything therefore suggests that the political debate on nuclear power will intensify in the coming months.

Julien Grosjean
Sector Manager -
Energy-Environment-Raw Materials Advisor
French Embassy in Sweden -
Regional Economic Service for the Nordic Countries

After South Africa, could Kenya now be a new African atomic powerhouse?

Kenya, a country which imports electricity from Ethiopia (major producer of hydraulic power), is facing strong domestic demand for energy, accelerated by the country's large-scale and fast industrialisation, but production using h draulic, wind and even geothermic resources as planned for 2025 will not be enough to meet their needs.
Kenya proposes to incorporate nuclear energy into its energy mix to reach 1000 MW in 2017 and 4000 MW ten years later.

International partnerships

The Kenya Nuclear Electricity Board (KNEB) is expanding the number of partnerships it has at international level to benefit from experience and expertise with nuclear when deciding on sites and feasibility studies. "*We have already signed agreements with the International Atomic Energy Agency (IAEA), as well as the Chinese Government, to speed up the development of nuclear energy in Kenya. Nevertheless, due to the many challenges such as the need to put in place the essential infrastructure, the electric power plant will only be operational after 2027*", revealed Collins Juma, CEO of the KNEB1. The costs of the project are estimated at 9 billion dollars and countries such as Slovakia, South Korea, China and France have already positioned themselves.

The future of energy in Africa

The whole of Africa is currently contemplating the role of nuclear in the energy mix. It will need to supply electricity to over 2 billion inhabitants. It possesses almost 20% of the world's uranium resources in 34 countries. Morocco, Ghana, Niger, Tunisia, Egypt and even Uganda are ambitiously working to take their place alongside South Africa on the list of nuclear countries. The emergence of an African nuclear park, a symbol of economic vitality and power on the international stage, will radically change the economic order on the continent. For western countries, the stakes are twofold. On the one hand they need to occupy a central place in the construction and operation of the future plants and, on the other hand, they need to ensure access to Afr can uranium to keep their plants running.

A debate with Les Entretiens Eurafricains

What could the cooperation between Europe and Africa look like? Nuclear requires political stability and African countries must be able to take ownership of nuclear, develop expertise and build a nuclear that is safe and sustainable. Together with Entretiens Eurafricains[1], we are ready and willing to open the debate and get the ball rolling. ***CFH***

1. Les Entretiens Eurafricains were created on 2014, with the « UE/Afrique(s) » Plateform in Paris, and « Eurafrique 21 » the association in Ouagadougou for West Africa

In Hungary
Climate protection is synonymous with nuclear power

The Hungarian government intends to meet its climate goals through a combination of renewable energy and nuclear power. Two Russian-financed VVER-1200 reactors are under construction at the country's only nuclear power plant in Paks. They will be up and running by 2026-2027.

"Without atomic energy, there is no climate neutrality", declared Hungary's Innovation Minister László Palkovics in June 2019. Hungary recently announced its support for the carbon neutrality targets set out in the European Union's new climate plan. This announcement is in keeping with a broader energy policy to renew Hungary's nuclear plants.

The history of Paks

In the 1970s and 80s, the USSR decided to inject fresh impetus into the civilian nuclear power sector, and to showcase the efficiency of Soviet technology. The town of Paks, 130 km from Budapest, was chosen as the location for Hungary's first nuclear power plant. Its proximity to the Danube guaranteed a regular supply of cold water. Four VVER-440 reactors (Russian-designed pressurised water reactors) would be brought into service gradually from 1982 onwards. Hungary also has a 10-MW VVER research reactor in Budapest. Commissioned in 1959 and rebuilt in 1990, it is used for research in fundamental physics, chemistry, materials science, biology and archaeology.

Soaring electricity demand

This industrial country with a population of over 10 million is going through a period of economic and demographic growth. Electricity consumption has increased steadily since the 1970s, reaching a peak of 40 TWh in 2016.

The Paks nuclear power plant alone produces 51% of the country's electricity. The rest comes from fossil fuels (gas and coal), with a strong upswing in renewable energy (7.2% of electricity in 2016).

Two new Russian reactors

To meet its growing electricity needs while honouring its climate commitments, Budapest signed an agreement with Moscow in 2014 to extend the Paks nuclear plant. Rosatom will supply two third generation (VVER-1200) reactors. Ultimately, they will replace the four existing reactors, which are scheduled to shut down in the 2030s. The project has gone ahead without an invitation to tender. It represents an investment of €12.5 billion, 80% of which will be financed by Russia through a €10 billion loan. The Hungarian Parliament has classified the contract for 30 years.

Hungary is not the only country to embark on strengthening its nuclear fleet. It is a member of the Visegrad Group alongside Poland, Slovakia and the Czech Republic, all of which are at the forefront of new European investments in nuclear power.

Maruan Basic
SFEN
Published in the RGN

***The Revue Générale Nucléaire**, created at the initiative of the Société Française d'Energie Nucléaire (SFEN), publishes scientific, technical and economic articles as well as information on use of nuclear energy.*
http://www.revuegeneralenucleaire.org/abonnement/

Poland needs support to reconcile
its development with that of a carbon-free economy

"They should go and protest in Poland"! President Macron really knows how to find new scapegoats when he is in trouble. But Poland doesn't need any lectures from anybody: it knows perfectly well that it must invest in new production capabilities to replace its coal-fired plants. But it also knows that it can't change its energy mix overnight! And that it will need support.

That is exactly what its "just transition" declaration at the COP24 conference was all about: supporting regions that are meant to be moving away from fossil fuels. In Poland, the challenges are above all social, considering that 800,000 jobs are tied to the coal mining sector. But there are also economic challenges, since Poland is Europe's second biggest coal producer after Germany. In addition, Poland is experiencing dynamic economic growth (GDP increased 3.1% in 2016, 4.8% in 2017 and 5.1% in 2019), so demand for energy is high.

How can this demand be reconciled with reduced coal production? The answer is by diversifying. But diversification means developing new sources to radically reduce emissions while maintaining high levels of economic and technical efficiency both from the consumer's point of view and that of the energy system.

How? Under its roadmap towards a carbon-free economy in the next few decades – Polish Energy Policy until 2040 (PEP2040) – the share of renewable energies is expected to reach 21% by 2030, and the first nuclear reactor could come into operation by 2033. The medium-term goal is to achieve 6 to 9 GWe nuclear capacity by 2043, accounting for around 10% of Poland's future electricity production.

The Entretiens Européens took place in Warsaw in 2013

The subjects debated included the social acceptance of nuclear power in Poland. The conference moved to Krokowa in Pomerania the following day, and was attended by local mayors prepared to accommodate nuclear power plants. But the investment is substantial, and no concrete commitments have been forthcoming from either the future operators or the government. Pointing the finger is not going to be enough: Europe must support Poland and promote the development of a diversified, carbon-free energy mix.

CFH

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 CO_2 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, Belgian 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 + balance + type study performed by PwC Enterprise Advisory and reviewed by Belgian Nuclear Forum analyses three scenarios that consider an identical, significant and ambitious growth of renewable energies between 2018 and 2050 as established by the Federal Planning Bureau: a significant increase from 19.7 % of the total volume of electricity currently from renewable sources to 44.2 % by 2030 and 67.4 % by 2050. The study is based primarily on official quantitative data supplied by ELIA, the International Energy Agency (IEA), the Energy Technology Research Institute (ETRI) and the Federal Planning Bureau.

More information: www.forumnucleaire.be

NUCLEAIR FORUM NUCLEAIRE

Choices at risk of penalising Belgium

In 2003, the Belgian government decided to fully phase out its nuclear power fleet by 2025. Nuclear energy currently accounts for over 50% of Belgium's domestic electricity supply, and over 80% of Belgium's low carbon electricity (solar and wind jointly account for about up to 15%). The replacement capacity (CCGT & OCGT) has not been constructed yet, although a CRM (capacity renumeration mechanism) has been agreed on by the Belgian Parliament (with support from the Green parties). Independent experts have warned that it might be too late to phase-out nuclear by 2025, in the absence of replacement capacity and with interconnections not being sufficient to deal with an abrupt and brutal loss of 6GW nuclear capacity.

The economic impacts of nuclear shutdown

Should Belgium decide to fully phase out nuclear by 2025, this will have substantial negative impact on security of supply, carbon dioxide emissions, employment, overall nuclear knowhow, electricity prices, and many other parameters.

With regards to electricity prices, it is estimated that a complete nuclear phase-out in 2025 could double electricity production cost by 2050 , with investments increasing by €36 billion between 2010 and 2030 . Belgium's trade deficit could increase with 3,7€/MWh by 2030 and the cost for import of electricity could rise to €300 million. All of these worrying findings come from independent research by academia, think tanks and research bodies.

CO2 emissions that could triple

When it comes to the climate impact of a Belgian phase-out, different

independent studies on the topic have similarly come to worrying findings. Carbon dioxide emissions from electricity production could triple by 2050 after a nuclear phase out , with 4 million additional tons of CO2 by 2030 , and 19 million tons per year as of 2030 . Greenhouse gas emissions would be 47% higher by 2030 than 2010 . All of this resulting from the fact that the share of fossil fueled electricity plants, currently representing 27% of Belgium's domestic electricity production, would reach a peak share of 72% by 2030 . With a sharp rise of carbon dioxide emissions as a result, completely opposite to the climate ambitions Belgium committed itself to under the Paris Climate Agreement in 2015. Nuclear energy is definitely a part of the solution for the climate protection, as a very good complement to renewable energy.

And consequences for training, employment and innovation

With regards to employment, a nuclear phase out in 2025 could potentially result in the loss of 7.000 direct jobs. Not to mention the job loss amongst subcontractors (not included in the 7.000 direct job loss figure). More generally, a nuclear phase out would have a negative impact on the longstanding internationally recognized position of Belgium as a nuclear power hub (based on the thorough expertise Belgium has in different domains of nuclear technology; from fundamental & applied scientific research to nuclear medicine; and over the complete lifecycle of nuclear facilities, from engineering and construction to dismantling and knowhow about nuclear waste). As such, a nuclear phase out could negatively impact Belgium's nuclear industry in applications other than energy, and in the long run create a nuclear brain drain.

10 more years for three reactors?

Photo credit EDF - Filiz 76

Belgium has 7 reactors shared between 2 power plants: Doel and Tihange. The Doel 1 and Tihange 1 and 2 units were extended by 10 years in 2015. The Tihange 1 and 3 and Doel 4 reactors could be extended by up to 60 years.

According to the Chairman of the Board of Electrabel, Johnny Thijs, an investment of €1.3 billion would be needed to extend these three nuclear reactors, thus avoiding the release of 8 million tonnes of CO2 per year while safeguarding a number of jobs in the nuclear power sector. Without nuclear power, Belgium will never achieve the climate objectives it set itself during the Paris agreements.

According to Belgian power grid operator Elia, the Belgian electricity mix was 60% nuclear, 9% wind, 4% solar and 27% fossil in March 2019.

Taken from an article by Gaïc Le Gros (SFEN)

Bernard Dereeper
President,
Belgium Nuclear Forum

Matthias Meersschaert
Relations and public Affairs
Belgium Nuclear Forum

[1] Cf. the studies of the Federal Planning Bureau, Climate-Energy Framework for Belgium to 2030 - Impact Assessment a selection of political scenarios by 2050, 2015;
[2] .Cf. «Energyville, Energy transition in Belgium: choices and costs, 2017 «; «PricewaterhouseCoopers, The Success of the Energy Transition, 2016» and FOD Economy & Federal Planning Bureau «prospective study Electricity 2030» realized in 2015.

Power to the people: community interests at the heart of a flexible, solution-oriented approach to nuclear industry development

With increasing needs in sustainable electricity and less dependence to the electricity market, the interests of local people must be at the heart of new nuclear projects, according to ***Andrey Rozhdestvin***

As competition with carbon-based energy sources intensifies and nuclear antagonists continue mounting pressure on the industry, we face a need to reorient our priorities and make a conscious shift in the way we address the needs of clients and consumers. The strategic choices that vendors make now are likely to shape the future trajectory of nuclear for decades to come and determine its role in the decarbonisation agenda. Now, more than ever, the interests of local communities should be at the heart of all new projects. Nuclear has the capabilities and the potential to address the world's most pressing sustainability challenges and empower people in even the most remote locations – quite literally. However, harnessing that potential requires the joint efforts of vendors, suppliers and end consumers alike.

A global nuclear renaissance

On the one hand, globally, the industry is experiencing something similar to a renaissance. 2018 saw a record commissioning of units across the entire world since 1990 – nine new units, over 10 GWe of capacity, and five units restarted in Japan. We've also witnessed five construction starts, raising the number of units being built to 55. These projects are necessary to respond to community demand for large volumes of clean baseload power. Even Europe, which is perceived as being on the fence about the place of nuclear in sustainable clean energy mixes of the future, has seen a promising revival of interest in atomic energy. The UK may become an epicenter of the European nuclear new build with one reactor under construction and several planned. Slovakia will soon have two new reactors of Mochovce NPP on grid. France postponed plans to reduce the share of nuclear in its generation mix from the current 75% to 50%. Political forces in Poland and Bulgaria committed to developing nuclear power plants in their respective countries.

What about Russia?

Russia is also dedicated to promoting the nuclear agenda on the continent. Together with our local partners, Rosatom is working on two large-scale NPP construction projects in the EU: the Paks II NPP in Hungary and the Hanhikivi NPP in Finland. The latter is an example of a demand-driven project, implemented according to the unique Finnish Mankala model, with direct investments in an electricity generating facility coming from various utilities and industrial companies. It is worth noting that most of the energy companies participating in the Hanhikivi project are owned by the Finnish municipalities. They will receive the electricity corresponding to their share of ownership in the Hanhikivi 1 nuclear power plant. The viability of this model demonstrates the growing need of local communities in sustainable electricity supply and less dependence on the electricity from the market. With Finland's current presidency of the Council of the EU, this case should be promoted in Europe as a proven pattern for direct engagement of the communities in clean energy development projects.

More flexible nuclear power, tailored to needs

On the other hand, a number of significant obstacles facing the industry undermine its potential and hinder momentum – ultimately detracting from nuclear's contribution to powering local communities. Addressing these challenges requires to shift the perspective on nuclear as more than just a reliable baseload source of clean CO2-free power. While large-scale NPPs are certainly the backbone of the industry, the current energy landscape requires a significant degree of flexibility to answer the most pressing electricity supply questions, including those associated with remote locations and decentralized power grids. There is no cross-regional one-size-fits-all client solution. Nuclear needs to prove its ability to be tailored to the needs of local communities, including specifics related to local energy demand and consumption, grid structure, geography and climate.

Towards more promising floating power plants

One of the solutions that we have developed to address this challenge

is the floating nuclear power plant concept. "Akademic Lomonosov", our flagship floating power unit, is planned to be connected to the grid in Russia's Pevek by the end of 2019. With its two KLT-40S reactors at 35 MWe each, it will replace the aging Bilibino NPP and the Chaunsk TPP, supplying Arctic residents with emissions-free energy. The facility's capacity is enough to power a city with a population of 100,000 people. Similar Russian made KLT-40M reactors provide power to propulsion motors of two icebreakers (Taymyr, Vaygach) that were built in Wärtsilä shipyard in Finland and have served at Arctic Sea for 30 years. Each icebreaker has one reactor, which has shown its reliability in harsh conditions.

Floating nuclear power plants are a very promising carbon-free electricity generating technology that can be implemented where large-scale NPPs aren't viable – remote areas both in the north and the south, as well as regions with decentralized power grids. Innovation in small-scale reactor technology allows to couple reliable baseload supply and client-oriented mobility and flexibility. With the possibility to provide also heat and desalinated water, SMRs and FNPPs will enable nuclear to become more applicable across a wider array of markets and geographies.

Ultimately, the overarching trend that will allow the industry as a whole to prosper is fruitful and productive international cooperation that takes into account local interests and specifics. This rings true for both large-scale infrastructure projects and smaller ones, like FNPPs and SMRs. Pooling together collective knowledge and expertise will allow nuclear to expand its contribution to sustainable, decarbonized energy mixes of the future, power communities across the globe and protect the environment.

Andrey Rozhdestvin

Regional VP, Director
ROSATOM Western Europe

The French nuclear waste deep storage project

The deep geological disposal facility CIGEO is designed for storing the highly radioactive, long-lived waste generated by existing nuclear installations (until they are dismantled), and by the processing of spent fuels from nuclear plants.

Protection from the most dangerous radioactive waste

Nuclear electricity production generates radioactive waste. The most dangerous waste cannot be stored above ground or at low depth because of its high radioactivity and long life. The purpose of the deep storage project Cigéo is to protect the general public and the environment from the dangerous effects of this waste over the very long term.

More than 25 years of research

In 2006, France decided to go down the route of deep geological storage, based on research that began back in 1991. To study and plan the deep geological storage facility, Andra has conducted research in various areas, involving around a hundred of its own scientists along with French and international partners who are recognised experts in their field. It also develops and uses its own tools and facilities, such as an underground research laboratory in Meuse/Haute-Marne, a long-term environmental observatory, and digital resources.

The facility's installations and operations

Cigéo will be built in Meuse/Haute-Marne and will comprise an underground area (where the waste will be stored), surface installations spread across two areas, and links between the above-ground and underground installations. Waste will be stored at the facility for over 100 years, and it will be expanded as and when needed. It will then be closed to ensure the safe containment of the waste over very long periods of time, without the need for human intervention.

Safety: anticipating risks

The basic aim of Cigéo is to safeguard the general public and the environment from the dangers posed by highly radioactive long-lived waste, while reducing the burden on future generations. Cigéo is designed to be safe during its construction, an operating period of around 100 years and after its closure, the goal being to minimise its impact and ensure there is no risk to humans or the environment during these different phases. The safety of Cigéo depends to a large extent on the geological stratum in which the underground facilities are built, and on the design choices made and the safeguards put in place.

A facility built to last

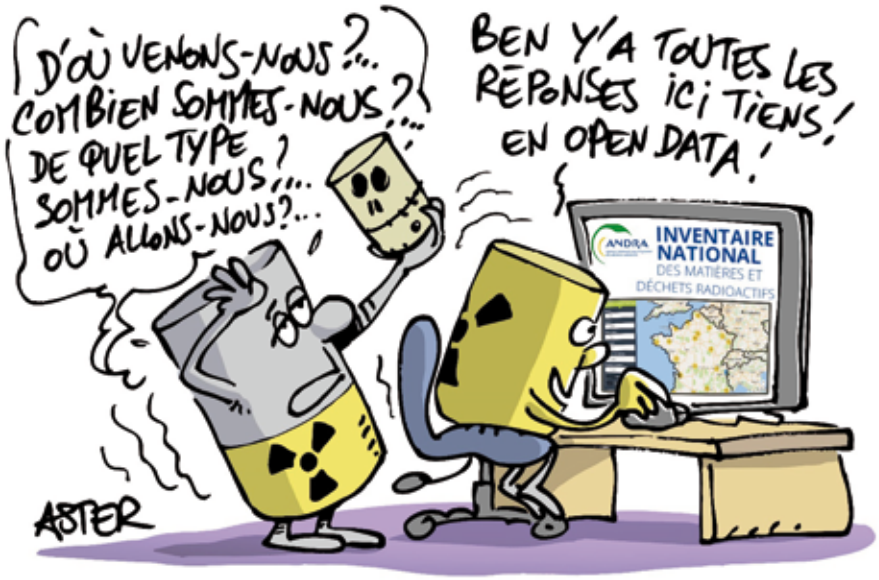
The management of long-lived radioactive waste requires a very long-term approach: the facility will operate for more than a century, and will protect people and the environment for hundreds and thousands of years to come.

To ensure that the costs are not passed on to future generations, provisions have already been made to secure its funding by producers of radioactive waste.

A project rooted deeply in the local area

Andra has been a major player in the Meuse/Haute-Marne region for over 20 years. It is already working with local organisations and residents to ensure that the Cigéo facility is a source of opportunity for the region.

https://www.andra.fr/cigeo



Closure of the French public debate

Here we are at the end of the public debate on the 5th PNGMDR (French National Plan for Radioactive Materials and Waste Management), which began on 17 April 2019 under the leadership of the special project commission (CPDP). Almost five months have gone by, during which 22 meetings have taken place all over France, from Gravelines to Marcoule, Cherbourg and Strasbourg. The debates have "provided valuable input; above all they have shown how the management of radioactive materials and waste relates to the real world by addressing questions on public health, worker and environmental protection, regional involvement, safety, security and funding, while engaging in more in-depth discussions about the commitments made to future generations", said special commission chair **Isabelle Harel-Dutirou** at the final debriefing meeting on 25 September 2019. The conclusions drawn from the debate will be presented in the commission's report on 25 November 2019. They will focus on the main issues related to the management of radioactive materials and waste, and on citizen mobilisation.

CFH

Les Entretiens Européens 2018

Recommendations for the management of nuclear waste in Europe

The issue of nuclear waste lies at the heart of questions about the future of nuclear power in the European energy mix. *Les Entretiens Européens*, which took place in Paris in September 2018 and were led by Claude Fischer-Herzog, were an opportunity to engage in wide-ranging discussions (with scientists, students and numerous leading figures from industry and institutions), and to take stock of the issue and draw up a set of recommendations.

It is worth noting first of all that, contrary to popular public belief, solutions do now exist for managing nuclear waste. According to experts, geological disposal is a scientifically and technologically mature solution for storing highly radioactive waste under the safest possible conditions, even in the long term. With so much at stake, any information provided must be as clear as possible, so that decisions can be taken in full knowledge of the facts. This is a difficult challenge given the complexity of the matter. Both reassuring simplicity and unnecessary, confusing detail are to be avoided: this is a long-term issue which raises questions regarding training (for political decision-makers and civil society) and the development of an ever-better-informed democracy. But it is a key issue!

Secondly, the promise of more attractive future solutions does not justify inaction today. If solutions exist, they must be deployed while allowing scientists to work on even more efficient solutions for tomorrow: thus, increasingly "elegant" technological options may be developed through a continuous improvement approach that has long proved its worth in many fields. Conversely, waiting for hypothetically "ideal" solutions would carry great risks (setbacks, successive postponements or even abandonment, and accumulation of waste that is difficult to manage pending disposal). Economic comparisons, which often encourage the postponement of developments due to discount rates that are in fact very unreliable nowadays, are inconclusive; and postponing decisions would also be ethically questionable, as it would leave future generations with the responsibility of developing solutions to manage the by-products of an energy production industry that did not benefit them directly.

Finally, the issue of nuclear waste management must be addressed from a wider European perspective: it is clear that the harmonisation of safety policies and standards, the joint implementation of major industrial projects, and the pooling of research assets and tools to develop cutting-edge solutions can only be beneficial, in terms of both the quality of management options and the affirmation of Europe's industrial strength, with, for example, the emergence of a genuine European nuclear waste management network.

Bernard Boullis
Former Director of Fuel Cycle Programs
CEA Nuclear Energy Direction

Find

La Lettre and *Les Cahiers des Entretiens Européens* 2018

www.entretiens-europeens.org

Les Entretiens Européens 2019 in Helsinki

Hearings will open debates on the scenarios of electricity growth in our societies and the daunting questions of efficiency in use and production that they raise, to make them compatible with the climate objectives of the Paris agreement.

Then four panel discussions will be held.

1. We will start from the electricity consumption needs of industrial sectors and local and regional authorities, their efforts for greater efficiency in use, and their relations with electricity producers.

2. We will examine the short-term and long-term responses of the energy sector, both from the point of view of the services it must provide to contribute to efficiency in use and on the problems of production costs which it must make compatible with long-term goals.

3. Then we will examine the place of nuclear power in the energy mix, its innovative technologies adapted to the needs of industries and territories, its contribution to the creation of a new network system consistent with climate objectives.

4. We will conclude with a panel discussion on governance issues between institutional, national and Community levels, for a better coordination between them (EU, States, Nuclear Safety Authorities, Courts of Justice...) promoting a long-term strategy and the creation of planning agencies through consultation between consumers and producers.

Moreover, we will hear from waste managers in Finland and France who have proposed deep geological disposal of their high-level long-lived waste: comparison of technologies. The issue of competence in the implementation agenda of solutions.

We will also hear from some major regions of the world facing explosive demands for electricity (or electrification) such as China or Africa, that are facing massive industrialization of their regions and countries.

Find the Helsinki program on the site: www.entretiens-europeens.org

50 speakers

from 12 countries in Europe and Africa

Belgium, Bulgaria, Estonia, Finland, France, Hungary, Kenya, Poland, Russia, Spain, Sweden, United Kingdom

Debates in 4 language

English, Spanish, French and Hungarian

TUESDAY 12 NOVEMBER

2 pm Opening by the Finnish Ministry of Economy and Employment, by ASCPE, Fin-Nuclear and the GMF

2:30 pm The growth of electric demand climate-compatible ?

3:30 pm The electrical mutations of industrial sectors and territories: articulate effectiveness in use and in production. International cooperation in research and innovation. The answers of the energy sector.

5:30 pm Neutrality or diversity carbon-free? Return compatible production with the costs of decarbonisation.

WEDNESDAY 13 NOVEMBER

9:30 am The new nuclear, a actor of the network-system «InduServices», with diversified technologies, flexible and durable, adapted to requests.

11:30 am Do not delay opening centers radioactive waste management.

2 pm Skills and Employment to enhance the nuclear sector in Europe.

3 pm Mutualiser et développer le dialogue constructif pour bâtir la stratégie européenne.

4:30 pm Recommendations for a long-term strategy

Tuesday 12 in the evening: Cocktail at the French Embassy with a representative from Kenya

Registration until November 8th
https://finnuclear.fi/EEN2019/

ASCPE
LES ENTRETIENS EUROPEENS
since 2003

- 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**
- 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

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