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THE ISSUES OF NUCLEAR COMPETITIVENESS IN EUROPE

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Proceedings of Les Entretiens Européens
Brussels – 19th of October, 2017

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

STUDY BY PWC ENTERPRISE ADVISORY REGARDING THE TRANSITION OF THE BELGIAN ELECTRICIY 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 ordered by Belgian Nuclear Forum analyses three scenarios that consider an identical, significant and ambitious growth of renewable energies between 2016 and 2050, as established by the Federal Planning Bureau: a significant increase from 15.7 % of the total volume of electricity currently from renewable sources to 44.3 % 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

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Nuclear technology is competitive. We must defend our industry and our internal market.

Claude Fischer-Herzog, Director of ASCPE

Opening

Thank you for coming to this 15th session of the *Entretiens Européens* on the nuclear industry. We are always ready to stand up and defend our industry in what is a relatively difficult context. The Entretiens were created in 2003 with the support of the Commission in the person of Commissioner Loyola de Palacio, and the participation of François Lamoureux and Dominique Ristori in Nogent (Haute Marne). At the time, Dominique Ristori was in charge of nuclear energy policy at the DG Energy. Massimo Garribba, the Commission's current director of nuclear energy, will be talking to us later on.

If you look in the files, you will find his interesting (and debatable) analysis of the complementarity between nuclear and renewable energy. We began the *Entretiens Européens* by talking about waste management, followed by the revival of the nuclear industry across the world, and finally societal ownership of nuclear energy. Then, Fukushima happened. It was a huge shock. Three weeks later, we organised a conference with the representatives of twenty countries to discuss pooling safety costs. Last year, we met to discuss investment in Europe's nuclear industry and, today, we are going to talk about competitiveness[1].

There are a lot of questions surrounding this issue, especially regarding third-generation nuclear plants. But we will also be talking about the competitiveness of the industry as a whole. The nuclear industry is the jewel in the crown of the energy sector. It is on the verge of decline in Europe, just as we are entering a new nuclear age with new technologies, and the industry is growing all over the world, not only in Asia and Latin America but also in Africa, where some countries, like Kenya, are really coming to the fore. André-Franck Ahoyo, deputy director of the Entretiens Eurafricains, will be talking to us about this. Growth must be global and shared, and we have a dual responsibility: to help these countries in their pursuit of increased industrialisation and consumption in a context of exponential demographic growth, and to do this with a view to building a new economy. We must help them tackle poverty, growing inequality and climate change. Especially since southern countries will be the hardest hit by climate change. So we need to work together to promote shared development. That is the overarching goal of the *Entretiens Eurafricains*. The nuclear industry can and must play a key role in this push for new development. In Europe, we are losing the battle against irresponsible and often irrational anti-nuclear sentiment, and are shifting more and more towards a German model that we don't necessarily want. Fukushima was a tragic accident, but we can learn from accidents. They have helped us to improve safety. Moreover, safety challenges are not confined to the nuclear industry. They affect a lot of other sectors too, and I'm not sure they all have such high standards as the nuclear industry…

The biggest challenge at the moment is the development of third-generation nuclear reactors. To cut the cost of this, we suggest creating a pan-European network to pool costs, enable economies of scale, and harmonise safety standards. We want to produce safer and cheaper nuclear energy, so that we perform better in both the domestic and international markets. We will therefore be comparing prices and costs in as transparent a manner as possible. Jan Keppler will be discussing these issues in his opening address. We will also be comparing nuclear energy with other energy sources, such as solar. We will look at the advantages of nuclear

[1] *See the list of Entretiens Européens on page 43 of the Cahiers.*

energy for electro-intensive companies, as well as its impact on regions and communities. These factors must be included in the cost of nuclear energy. We will also be talking about safety issues and discussing how to create a market ripe for financial and technological investment. Xavier Ursat's article, which you will find in *La Lettre des Entretiens Européens*, is very clear: he laments the distorted competition between Europe's liberalised nuclear energy market and the tightly regulated and administered nuclear industry everywhere else, in Russia, China and even the United States, where many states are regulating their markets again to save their plants. How are the Commission and the Member States going to promote a low-carbon economy without differentiating the nuclear industry from the rest of the market and providing it with guarantees? The Commission claims that «it goes against our market rules». But when it wants something, if finds a way! Today, we are seeing positive discrimination in favour of renewables, and the Commission, which has set a target of 50% renewable energy by 2050, is trying to adapt the market by introducing a carbon price signal and updating state aid mechanisms. Not only do we need to reform our market, but we also need to go further by building a real, pan-European nuclear industry in order to regain the leadership of the global market. Once again, we do not want to lose our expertise, as the nuclear industry has a promising future and we can help countries who are thinking about embracing nuclear technology, or are already starting to do so.

The European ambition, 60 years after the EURATOM treaty

With
Bertrand de l'Epinois, president of FORATOM

Hearings

Thanks, Claude, for these words of introduction. We are here to talk about the competitiveness of nuclear energy. The European Union defines competitiveness as being the capability of a country, a region or an economy to maintain and raise the standard of living of its inhabitants. To achieve this over the long term, it needs to be kept up over time. Standard of living relies on a number of factors, not only providing jobs and contributing to social cohesion, but also contributing to shaping a quality environment. Energy is a cornerstone of standard of living. We all need clean, safe and affordable energy in order to sustain our society. The EURATOM treaty came out 60 years ago, at the same time as the Treaty of Rome. In doing so, the founding fathers of the European edifice recognised the central role of energy in our modern societies and economies, designing policies aimed at fostering nuclear in Europe. The energy from nuclear power, which derives from a major discovery in modern physics, has changed the paradigm from the point of view of electricity, and proved itself a very bountiful and efficient source of energy. The nuclear industry has kept its side of the bargain.

Let us now move on to the question of the competitiveness of nuclear energy: what benefits does nuclear bring to the economy and to Europe?

First, in terms of security of supply. Our world today is riddled with geopolitical tensions, as was always the case and always will be the case. We can expect a renewed rise in tensions, which will have consequences for access to energy. Nuclear power is a crucial aspect from this point of view. It may be synonymous with energy independence, and a factor for stability and peace. This is not the case with coal or oil. Uranium represents only a tiny fraction of the price per MWh. It comes from a relatively diverse range of sources, and because of the small volumes needed safety stocks can be built up. Europe currently holds a three-year

stock of uranium. This can be increased if necessary. In the event of tensions, if the uranium price surges, it would have little impact on electricity prices, and it would even provide potential for more geological reserves. Renewables can also contribute to the goal of independence, but that depends entirely on what reserves can or cannot be held when the sun does not shine and the wind does not blow. Only nuclear power provides continuity of service, and with it grid stability, an essential parameter of security of supply.

No on to the environment. Nuclear energy is clean, it has very low CO_2 emissions (a similar order of magnitude as renewables). Protecting the environment has a safety aspect, so it is a priority. Europe has the skills, experience, regulations, standards and controls necessary to ensure that nuclear is safe. What's more, there are ever more challenges regarding use of space. Because it is compact, nuclear requires little space, effectively safeguarding the greatest number of landscapes. Wind turbines cannot make any such claim.

Finally, on to the economics. After the initial investment, nuclear has fairly low and viable operating costs that do not depend on the market. Power plants should be regarded as a public good for society. Predictability of energy costs is crucial for the economy because investment decisions depend upon it. New projects have been cast into doubt because of delays in construction. We need to face up to this challenge, which is linked to others: these power plants are the first of their kind. We have to be able to industrialise new installations. European policy can certainly encourage this trend with standardisation regulations. The value added of the nuclear industry in Europe is that little fuel is imported, resulting in a

favourable balance of trade. And it creates hundreds of thousands of skilled jobs.

The ambitions of the founding fathers as set out in the EURATOM treaty must be reasserted and renewed. The fundamentals that have characterised the expansion of nuclear in Europe still seem just as relevant today. To pave the way for the future of nuclear policy in Europe, we need to focus on security of supply, and on how we should set about achieving the targets laid down in the Paris Agreement (COP 21). Electricity market design is a priority, along with greater efficiency and industrialisation of new projects. The markets are in disarray. We need to review the way they are designed, in order to achieve our environmental, economic and security of supply targets over the long term. For this, we must shape the markets and devise regulations that recognise, make full use of and reward all the services contributing to electricity generation (e.g. low greenhouse gas emissions, security of supply, continuity of service and grid stability) and that encourage investment.

Nuclear generation - The potential to play a central role in a low-carbon future

With
Jan Horst Keppler, senior economist to the OECD Nuclear Agency

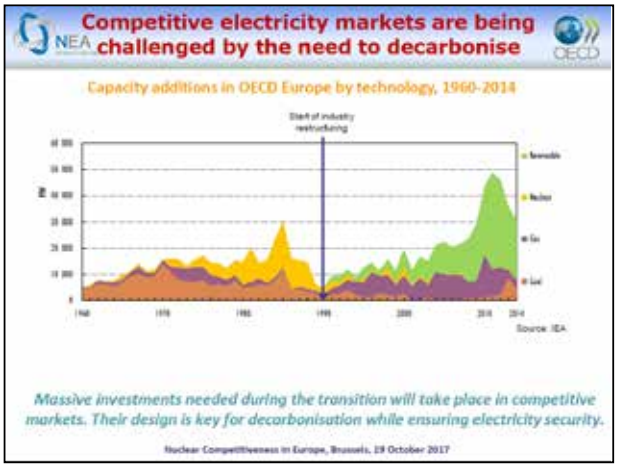
I'm delighted to be here. I am giving this presentation on behalf of Professor William Magwood, the Director-General of NEA, who asks that you excuse him.

I will talk about the competitiveness of nuclear energy based on three studies by the OECD's Nuclear Energy Agency[2]. The first study looks at system costs (project management and financing for the construction of new power plants). The second study, published every 5 years, covers the

[2] *Nuclear New Build: Insights into Financing and Project Management (August 2015) written by Jan Horst Keppler and Marco Cometto, both NEA NDD; Projected Costs of Generating Electricity: 2015 Edition; Nuclear energy and renewables, 2010.*

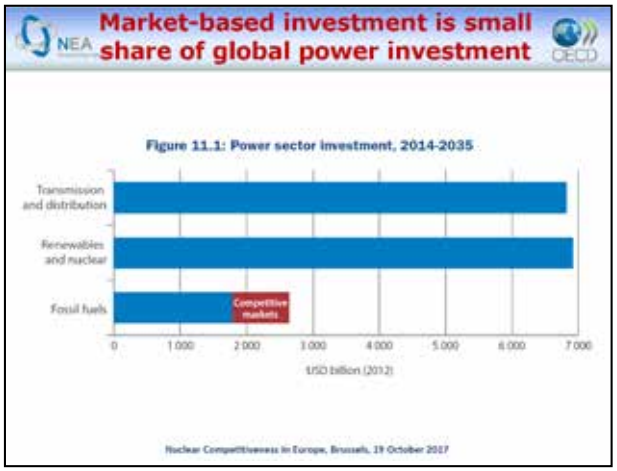
costs of electricity production, and the third the comparison between nuclear and renewable energy.

I will come back to project management and financing in relation to the construction of new nuclear power plants, but first I would like to remind you that renewables are having a hard time competing in liberalised energy markets. Moreover, if we compare nuclear facilities and gas, both have the same values and are as competitive as each other. But if prices drop to 50 or 60%, nuclear investors will suffer greater losses than gas-fired power stations, from 3 to 5 billion euros over the lifetime of the project. That's what makes all the difference because we can't guarantee prices and investors know it. When restructuring of the sector and market liberalisation began in the 1990s in Europe, nuclear investment peaked in 1986 then came to a halt as gas recovered.

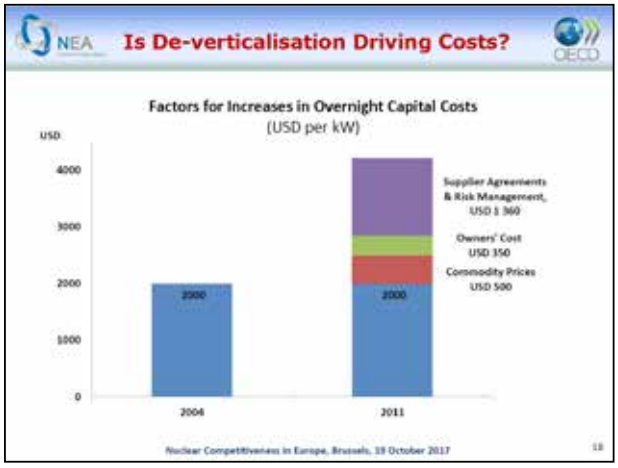


In a liberalised market, nuclear power cannot compete with either gas, which is far better off because of the lower investment costs, or renewables, which, as Claude said, benefit from a kind of positive discrimination.

Concerning project management, liberalised markets at global level represent a small part of the electricity sector. There is some long-term price stability. We are not asking for the moon, but for some return to normality in the European energy sector.

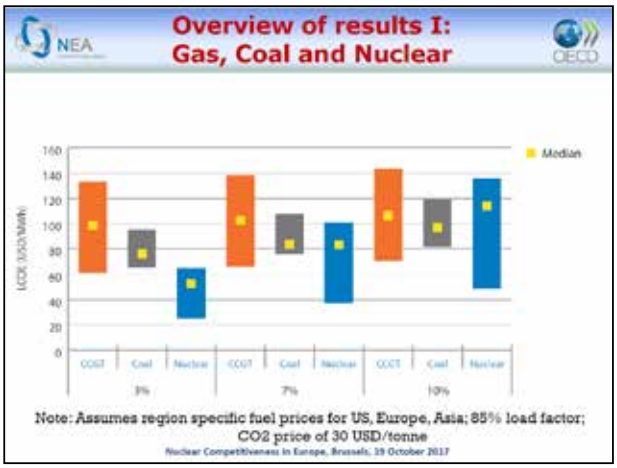


The Chicago study on new nuclear constructions shows the reasons for the rise in plant prices in 2004 and 2011. In 2011, we were at $4,000 per kW. We are well beyond that today, due to the price of essential commodities and regulatory project management complications. In the United States, increases in the cost of a new nuclear power plant are incurred mainly through supplier agreements and risk management. These are mainly financial costs. Suppliers, subcontractors, etc. have all covered their financial risks, no one wants to bear the residual risk of project management and this is what has increased the total cost of the project. This is what we saw this summer, for example, with the Vogtle and Summer power stations in the United States.



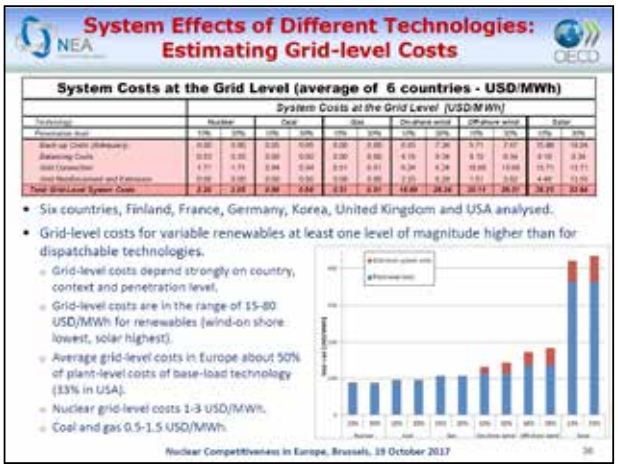
In the cost study, carried out with our colleagues at the International Energy Agency (IEA), we can see that nuclear energy depends largely on interest rates: if the rate remains low, nuclear energy is competitive. When the rate goes up, it's less so. On the other hand, gas is not affected at all by interest rates. It's less capital-intensive and changes are linked to the difference in gas prices between Asia, the United States and Europe. Coal is in an

intermediate situation. As for renewables, they were even more expensive in 2015 than conventional technologies, but new figures from the UK show that contracts differ by £57 per MW (approximately €70 per MW) for offshore wind farms. There is still room for manoeuvre for genuine competitiveness at the power plant level.



Our main work at the OECD focuses on costs. If significant decarbonation is to be achieved, the costs of renewable energy systems must be taken into account, including grid connection and short-term cost balancing (e.g. if a cloud passes over a solar power plant or if the wind is lighter in the case of wind turbines), and especially the long-term costs of maintaining back-up capacity. We have major pressure drops. Many gas-fired power plants have stopped operating for this same reason. Nuclear power is somewhat protected in the short term thanks to its low variable costs, but it suffers from fluctuations in electricity prices; however, pressure drops are limited compared to solar energy in particular. This applies to existing plants. When it comes to new plants, everything changes: it's a question of long-term investment. The system will be realigned, with less nuclear power and more coal, and especially gas. The irony of all this is that the new system with 30% renewables will have a greater carbon impact than the old system! This is the important lesson that needs to be learned, and the message we are trying to get across to politicians.

System costs are quite high, at least for renewable energy. There will be a second study next year, around January, which will update these figures. All technologies have system costs: they are in the order of 1 or 2 euros for nuclear power (some costs are linked to the reinforcement of the grid near the power plants), but the highest costs concern variable renewable energy, which increase up to 50 dollars per MW if you have a 30% solar energy penetration rate. However, let's be clear: the system costs differ in each country and depend largely on the surrounding system; and they increase exponentially with the share of renewable energy penetration.



In conclusion, as far as system costs are concerned, the integration of renewable electricity is a major challenge and can cost up to $80 per MW (this is the case for solar energy in Finland, which of course is not an ideal solution in this country). The new nuclear systems exist, but they are modest. The cost of the total system increases proportionately with the increase in renewable energy. We must insist on the need for proper accounting and correct allocation. We need new regulatory frameworks to reduce and internalise system effects. This may include capacity payments for low-carbon distributable capacity, like in the case of nuclear. For long-term contracts, we need a baseline load capacity that can be distributed, and to review the support mechanisms for renewables. There has already been some progress in making electricity markets a little more rational, particularly as regards the negative prices that affected producers for a few years. We need to work on a combination of flexible resources and on the coexistence of nuclear and variable renewables, with a more flexible and cheaper nuclear solution. We know that no reduction in the carbon footprint is possible without nuclear power. We have a very important role to play in the future electricity market.

Yves Desbazeille, Director General of FORATOM – I have a question about the new mix: you said it increases CO_2 production, but do you have any figures? This is important when talking about the energy transition. If it's a transition

to more emissions, I'm not sure that's the way to go. Another important issue that has not been addressed is the cost of renewables. If we have renewables at €50 per MW, which are also subsidised, and if prices go down to 0, the threshold remains 50. This is a debate that I have never heard in Brussels or anywhere else.

Roberto Passalacqua, European Commission DG Research and Innovation – We have forgotten to address the topic that I call «the big misunderstanding», and which could be the subject of the next Entretiens. In the last presentation, we saw that there is no economic incentive for nuclear power, and that there are significant financial risks. Are they not linked to the low public acceptance of nuclear power? Investors cannot be certain about the future, but the nuclear community has made some communication errors. What is the risk to the population? We have heard that the dose received by the population in Fukushima was no higher than the dose received in the United States. Financial assessments must take this into account.

John Laurie, Fission Liquide – My question concerns the advanced nuclear sector. There was a conference organised by the SFEN in Paris some time ago. The President of the American Nuclear Society said that the aim was to halve costs and progress twice as quickly, all in the not-too-distant future. I'd like to know what the panel thinks. How can we make use of these technologies in Europe?

Richard Ivens, Director of Institutional Affairs, FORATOM – We have tried to rebalance system costs in the Commission's clean energy package. What impact will this have on the renewables and nuclear cost balance? I have the feeling there may be a rebalance, but we don't have any figures. Can you clarify this point?

Philippe Herzog – I have doubts about the financial cost. Your argument applies to all long-term investments. The financial cost of invested capital is extremely high given the general context of uncertainty when it comes to infrastructure development. It's not nuclear-specific. The right question would instead be: are there additional special circumstances for nuclear power? Otherwise our perception is biased.

Bertrand de l'Epinois – I'd like to make a remark concerning the question raised by Richard Ivens: there is an economic component and a regulatory aspect. Do renewable energy producers have to supply and manage their own back-up? This aspect may be financial, even penal, and covered by public policies: who is responsible for balancing the network in terms of production – rather than in terms of management? Who has the means to guarantee that there will be no large-scale blackout? This isn't easy in a diffuse market with lots of intermittent energy sources. I'm not sure that the penalties and funding mechanisms are sufficient to guarantee this.

Regarding advanced nuclear technologies, my answer will be very general in nature. Nuclear physics and the discovery of fission are recent, this is a new science. It was discovered 70 years ago. There is still much room for innovation and the transformation of the nuclear sector in the future. There are new innovations such as SMRs and fusion, and the younger generations need to understand that nuclear offers lots of opportunities for innovation.

Philippe Herzog has already begun to answer the question of financial risk. There is an economic and financial issue, quite distinct from public acceptance. In some countries, public acceptance is not really a problem. Nevertheless, we need to finance large-scale, very expensive projects that will bear fruit in the long term. There are elements of uncertainty, the market is very erratic, it fluctuates and can even produce negative prices. It's

therefore difficult to invest 5 or 10 billion euros in a project without some predictability of the revenue this will generate.

Jan Horst Keppler - Mr Desbazeille, the figures provided in my presentation are the most recent at our disposal. If we have a system based totally on fossil fuels and we include some renewable energy, then the CO_2 emissions will actually decrease. But if we replace a large share of nuclear power with a mix of gas and renewable energies (as in France and Germany), we increase them.

Regarding the market value of renewable energies, it's true that this is a major problem. Renewables (and in particular solar energy) are not designed for a liberalised electricity market because they are always «co-produced», they bring prices down and end up below market prices due to the concentration and the fact that these plants produce only for a limited number of hours. When we add renewable capacities, the value of these systems increases and the price of electricity gradually decreases, but it takes a long time. On top of this, there is a growing gap between prices that are falling in some cases because some installations are supported by public authorities and prices that are rising. This is what we are seeing in Germany: the price is superior to the market price of electricity, with prices that are marginally higher this year than in 2016 and 2015, so the subsidy has decreased slightly. There is still a difference between the retail and wholesale price, and this has an impact on the organisation of the electricity sector.

Regarding the financial risk, and public acceptance of nuclear power, I agree with Philippe Herzog and Bertrand de l'Epinois. In some countries,

public acceptance of nuclear technology is fairly high, but financial risks persist, as do difficulties in launching projects.

Concerning advanced nuclear power, as an economist in a sector dominated by engineers, I take an iconoclastic position. I may not give the same answer as the majority of people here, or even the OECD. Personally, I wonder if we are not facing a risk of it disappearing due to too much innovation. There is of course the technology we know about, innovations that keep coming, inventions that are multiplying, but I see nothing concrete for the next 30 years. The second generation works well, and I wonder if we are not multiplying technological innovations to the detriment of a system that, in spite of everything, works well.

Mr Ivens, the obligation to include balancing costs would, according to our calculations, increase the cost of a MW by €4 to €5. In the case of renewables, this would therefore have a huge impact on the overall cost of the electricity generated.

Transparency, an issue for competitiveness.
The truth on costs and prices.

Chaired by **Jan Horst Keppler**, senior economist to the OECD Nuclear Agency

With

Attila Aszodi, State Secretary for the Maintenance of the Capacity of the Paks Nuclear Power Plant, Hungary
Göran Hult, Nuclear expert, Fortum, Finland
Andrey Rozhdestvin, director of ROSATOM Western Europe
Georges Sapy, member of Sauvons le climat

Round table

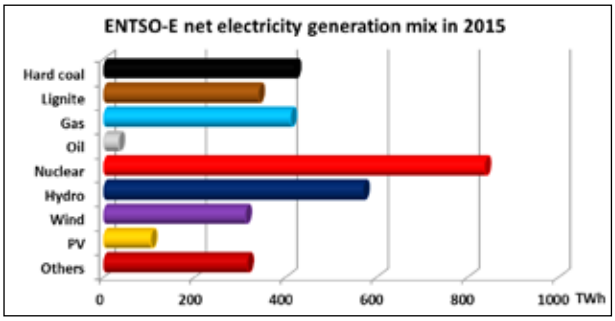
Jan Horst Keppler – Thank you all very much for being here today. You all have a lot of experience of nuclear power and this is a chance to share it with the public. We have already talked about the competitiveness of nuclear power, and I've given you my thoughts on that. I invite you now to give us your point of view. You represent Hungary, Finland, France, Russia... Why do you think that nuclear power is still a winning proposal?

Let's start with Mr Attila Aszodi, Secretary of State for Nuclear Energy in Hungary.

Attila Aszodi – Thank you for inviting me. I am responsible for the Paks2 project in Hungary. We are renewing our fleet with new units. I'd like to explain where we stand.

Let's start with a European perspective. The Paks2 project was launched because it is essential that we recognise that all EU Member States have the right to decide on their energy policy. It's worth reminding ourselves that this is stipulated in European law. National realities are very different. In Austria, for example, 60% of the electricity produced comes from hydropower. This is not at all the case in Hungary, which is a «flat» country. So, we need nuclear power.

I'd also like to give a few important figures concerning the European nuclear environment. Our production capacity in Hungary is 3,330 TW per year, 25% of which is produced by nuclear power. If we add this to fossil fuels, we reach a figure of 36%. It will take a lot of investment to replace them. Another interesting figure: the total capacity of power stations in Europe represents 1,000 GW, 900 GW of which is found in continental Europe. Of these 900 GW, about 600 GW come from large power stations with a capacity of over 50 MW. If we look more closely at the mix and distribution of these capacities, they are broken down into 12% for nuclear power, 20% for hydropower (which is much more than is often believed) and 21% for gas, with over 41% for all fossil fuels combined. So if we had to limit fossil fuels to fight global warming, we would immediately lose 41% of our production capacity in Europe.



40 or 50 years ago, the large power stations were primarily coal-fired and hydroelectric power plants. Then, 20 or 30 years ago, there was a nuclear boom with the construction of new power plants. Finally, in the last 20 years, the mix has mostly been gas, a little wind and a little solar. In the next 10 to 15 years, the old fossil structures will gradually disappear. We're going to lose about 500 TW. Which is enormous in terms of generation. They must be replaced, or we will lose a significant production capacity and therefore consumption. According to the 2016 World Energy Outlook (in a 450-ppm scenario), fossil energy needs to decrease by 10% by 2040, nuclear power needs to remain at current levels, and hydropower, wind and other renewables need to progress if we are to meet our climate objectives. This is exactly what we are doing in Hungary; we are taking into account the expected gradual reduction of fossil fuels, and we believe there is a life beyond photovoltaics and wind energy and that this life will come from nuclear power.

The Paks project of course involved lengthy negotiations with the EU. The intergovernmental agreement has been signed. We have negotiated six major issues, and today the negotiations are closed. The Commission has granted us all the authorisations, and we can begin implementing the project. The Commission launched a state aid enquiry in November 2015. It lasted 16 months. The Commission asked third parties – government, NGOs, etc. – to express their concerns about the project and discuss them. The Commission then gave the go-ahead for the project. The decision has been public for ten days, so it's very recent. The project includes state aid. The Commission examined the potential investment conditions for a private partner. The calculation was based on a comparison of the internal rate of return and the cost of capital. The Commission concluded that a private investor could invest if it was able to obtain a return on investment of 7.88%. Based on simulations, it has estimated that the real rate of return on investment will be 7.35%. So there is a difference of half a point. The state aid comes from this difference. The Commission nevertheless believed this project capable of achieving the EU's common objectives on the basis of the EURATOM Treaty, that there is a market to be served and that this project will improve what the market cannot do on its own. The measures that the government is to take were deemed adequate and proportionate to the needs. We've been given the green light. We are in the process of preparing the licence applications necessary to begin the construction of the nuclear sites. The environmental licence has already been granted, along with the site licence and EU approval. We're almost at the end of the process.

Jan Horst Keppler – Thank you for that presentation. Let's now move from Hungary to Finland, another country that is continuing along the nuclear path. Mr Hult works at Fortum.

Göran Hult – I am Swedish, but I work for a Finnish company. Let me begin by explaining our strategy. The aim is to invest in cleaner energy sources in terms of CO2 production, but since this objective has not yet been achieved we are continuing to invest in nuclear energy alongside other sources such as wind power. The situation in the Nordic countries may seem a little confused because we are investing in nuclear power in Finland, but we are closing down good power stations in Sweden, which can raise doubts. But there are important differences. Sweden has always had a good energy balance; we export 50% of our production every year, energy generation has been low-carbon for some time, we have good wind potential with a high capacity and very low cost, and we have 35% hydropower. The system is therefore very flexible. Finland is very different. It has been a net importer for a very long time, it's dependent notably on Russia and increasingly on its Nordic neighbours for its imports of fossil fuels in the energy mix which must be replaced. There is not as much water or wind as in Sweden. The situation is therefore less favourable because of natural conditions, which justifies the fact that electricity in Finland is a few euros more expensive than in Sweden.

Sweden built twelve nuclear reactors up to 1985. In 1999 and 2005 the authorities closed two of them for purely political and non-financial reasons. In 2016 some plants were closed down, others will be closed in 2019 and 2020 because they are not profitable. They are not profitable not only because the recession has prompted people to consume less, but also because subsi-

dy systems have been introduced for renewables. This has had an impact on nuclear power and made it impossible to export at decent prices; we are currently at 20/25 euros per MW. There is also a €7 tax on nuclear energy, and to this must be added operational costs of €10/15. We must prevent the rest of the fleet from being closed down, and the Parliament has in fact decided to do away with this €7 tax from next year onwards. Prices may therefore improve and, in the long term, this could justify maintaining the current fleet. As far as new constructions are concerned, I'm not very optimistic. After 60 years of operation, in 2040-2045, Sweden will increase the share of renewable energy while maintaining its share of nuclear power.

The situation in Finland is very different; a 1,600 MW reactor will be added to the fleet in 2020-2025. A 1,200 MW project is also expected to become available in the mid-2020s, so nuclear power will contribute greatly to the country's energy production. The oldest reactors will have to be shut down if others are built. The political will is there. The old power plants will remain in operation for at least another six years.

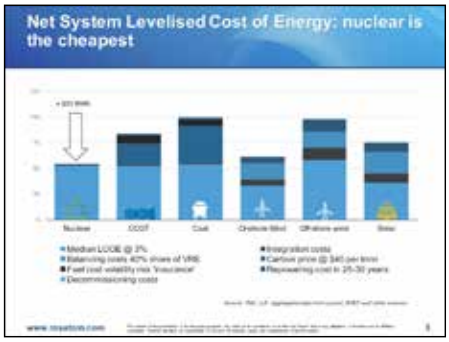
In my opinion, the new plants will not be competitive in relation to offshore wind power. It has a very different value profile, and this must be taken into account in a market still relatively inflexible. In some countries nuclear power will be very competitive, but this won't be the case in Sweden. Of course, certain bases are needed. In Sweden there have never been any subsidies for nuclear power, there will never be any. It doesn't matter, but we don't need obstacles, in other words taxes. Decisions must be made on the basis of needs, not on the basis of political convictions, for the market to function more effectively. We need clear signals, and politicians to take heed of signals from the market. Thanks to this will to decarbonise as much as possible, things will change. Above all, we need greater harmonisation in Europe so that we can build identical reactors in different countries. Such harmonisation is needed for SMRs.

Jan Horst Keppler – Thank you very much, I'm glad you presented an opposite view to that expressed in my presentation, it allows for a more balanced discussion. And thank you very much for shedding more light on the Nordic market, and highlighting the differences between Finland and Sweden. It was very enlightening. Nuclear can be an economic option in some countries and not necessarily in others. I hand the floor to Andrey Rozhdestvin, Director of ROSATOM Western Europe.

Andrey Rozhdestvin – I would like to thank Claude for organising this event. This year marks

the 15th anniversary of *the Entretiens Economiques Européens*. We appreciate this opportunity to meet and discuss these topics. I'm delighted to be sitting alongside my Hungarian, Scandinavian and EDF colleagues. We have two power plants in Hungary and Finland, and we have been collaborating with EDF since 1971 in the gas sector.

We have analysed the LCOE – the levelised cost of electricity – but there are misleading elements in this analysis and there are certain factors to consider: the cost of capital, the price of carbon, the balancing cost and the volatility of fuel prices. Nuclear power is quite competitive if these different factors are taken into account, and if we use the LCOE system, nuclear power is almost at the same level as renewable energies.



Will that be enough? We need to take a step back and analyse the same factors as in the past. It's true that renewables have seen a significant leap forward while nuclear power has stagnated. This has prompted much thought. How can we improve our competitiveness to continue attracting investors and hence obtain the necessary funds? We have carried out analyses and come to the same conclusion as Mr Keppler. Growth has come mainly from agreements between suppliers and on risk management.

We developed a pyramid divided into three levels (macro/meso/micro) and analysed each level, although I don't have time here to go into detail.

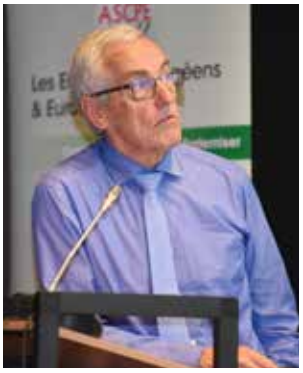
At the meso level, there is the supply chain and state aid support. It's a must, without it you can't go abroad to build a power plant. That is the conclusion we have reached. Rosenergoatom is the second largest operator of nuclear power plants, it's the number 1 for electricity generation in Russia. It is therefore a power generation giant with decades of experience in operating VVER nuclear power plants. After Fukushima we decided to continue building. There have been questions, but it's a crisis and therefore also an opportunity. Since 2010 we have commissioned a number of nuclear power plants in Russia, India and Iran. It has not been easy, including in Russia. We have held costs in Rostov for the first time since the Soviet era, but in all other cases costs have proven to be higher than expected. Nuclear projects have become much more complex, so it's impossible to manage these types of projects without the support of digital tools. We are therefore working with Dassault to develop this approach for NPP constructions, drawing on their experience in the aerospace industry. Then we built the first Generation III+ power plant, Novovoronezh, which has just been connected to the network. It took ten years, and as far as we're concerned it's the first prototype of its kind. We thought it would be faster. But next year we will be connecting a new Generation III+ power plant in Leningrad. We have achieved economies of scale, so it has been a successful mission. We are also working on improving plant performance, in terms of equipment lifetime and staff numbers.

The supply chain is at the meso level. The approach is quite simple: we cannot go it alone to build a power plant. We have to cooperate. Alstom has won the bid on a project in Finland, Schneider will also be involved. In other countries we are working with partners like Areva, with whom things have always gone well, and we're working with Schneider and Siemens on electrical equipment, which accounts for 9% of power plant-associated costs. We have also reached an agreement to build four reactors in Turkey.

State aid is absolutely essential. If we compare renewables with nuclear power, we must balance the support for these two sectors. In conclusion, here are two examples of obstacles we can encounter. The requirements to be met vary from country to country. In Turkey there is a law on olive groves, we cannot build anything in these protected areas; in Finland it is frogs that are protected. These were unexpected obstacles that had to be overcome. That's why we work with specialists. It's important to work at international level, as we did with Engie in Turkey. We have no choice but to cooperate.

Public acceptance is important, because if the public refuses the plants the project will never see the light of day. In India, it was the fishermen who were against the construction of a power plant, but we convinced them by explaining China's experience. We must change our approach to be competitive, lower the costs and increase speed. There are mega-projects for which we must cooperate, and this way we will be able to bring benefits to millions of people; but for this to be successful and to remain competitive we need the support of the various states.

Jan Horst Keppler – Thank you for showing things from an industrial perspective. I give the floor to Mr Georges Sapy, a member of the NGO Save the Climate, who will compare the costs of nuclear power and solar energy.



Georges Sapy – Can photovoltaic (PV) solar energy become competitive? It's above all a question of latitude. Obviously, solar energy is much more powerful at low latitudes around the equator, at intertropical latitudes. Light energy is very strong in these regions, so the load factor is almost as high as it can be, and days and nights last the same length of time pretty much throughout the year. This is very important because it allows a high load factor, it lowers production costs and photovoltaics are integrated into electrical systems. It's therefore possible to make do with daily storage by pumped storage power stations or batteries, which are relatively affordable. So the two large ground-based power plants – Bolero in Chile in the Atacama desert and Kamuthi in India – are at very favourable latitudes. In our temperate regions, however, the parameters are unfavourable, and have a negative influence when combined. The light energy received is much weaker, especially in winter. France has a load factor of two on average. Days and nights very greatly in length between summer and winter. In Paris, the difference exceeds 100%. If we combine these two negatively cumulative effects, the load factor between winter and summer production exceeds 4, which reduces the value of the annual load factor, has a negative impact on depreciation and results in higher costs. Moreover, photovoltaics integrate very poorly into the electrical system at our latitudes. Production

is very low in winter, yet demand is at its highest in this period, and vice versa in summer. Photovoltaics are not therefore well-suited to grid requirements. Under these conditions, daily storage is no longer sufficient, and integrating photovoltaics into the electrical system means either agreeing to a very sizeable back-up in winter, or using an inter-seasonal storage system between summer and winter. The only inter-seasonal storage that can work is power-to-gas-to-power, which remains theoretical because this type of storage has no viable economic model. In fact, the costs of megawatts removed from storage are unsustainable for consumers.

In France, the average cost of production varies greatly between the north and south due to the difference in sunshine and the resulting load factors (less than 11% in the north and about 16% in the south). Can photovoltaics become competitive? The only possibility seems to be ground-based power plants in the south of France, ranging between 64 to 78 euros per MW. And although the cost of photovoltaic installations will continue to fall, it won't fall as much as we might think. Panels account for about half of the cost, and although it may well decrease this will be difficult to quantify; the other components and works, including civil engineering, mechanics and electronics as well as transport and on-site assembly work, require a lot of labour, so the reductions are likely to slow down quite quickly.

Global comparisons need to be made on real projects: the Cestas 300 MW ground-based photovoltaic power plant commissioned in December 2016 is the largest in France, and even in Europe. It has a load factor of 13% (the French average), but the guaranteed selling price is €105 per MW, which is a lot. To this we must add the costs of compensating for its intermittent nature, plus any storage costs. Which brings us to a price of €31 to €47 per MW according to an OECD study. The environmental competitiveness of photovoltaics is very poor if the back-up solution makes use of fossil fuels. The low photovoltaic load factor entails a lot of replacement. Which requires switching to back-up systems using hydropower or even nuclear power. This raises the question of complementarity between nuclear and other sources.

Jan Horst Keppler – Thank you for this update on solar photovoltaics. The last speaker, Mr Jean-Pierre West, will tell us about the latest EDF nuclear projects.

Jean-Pierre West – Thank you Claude for the invitation, I felt quite honoured and was very happy to accept. My message is threefold: the world is in need of affordable, reliable and environmentally-friendly energy. We must not lose sight of this fact. In order to mitigate the effects of climate change and ensure the sustainable development of economies with a high growth potential, we will need all the energy sources capable of reducing our carbon footprint. If we don't want to miss the boat, we will need renewables, they are inevitable, but also nuclear power. Concerning this low-carbon future, France and EDF are in a relatively privileged position. In France, the average CO_2 emission rate is 17 g of CO_2 per kW, compared to an average of 300 g of CO_2 per kW in Europe and 505 g of CO_2 per kW on average in Germany (the European champion). Between 2010 and 2015, emission rates in Germany increased by 450 to 505 g of CO_2 per kW. At the same time, France managed to reduce this figure from 40 to 17 g of CO_2 per kW because we closed the coal-fired power stations. We can certainly develop renewables while also using nuclear energy. This is made possible by network stability and security.

Regarding our nuclear power plants, EDF is looking to optimise its *Grand Carénage* (major refit) programme, i.e. the maintenance programme for the 2014-2025 period. EDF has estimated at €48 billion the cost of maintaining the power plants, replacing the main components, increasing plant safety and lifetime and hence exceeding the 40-year mark. That's 4 billion a year. A certain level of investment, in the order of €3 billion a year, is needed. This *Grand Carénage* will leave us with an additional €1 billion a year to maintain the fleet. Costs range between €32 and €33 per kW; from 2025 onwards, they will decrease to about €30 per kW. These different costs along with the long-term expense of decommissioning and managing waste have already been taken into account. We have dedicated assets to cover the corresponding costs when the time comes. It is clear that continuing the existing fleet is the most

competitive solution. No other generation capacity will cost less than this existing fleet.

Generation III has increased development costs, but the difference between Generation II and Generation III is more significant in Europe than in other parts of the world, due to the very structure of the energy market in Europe. We should not forget that other regions of the world (China, Korea, perhaps also Russia) have successfully managed the industrial transition from Generation II to III to maintain this standardisation, and they have implemented financing and planning methods in accordance with a strong national or regional policy in order to limit the cost increase. That is what we did in the 1980s and 1990s in Europe. There are different situations. It's very difficult to compare energy systems. Nevertheless, there is a guaranteed price mechanism in Europe, and I think it's well-suited to the European energy market. Construction costs for Generation II power plants have evolved but in a very limited way compared to the rest of the world (particularly in relation to the United States), because there was stability in terms of safety requirements, with early involvement of private partners, and a very standardised approach. For Generation III, the reactors were significantly delayed, and costs were increased due to high safety requirements, a more complex design and strict project and engineering controls. Reducing these construction costs is therefore difficult, although the aim is to reduce them by 30% for the next generation. We are halfway there with our optimised EPR project.

There are three main ways of making this possible: improving plant productivity by taking feedback into account as early as possible along with industrial constraints in the construction process; optimising construction; and, if possible, stabilising safety standards. Methods and tools need to be improved. We also need to go digital. At EDF, our objective is to reduce costs by 30%. In the current context, these costs cannot be compared to those for renewables but rather fossil fuels. Nuclear power must be designed to be compatible with the strong development of renewables.

Jan Horst Keppler – Thank you for that presentation. If we look at the OECD publication, the projected costs are increasing. They represent 5,000 US dollars per kW. But at Flamanville costs are more in the range of 7,000 to 8,000 US dollars per kW. If you aim to reduce costs by 30%, what is the baseline for this reduction?

Jean-Pierre West – I'll start with Flamanville and the HPC project. This information is public. Regarding Flamanville 3, tests will be carried out at the end of 2018 involving fuel loading, and the final cost – at estimated completion – is expected to be €10.5 billion. We are in line with the budget and planning. The HPC project stands at £19.6 billion for the HPC 2 reactor. We will use these figures as a basis for calculating the reduction and focus on those mentioned by Georges Sapy in terms of costs per kW. The order of magnitude is between 17 and 18.

Oliver Adelman, Platts nuclear publications – Why was Flamanville optimised and HPC wasn't? When will building begin Mr Aszodi? Can you give us a progress report on the timetable? Might the national construction programmes slow down for economic or other reasons?

Panagiotis Manolatos, European Commission DG Research and nuclear efficiency – Mr West, you said that we need to stabilise requirements in order to reduce costs by 30%. What do you mean by that and how do you think it can be done?

Attila Aszodi – Construction of the unit should start in 2020, commercial operations in 2026 and 2027.

Jean-Pierre West – Concerning Flamanville 3, some of the safety requirements have evolved since beginning the construction. It's a nightmare scenario because we have to review the whole project. You must discuss this with the safety bodies and ensure that safety requirements will not change again. Regarding national construction, let's take the example of France. There is a law on energy transition, which must be integrated into the French *Programme Pluriannuel de l'Energie* multi-annual energy programme (PPE). There is

a limit on how much electricity can be produced using nuclear power. When Flamanville 3 starts operating at the end of next year, two power stations (Fessenheim 1 and 2) will therefore need to be shut down. For the rest, no decision has been reached, a PPE will be debated, discussions have just begun, so it's in the hands of politicians. We will implement the PPE approved by the government and Parliament, as we are doing with the current plan.

The difference between Flamanville 3 and HPC is that we have an energy market with different regulations. The difficulty lies in the fact that we cannot easily reproduce our models, because the safety requirements for HPC are different to those we have in France.

Attila Aszodi – Jan Keppler asks why we are developing the third generation since the second generation is sufficiently efficient and economical. In Hungary we conducted as open a process as possible, with nine public sessions. The Greens will not be able to attack the plant because it emits no emissions. Generation III or III+ is today mandatory: we must maintain the safety requirements and the radioactivity in the plant.

Jan Horst Keppler – I totally agree, I was just playing devil's advocate. We need a degree of stabilisation, and of course Generation II has become the new standard.

Claude Fischer-Herzog – Why close the power plant in Fessenheim when, even according to the ASN, it could still operate? Also, EDF is saying that it will respect the PPE – even if it means reducing the share of nuclear energy to 50%. According to the Court of Auditors, this would mean closing seventeen plants. Bearing this in mind, what will this mean for the *Grand Carénage*? The cost of closing two power plants is €10 billion. At the same time, the government is talking about injecting 15 billion for renewable energies! In addition, EDF will ask for compensation, which will increase costs even more. And EDF may have to change its economic model at a time when Russia is particularly aggressive. How much do we expect this mess will cost? Germany has already spent 135 billion on the closure of seven power stations, there is talk of 350 billion for the entire fleet.

As far as cooperation is concerned, we do cooperate, but not in all areas. Then there is the competition. Which is fierce and not always fair. The Russians have already won the markets in Hungary, they are in Finland and want to move to the UK. They are not playing by the same rules as us, they have state aid, and this will have an impact on prices for consumers.

Jean-Pierre West — *Dura lex, sed lex:* we must abide by the law. EDF has an agreement with the government if closure of Fessenheim is confirmed: there is a fixed share of €490 million that must cover the anticipated costs of dismantling and of training personnel, and a variable share depending on the loss suffered, which will be estimated according to the 900 MW fleet.

There is a difference in how the markets work. In our market, we need mechanisms like the contract for difference. Internationally, competition exists but we are also present, including in India: we have presented a proposal for six EPRs there.

Prosperity of territories. The impact for growth and employment.

Chaired by **Graham Weale**, Honorary Professor of Energy Economics and Politics at the Ruhr University Bochum,

With
André Franck Ahoyo, Deputy Director, ASCPE-Les Entretiens Eurafricains
Peter Claes, IFIEC Deputy Director
Valérie Faudon, General Delegate, SFEN, France
Kirsty Gogan, Co-founder of ENERGY FOR HUMANITY
Robert Leclere, President of the Belgian Nuclear Forum

Round table

Graham Weale - Accidents such as Fukushima have led several governments to commit to exiting nuclear. These decisions are often taken precipitously without properly thinking the future implications through, and even though nuclear has marked the industrial growth and day-to-day life of our countries since the 1950s and 60s. What consequences will these choices have? It will certainly entail dismantling costs, expropriation without compensation, and as others have mentioned earlier, it will make it impossible to attain the target of reducing CO_2 emissions by 40% by 2020. Moreover, can the cost of the energy transition be measured on the basis of wholesale energy prices, whether for nuclear or for any other source of energy? It would seem to me that it cannot, even though it is currently measured in that way. On that basis, the cost of the energy transition is calculated at €25 billion per year, equating to 1% of GDP. Turning to Germany, its economy is growing strongly, and it has an efficient manufacturing base supported by aid that give it access to low-price energy. Is this situation tenable? Industries that are large consumers of energy are already expressing reservations, taking the view that it will not be possible to maintain some of the current concessions when renewables come to account for almost 50% of electricity generation. Germany has rejected nuclear in favour of renewables based on the promise of creating 380,000 jobs (initially 500,000), without taking into account the jobs lost in nuclear.

Against this background, it would be worthwhile looking more closely at the hidden costs and benefits within both systems, although in the final

analysis it's the arguments made at the time of the investment that count the most. What is absolutely clear, is that the valuation of the cost of carbon in the emissions quotas trading system is too low. It is set at 7 dollars per tonne in Europe whereas in the view of many independent experts and also the French government, the real cost to society might be closer to 30 dollars per tonne. An important discussion took place today on the possible introduction of a floor price in the Emissions Trading System (ETS), which would obviously change the economics of it very quickly.

Going back to Germany, its importance in Europe cannot be denied, it is the country with the smartest positioning and it occupies the most important posts in its institutions. So, when reading the Winter Package, we may ponder over the absence of the word «nuclear». To what extent has German influence been imposed upon Europe?

Here we will address how these matters are understood nationally and regionally, in France and in Belgium, since we will finish with a continental

perspective. But first, Peter Claes will explain the effect that nuclear energy has on the operations of energy-intensive companies and industries. How does he see things? How does he see the market and how does he explain the high price levels for energy in Belgium by comparison to its neighbours?

Peter Claes – Thank you for this invitation and for giving me the opportunity to talk about consumers. We do not hear about them enough, and perhaps sometimes even forget them. Industry obviously needs energy. It is its biggest or second-biggest expense and is one of the main operating cost inputs for businesses. In Belgium, there are around five large and very energy-intensive corporations consuming about €1 million per month (many businesses do not have that much in cash). IFIEC is neutral as regards the technology and it's not our job to tell other people what they should do. The choice of energy mix should be decided by others depending on the available options. However, we need a balance between sources, given the climatic, environmental, safety and competitiveness challenges. Not all countries have done the same as Germany in introducing measures to make energy competitive, and some are currently suffering the consequences of energy that is too expensive. Clearly, it is essential to assure continuity of service, because the worst thing of all would be a shortage of energy.

It's true that each source of energy we produce has its own advantages and disadvantages. What we want is greater liberalisation of the market, which we have been advocating since the 1980s and 1990s. In our view, liberalisation is still the best way of achieving competitive prices and quality service, because if an operator does its job badly, it will find itself replaced by a competitor. We do not think that public-sector agencies and governments are in the best position to put a competitive market in place. The market needs to be free, with measures imposed by governments that can lay down the rules. In the final analysis, it is the market players that must decide on the type of technology to be used, taking climate change and competitiveness into account. But if you believe in the market, you may question the merits of long-term contracts. The European Commission sees no problem provided they do not become a source of monopolies. It would seem to me that in most countries in Europe, the markets are moving in the right direction, with many industrial companies having the option of alternatives to these long-term contracts.

With the transition gaining traction, we now need to focus more on research and development, because the current technologies will not enable us to achieve the three energy policy objectives: climate, competitiveness and safety. If we want to achieve these targets by 2030/2040, we need to invest more in research and development.

Here are a few thoughts by way of conclusion: it is up to the market to decide, depending on the parameters imposed by government, on whether or not to go down the renewables road. But the question also arises as to the cost of the replacement or energy shift, which is estimated at between 80 and 100 dollars per tonne. Research and development is needed to supply new clean technologies that are affordable from a financial point of view. If industry is to be lumbered with a carbon cost of between 80 and 100 dollars per tonne, it's clear that many companies will relocate their businesses.

In Belgium, by comparison to other countries throughout the world, nuclear does not account for as high a proportion, but our system provides a certain stability. In the long run, nuclear must therefore have a role to play in the energy mix. With the threat of climate change, I fail to see solutions that do not involve nuclear energy.

Graham Weale – Regarding research and development, a group of researchers from the Copenhagen Consensus think tank, backed by eight economics Nobel prize winners, have reached the following conclusions: a dollar devoted to a properly targeted research and development programme can have a much greater impact on combating climatic warming than the same dollar invested in renewable energies. I leave you to draw your own conclusions from that. What would you have to say to the European Commission about the Winter Package, especially now that the word «competitiveness» no longer appears in it?

Peter Claes – It lacks balance between the three targets: climate, safety and competitiveness. Considering climate as being a fundamental objective should not lead to measures that are likely to encourage businesses to relocate elsewhere. We need a balance between the three levels, and all carbon policies should be decided at worldwide level to achieve it, rather than favouring one sector over another. We can give incentives for renewables, certainly, but it's research that is crucial, and that is what is missing from the Winter Package, as well as the assurance of the security

of supply of electricity. Our current technologies cannot meet needs or attain the climate targets.

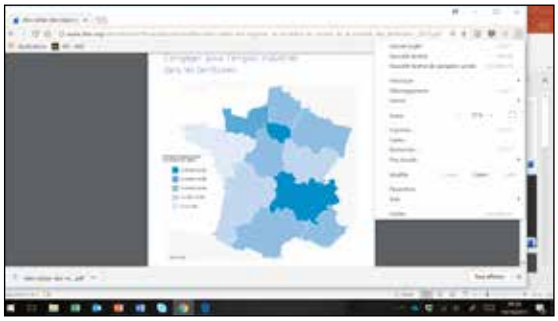
Graham Weale – Valérie Faudon, nuclear energy is one of France's major assets, but in spite of that it would appear that part of the nuclear industry is under threat. What do you think of the French position?

Valérie Faudon – During my travels abroad I have often been asked whether nuclear is compatible with tourism and agriculture. This question is worth asking, because although France is renowned for its tourism, some power plants are within five kilometres of tourist sites, which really goes to show that nuclear is a clean technology. Agriculture and wine production contribute to France's strength in Europe, but here again agricultural and wine growing regions sometimes have nuclear power plants in them, for example the Loire Valley.

Turning to our subject, nuclear energy's contribution to regional development, in France we engaged in a major debate on the energy transition as well as a complete reorganisation of France's regional structure with the creation of ten large regions. The politicians and elected representatives debated at length on the question of energy at the regional level. These discussions took place against a background of France considering that its future was bound up with the regions and renewables. Nuclear power, which is centralised by definition, would no longer have a place in this more regional vision of French energy policy. It is therefore a matter of demonstrating that nuclear plays an important role and makes a major contribution to the production of electricity in France. Its contribution in terms of electricity production is obvious, since the price of electricity for German households is 70% higher than in France; Europe-wide, we are also well placed as regards prices. Furthermore, nuclear energy is the third largest industry in terms of jobs with over 220,000 employees spread over 2,500 nuclear companies.

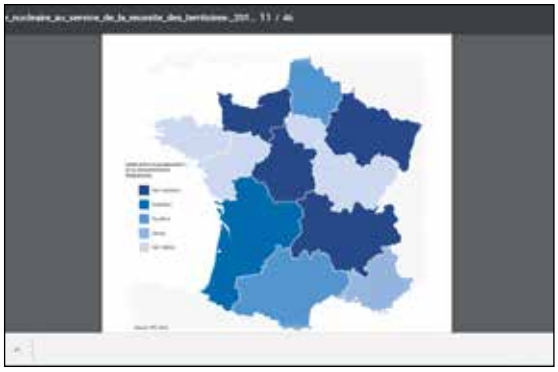
In France, 70% of the population lives in towns and cities, a proportion that will continue to increase. Paris is a big city that is growing, particularly with the Grand Paris – Greater Paris – project. This will involve building new transport infrastructure, leading to greater electricity consumption in that region.

In France, nuclear industry jobs exist in areas of



varying concentration. Brittany has no nuclear power plant, but has many small companies that work for that industry. Furthermore, of the 2,500 nuclear industry companies, 1,600 are SMEs. The Bordeaux region is rather unusual because, in addition to the nuclear industry, it's the French region with the greatest number of solar panels; Gravelines is home to the biggest nuclear site in Europe, but we also have Aquitaine, and others.

The Gravelines power plant plays an important role in the economic development of the region since there are aluminium industry companies there, as well as in Dunkirk; these companies would cease to exist if they were to lose their access to quality energy. We have sites that are located side-by-side in industrial areas. Moreover, we have conducted a study that demonstrates that nuclear industry employees are often very well trained, with levels of skills that are on average twice as high as those for employees in industry generally. This point is important in so far as it contributes to creating real industrial depth and a real social and cultural dynamic. What is more, nuclear contributes greatly to international perception, and the Gard region for example benefits from this visibility. This applies also to Lyon,



Solidarity and trade between French regions

whose SMEs export 60% of what they produce to China.

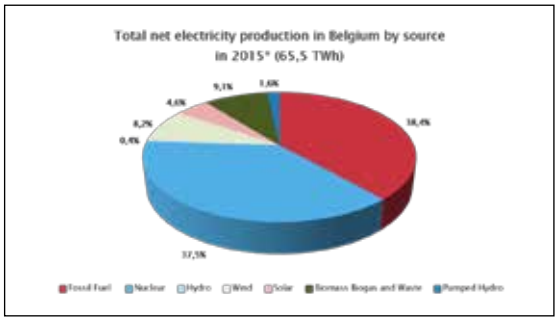
Certain regions are growing thanks to a solidarity network. For example, Brittany benefits from what is produced in the neighbouring regions such as Normandy and the Loire Valley. Solidarity also manifests itself in the price of electricity, which is identical wherever you are.

Yves Desbazeille – You talk about nuclear having a level of skills twice as high as the rest of industry, but I wonder, what criteria do you base this on?

Valérie Faudon – We looked at the vocational qualifications in the various sectors of nuclear energy and found that two thirds of employees were of manager or supervisor grade, twice as high as in other types of industry. In some regions, such as eastern France, the nuclear industry is the main source of jobs and an extremely high level of qualifications is required. EDF has initiated a project called *L'Ancrage territorial*, setting out its undertakings to the local area, in which it undertakes to make substantial use of local suppliers.These points are relatively well documented at each site to highlight the contribution that nuclear makes locally.

Robert Leclere – My presentation is about the energy transition and how it is being implemented in Belgium. The definition of the energy transition varies from country to country, but there are constants. The first of these is lower-carbon energy production, involving a dramatic reduction in the use of coal, oil and gas. But also decentralised production, with the growth in offshore and onshore wind power, photovoltaic, biomass and digitalisation to improve management. These objectives are known and accepted by everyone, but take different forms throughout Europe. France wants to move gradually to 50% nuclear energy, while Great Britain, with its contract for difference, has decided to subsidise nuclear energy.

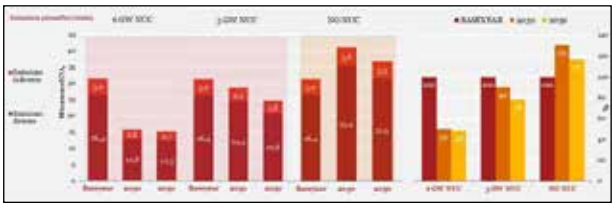
Belgium, on the other hand, has chosen to shut down its power plants by 2025. However, it's worth plotting these facts on a time line projected through to 2050. With the closure of the nuclear installations in 2025, it is hard to imagine what the situation might be in 2050. There will certainly be more renewables, and perhaps still nuclear if the law changes, and finally other sources. Between the two we have what is called the energy transition. How will the current situation develop by 2050 in the context of the three criteria referred to earlier: security of supply, prices/competitiveness and finally the impact on the climate?



2015 was not a good year for nuclear in Belgium, with its share being relatively low due to the shutdown of two units for several months. But we should also note that fossil energy played an important role and was used to make up for the shortfall in energy, independently of imports. In 2015, renewables were still relatively insignificant.

On this basis, we ran three scenarios: 1. exit from nuclear starting in 2025, with the closure of seven nuclear units according to the timetable laid down in law; 2. retention of 3,000 MWe of nuclear capacity until 2050, which is half of it; 3. retention of 6,000 MWe of nuclear capacity until 2050.

We compared these scenarios with the targets set out earlier, and in all cases the country will be unable to meet its climate targets if we reduce Belgium's nuclear capacity.



Climate targets

Only the renewables/6,000 MWe nuclear scenario reduced CO2 emissions squarely in line with European and Belgian targets. This means that to achieve the 50% reduction, capacity at least equivalent to current output is essential.

Economists are predicting a sharp growth in renewables by 2030 and much more again by 2050, but this growth raises questions as to resupply. In all three scenarios we end up with a cross-hatched line for «other sources of energy», in other words fossil energy. In all cases, production from fossil energy will be needed, or we would have to import. Only with scenario 3, which involves retaining the existing capacity, could export be considered.

Security of supply

Absence of nuclear power has serious consequences from a political point of view because it presupposes dependency on either fossil energy or imports, and imports would have a direct impact on the country's balance of trade. From an economic point of view, it is therefore best to produce at home rather than to import.

Regarding costs, if we want to develop renewables at a sensible cost, nuclear has an important role to play because we do not have any 3rd generation plans and the existing nuclear capacity could allow sensible prices through to 2030/2050.

To sum up, renewables and nuclear complement each other, backed by storage, not only from the point of view of reliability, but also as regards affordability and durability.

Philippe Herzog – I have two questions: have projections of this type already been carried out in France? Has the Commission recently produced any similar projection?

Valérie Faudon – At the time of the energy transition law, ANCRE, the French national energy research centres association, carried out a study on the consequences to the climate of moving to 50%. The study shows an increase in CO2 emissions. There were no studies on jobs or exports. We published a paper to disprove the claims of a candidate at the last presidential election who asserted that renewables created more jobs than nuclear. This information came from a mistaken reading of an American study.

Massimo Garribba – It is perhaps up to me to reply on behalf of the Commission, which studied the question and produced a report for 2050, in the PINK, which was published last year but which needs to be updated. There is currently no timetable for a new study to be published.

Graham Weale – I now hand you over to Kirsty Gogan, who will address the role of nuclear in a low-carbon environment, and how to ensure the availability of sources of low-cost energy wherever you are in the world.

Kirsty Gogan – This invitation gives me the opportunity to tackle questions such as: How can we relaunch investment and innovation in nuclear? What are the ethical, economic, social and scientific challenges for nuclear to be a sustainable and competitive power source? Energy for Humanity has three objectives: first to promote the marketing of evolving nuclear energy, competitiveness after consolidation, then influence political decision-makers.

My presentation will focus on the United Kingdom and the importance of competitiveness. The three key words for this talk will be productivity, cost and innovation. We have seen a dramatic decline in labour productivity across nearly all advanced economies from 2005-15, compared with the decade before. Of all the advanced countries, Britain has fallen furthest, and hardest. Post-Brexit, Theresa May's new government appears to have understood the importance of an industrial strategy. The UK Government has recently published an Industrial Strategy report and a Clean Growth Strategy report, which advocate greater interventionism in the industrial sector. The Energy Minister said that the new energy trilemma is productivity, security, affordability. With this the UK has pledged to phase out coal, and has ambitious and legally-binding carbon reduction targets.

The decision to proceed with Hinkley Point C (HPC) nuclear power station in the south-west of the United Kingdom (where £2.4 billion has already been invested by EDF Energy) will pay for itself through additional jobs and the production of clean energy. We hope that this will lead to more investment in infrastructure. This power station will operate for over 60 years and save up to 7 million tonnes of CO2 each year with a capacity factor of more than 90%. But, already, it looks like an antique. Will it be possible to standardise and duplicate the design, making it scalable to solve our national energy security needs, let alone contribute to the global challenges of clean energy access within urgent timescales?

HPC is a high-cost outlier compared to new build elsewhere, and a world apart from South Korea or China. However, wherever you build, the cost of the nuclear island remains fairly consistent. The major cost increases in Western Europe come from indirect costs. We have heard that the mar-

ket context is driving costs more than the complexity of the EPR reactor design.

What drives cost in nuclear new build is a question that my organisation is deeply involved in. The reason for this is that for nuclear to make a meaningful contribution to solving climate change, two major barriers need to be addressed: high costs and low public confidence.

The UK offshore wind industry recently smashed expectations with astonishingly low prices. Prices have halved in 5 years. Other low-carbon technologies are playing catch up. Emma Pinchbeck, director of Renewable UK, had the good grace to point out that despite the offshore wind industry now clearly leading the pack on price, "we still think nuclear can be part of the mix – but our industry has shown how to drive costs down, and now they need to do the same."

Decarbonisation represents a massive growth opportunity for the electricity sector. If we want to achieve the fastest, most cost-effective and feasible path to decarbonisation then we need a mix of technologies. Nuclear must form part of that strategy because it's impossible to electrify everything, and very often nuclear competes with solar and wind power, but also with gas. The remaining decarbonisation will take place in transport, construction, heating, industry and many other sectors. The British government also intends to ban cars running on diesel by 2020 to encourage electric vehicles, which should lead to the production of clean energy. The development of synthetic oil will also be encouraged.

The Energy Technologies Institute (ETI) has modelled scenarios to show how the UK can achieve 2050 carbon reduction targets. ETI's lowest cost involves around 40 GWe of nuclear capacity installed by 2050 as part of a balanced mix of energy technologies. But to achieve that, confidence in the ability of the nuclear industry to deliver new nuclear plants is key, and right now confidence in the British government's commitment to new plants would seem to be low. The nuclear industry therefore needs to undertake a radical transformation if it is to rebuild investor trust and credibility.

There are three major barriers to overcome: financing very large capital projects is expensive; conventional nuclear plants are large and complex, bringing very significant construction risks; and projects may not be delivered on time.

Cost reduction strategies – as outlined in the new Energy Innovation Reform Project report – that we are interested in testing include: simpler and standardised plant designs; production-line integration, similar to a shipyard; modularisation; reduced material requirements, shorter construction time; a higher power level; and greater efficiency.

The offshore wind industry has shown that innovation, collaboration and transmission can be drivers. The nuclear industry must follow its lead to tackle construction delays and cost overruns, the slow build rate and high financing costs.

Given the low labour productivity of Western countries, and especially in the construction sector, the future may lie in the assembly of mass-produced units that can be manufactured and shipped to sites for installation.

Graham Weale – How long does Europe have to get its act together? Because we have been told that the cost of solar energy was 1.9 dollars per KWe and that it is expected to fall further. How can we stop these countries becoming magnets for businesses that use a lot of energy? Our last speaker will take us to Africa, where there is only one reactor but where by 2050 the population will have doubled to stand at 2 billion people, making it the world's most populous continent. Africa will therefore need a lot of energy, and nuclear power will be part of it.

André Frank Ahoyo – We share a strong belief within Entretiens Eurafricains that investment is a choice made by society. It is the choice of a society that is looking to the future. To achieve this we need to revisit the saying of Laozi: «The best way of predicting the future is to create it». Tackling the question of nuclear and its impact on growth in Africa is no flight of fancy when it comes to the three ideas that I want to share with you.

Africa needs to be seen as a potential market, not only for covering its needs in electricity but also

for moving to the rank of an emerging power because, as with coal in the past, nuclear will make it possible for it to hoist itself up to a more enviable rank. 34 African countries out of 54 have uranium mines, giving them access to the nuclear industry. They account for almost 20% of worldwide uranium resources. Malawi, South Africa, Niger and Namibia are the countries with the greatest reserves; the DRC was the first African country to build a nuclear reactor. That was in 1950. But it stopped working in the 1970s. The major developed and emerging countries such as France, the USA, Russia, China, South Korea and Slovakia have been involved in programmes for developing nuclear in Africa, either to secure uranium supplies, or to build a nuclear industry by building power plants, engineer training centres or for setting up safety authorities.

The IAEA (International Atomic Energy Agency) helps countries to set up institutional and legal frameworks to raise awareness of civil and medicinal nuclear (for example Benin, which in September 2017 adopted a law on radiological safety and nuclear security). Many African countries have started up nuclear programmes: Algeria, Egypt, Morocco, Ghana, Kenya, Uganda, Namibia, Niger, Nigeria, South Africa, Tunisia and Zambia, some of which are the drivers of Africa. South Africa is the only country to operate nuclear on the continent, with a power plant made up of two reactors producing an output of 1.8 GW. It plans to add another eight reactors to achieve an additional output of 9.6 GW by 2030, meeting 6% of its electricity needs. Russia is poised in Egypt and Nigeria for projects that should come to fruition in 2025. The first 1000 MW power plant in Kenya should come on stream in 2027 (built by China) and the target is to achieve 4000 MW in 2040.

The continent will have 2 billion individuals in 2050, who will need energy for lighting and to meet their needs in water, health, production and product processing. Its economies are experiencing a structural transformation, and nuclear makes sense for achieving a transition to low-carbon emissions that is resistant to climate change, while at the same time improving energy efficiency and fostering regional cooperation (COP 21 and 22). South of the Sahara, 30% of the population has access to electricity, and out of the 54 countries on the continent, over half have an electricity connection rate of less than 20%. The diminishing number of conflicts and the progress made by democracy have brought with them gains, albeit still limited and fragile.

Building nuclear power plants requires great political will and/or regional cooperation. Moreover, the ability of African countries to keep their installations secure and to process radioactive waste must be studied before anything else. According to the IEA, 50 billion dollars per year are needed to achieve universal access to energy by 2030, equating to 1,000 billion dollars over the period 2010-2030.

To conclude, the development of nuclear in Africa should not be regarded as just a Utopian ideal. We need to bear in mind the moral of history: *«don't go to sleep thinking something is impossible, because you might be woken by the noise of somebody else doing it»*. We could be in for a surprise!

Safety, an asset for competitiveness – Safety costs: how to reduce them without reducing safety

Chaired by **Fanny Bazile**, Senior advisor, Nuclear Energy Direction, CEA, France

With

Massimo Garribba, Nuclear Director, DG Energy of the European Commission
Anders Johansson, Senior Nuclear Technology Advisor, Vattenfall AB, Sweden
Frédéric Lelièvre, SIVP Sales, Regional Platform, INC, AREVA NP, France
Bertrand de l'Epinois, Member of the Board of WANO

Round table

Fanny Bazile – Safety and competitiveness are highly sensitive issues. To what extent are safety requirements compatible with competitiveness? It's a complex question. Nuclear power is a relatively new but, at the same time, mature energy source that has generated a lot of feedback. How can innovation help to improve safety? The safety requirements for Generation III+ reactors are growing, bearing in mind the feedback from the Fukushima accident. At the same time, we must continue to be competitive in the global markets. So, both operators and sellers have some big decisions to make.

And how does the pursuit of higher safety standards affect competitiveness? The aeronautics industry, for example, has improved both its safety standards and its competitiveness. Can the nuclear industry follow suit? If so, how? What are the respective responsibilities of the various actors and stakeholders (governments, operators, regulators and NGOs) in terms of improving safety and cutting costs? Lastly, what might be the impact of harmonising safety standards, particularly across Europe?

I give the floor to Mr Massimo Garribba.

Massimo Garribba – Nuclear safety and competitiveness are not mutually exclusive. You cannot have one without the other. Competitiveness is a key factor. In Europe, we have made rapid progress in this area with the introduction of two new directives. Safety is a high-level objective, which is covered by a European agreement. But the problems are starting to emerge now, because there are fourteen different national policies on how to enforce this agreement. That's a good thing for safety, but it's perhaps not so good for competitiveness. If you have a pyramid with the objective at the top and the implementation rules at the bottom, you must decide how far you need to go down to make sure that standardisation efforts are effective. Since the late 1990s, there have been a lot of regulatory and private initiatives that have not delivered any visible results in terms of standardisation. We talked about this in Prague a few weeks ago. There are different regulatory traditions, and different industrial practices.

The industry has changed a lot in the past 50 years. The need for transparency is great. The general public must be able to understand that standards are improving. The real problem is that we cannot have a global approach. There are choices to be made. Let's start by choosing a few components in the

supply chain that could be harmonised. First of all, is there any interest in harmonising them? It would have a direct impact on competitiveness. Are there any other sectors that produce these components to an adequate level of certification? We could create a positive dynamic by harmonising some components a step at a time; we need to proceed by trial and error. We must not harbour any illusions. There is a trend in European legislation towards continuous improvement, so safety levels will steadily improve. But the nuclear industry will take a lot of time and money to develop.

Anders Johansson – I'm going to pick up where Massimo Garribba left off. We must take the situation in Europe into consideration. We have a varied fleet, and we can't change that fact anytime soon. Standardisation makes sense from a cost perspective, but it also goes hand in hand with safety. Doing the same thing over and over makes for better results, at a lower cost. Standardisation would result in a safer and less costly nuclear industry. Quality improvement is just one of the consequences of standardisation. There are others, such as a longer life cycle. The safety of a nuclear power plant is increased over its life cycle, which is estimated to be 60 years. It's difficult to strike a balance between the two trends. The more we share our experience with others, the easier it is to maintain plants. This applies to regulators too. Together, they can learn to manage a more standardised fleet and thus improve safety over the long term.

It is not only components that need to be standardised, but also criteria and solutions. Unfortunately, the sector has not always been able to produce the same solutions to the same problems. One of our biggest flaws is that we think we know better than everyone else, and that our solutions are better than theirs. We have to get past that, and understand the value of sharing. Standardisation is applicable to components, design, solutions, approaches, design and analysis tools, and everything relating to the documentation of what we do.

Future installations and constructions could have a real ripple effect, and the next generation of small modular reactors could lead to greater standardisation and more experience sharing. The EU's research centre conducts a lot of research projects that could benefit the sector's supply chain and thus enhance the current fleet. Components will be improved as a result, and it will be possible to use them in the same manner in different parts of Europe. That will be very beneficial for both safety and competitiveness.

Frédéric Lelièvre – We all know how important safety is for our industry. Without a certain level of safety, our industry wouldn't exist. When an Areva facility fails to meet an adequate level of safety, we shut it down. The two issues are closely intertwined. Project costs are linked with certification. Reworking impacts on planning. And planning has the biggest impact on competitiveness. The faster we do things, the more competitive we are. In France, we stopped building nuclear power plants for a while. When the time came to build Flamanville, the safety gap was too wide, and the schedule went off the rails. The work had to be done again, and the costs spiralled out of control too.

After Flamanville, what sort of reactor are we going to have in France? That's not an easy question to answer in our industry. How can regulators and manufacturers increase competitiveness while maintaining an appropriate level of safety? Certification standards must be clear, predictable and stable. Regulatory changes during the construction of Flamanville created problems. The various safety bodies must recognise industrial codes and standards to avoid the need for specific, project-by-project solutions. Lastly, the safety bodies must agree on a fundamental set of principles that would lay the foundations for a common framework that manufacturers would understand, and on which they could base their actions. Manufacturers also have a lot to do. If they fall short of quality standards, they create a climate of distrust between themselves and the safety body, which only slows the progress of projects and therefore increases costs. That is exactly what happened in Le Creusot. Tools and methods should be updated when the project is submitted. In France, we haven't yet progressed from what I call a business-based structure to a system-based structure. Designs must be standardised. The supply chain must also be harmonised to increase quality and safety and to make sure there is a big enough pool of top-notch suppliers to reduce prices.

Bertrand de l'Epinois – WANO is the World Association of Nuclear Operators, which focuses exclusively on safety without setting any targets for competitiveness per se. We work on reliability because per-

formance quality can improve safety, the two go hand in hand. If we reduce the number of accidents, breakdowns and faults caused by inadequate maintenance for example, then we can maintain safety standards. A facility that never stops running is dangerous, because there is no time for maintenance.

We are a global organisation. Every nuclear operator in the world is a member of WANO. Recycling plants may also become members. We are organised on a regional basis. Our head office is in London, and we have a support team in Hong Kong. Safety is primarily the responsibility of each individual operator, but there is also a need for cooperation. We encourage information sharing and emulation of best practices. We operate a stringent external confidentiality policy while promoting the free exchange of information internally. We carry out peer reviews; every four years, we visit several facilities with a team of 25 industry professionals from various facilities, and we inspect a whole range of aspects. You have to be out there in the field to see the flaws and, in some cases, the positive results, and to understand the lessons that can be learned from professional excellence. The operator produces and implements a plan of action, and we provide technical support. Two years later, we return to the facility for a follow-up visit, to see how the action plan is progressing. There may be a second action plan, or the first one may be updated. The attitude of the top management is crucial, and must keep pace with what is happening on the ground. We have had some very interesting feedback. It is good to have a clear picture of the problems and of any accidents. We are very efficient, and work very closely with operators on the ground. We operate only in the nuclear industry, so we can be quite frank and direct without worrying about eavesdroppers from other sectors, which is an asset. Then a final report is drawn up, and the results of our review are published. We highlight inadequate performance, and may send in a delegation of CEOs if the situation is really bad. We do not have the authority to impose sanctions, but we can apply a certain amount of peer pressure. That is very effective when it comes to improving safety. As far as competitiveness is concerned, we encourage the reliability and availability of installations as much as possible. In fact, many of our activities support safety and competitiveness in general. We expect all our members to make sure their managers know what their roles and responsibilities are. Leadership and management teams must be on site and trained accordingly. It enables them to identify any deficiencies. This way, we are able to increase the stringency of operations considerably. It improves safety and efficiency. We also provide support in regard to preventive maintenance; we help our members use pooling systems to prevent operations being repeated unnecessarily. Our attitude towards safety is very clear. There can be a conflict between safety and production. If an installation has been powered down, some want to start it up again immediately while others prefer to wait. Safety must be the first consideration in any operational decision. When a choice has to be made between profits and safety, safety must always come before competitiveness. There is no doubt about that.

Fanny Bazile – Thank you very much. According to surveys like Eurobarometer, the biggest obstacles to public acceptance of nuclear energy are waste management and safety concerns. There are a lot of technically feasible solutions for managing waste, we just have to make sure the public understand them properly. Do the public understand the safety improvements you have all mentioned?

Frédéric Lelièvre – No, they don't. The core in Flamanville is safe, but it has received more negative coverage in the press than anything else.

Bertrand de l'Epinois – WANO does not aim to promote nuclear power. We are not here to increase public acceptance or public trust. That is not our job. That said, perhaps what we do has an impact on public opinion. But it's not something that can be measured.

Yves Desbazeille – We need to make sure people know about WANO, and that progress is being made every day. The problem is that the public aren't well enough informed.

Bertrand de l'Epinois – We share information on who we are, what we do, and what our values are. Maybe that's not enough, maybe the media don't

talk about it enough. We never publish information on the situation of individual plants. It's always difficult to provide a general safety review, we often get bogged down in banalities and generalities. But we do tell people that we are here, and what we are here for.

John Laurie – I've heard you talk about standardisation, performance, etc., but that's not enough. To achieve both competitiveness and safety, we must tackle the danger. Take aviation for example. The risk of the plane crashing is low, but when it does the danger is high. The same applies to nuclear power plants. How do we eliminate the danger? It's possible, but we need to change the technology. Risk reduction pushes up costs, while lessening the danger will bring costs down.

Massimo Garribba – That's a very interesting question. But you can't compare an aeroplane with a nuclear power plant. Aeroplanes sometimes crash, but everyone still flies. We have had two and a half accidents, and they have been enough to completely change public sentiment: even though the risk is minimal, the impact is huge. Tens of thousands of people are displaced for years; sometimes they have no hope of ever returning home. That's why we need Generation III, and why we are working on Generation IV. People are afraid of the unknown. There is a general tendency at the moment to want to return to the past. Immunisation programmes are seen as something negative nowadays. The same goes for technology in general.

Frédéric Lelièvre – Everything that happens in the containment building stays in the containment building. But we have a problem with competitiveness today. What you are talking about will take a long time, it's not the same time scale. Your proposal doesn't solve the competitiveness problem that we have right now, and that is a big concern to us. Other institutions can think in the long term but that's not our role as industrialists.

Jean-Philippe Brette, member of Sauvons le climat – Are we going to get to the stage where we have too many safety requirements, which could reduce competitiveness and even undermine safety itself?

Fanny Bazile – That's a technically and politically complex question.

Massimo Garribba – We're still a long way off that situation, ask the question again in ten years' time.

Bertrand de l'Epinois – Even if increasing requirements is detrimental to safety, it won't mean that safety measures are excessive. When there is too much complexity and paperwork and not enough on-the-ground presence, it's true that the situation is not ideal. There are more and more processors but fewer and fewer processes. The balance must

be restored and teams on the ground must be reinforced to ensure positive feedback for the general public. We firmly believe that things can improve, and that a target of zero accidents is feasible. Of course, it will be a gradual process, as improvements are being made all the time. We must do better than we are doing right now.

Kirsty Gogan – I have a lot of respect for the safety culture, and nuclear energy is the safest way to generate electricity. But is it really completely safe, and how much does it cost to maintain this level of safety? What sort of cost-benefit analysis are we looking at? The safety culture seems to be doing more harm than good. Risk assessments focus primarily on radiation protection. The safety culture has had a big impact on the competitiveness of nuclear energy compared to fossil fuels. Coal would be banned if it was as highly regulated as nuclear energy. Why not include the advantages of nuclear energy in risk assessments? That would make sense.

Claude Fischer-Herzog – Both governments and operators have backed the safety directives. The framework put forward by the Commission and ratified by the Member States is at the forefront worldwide. Safety costs more here than for any other operators in the world. There is no denying the conflict between competitiveness and safety. We are told that GII is no longer adequate and that we need to move on to GIII or even GIV. We are also investing substantially in ITER, and yet all the nuclear safety bodies in the world have agreed to continue with GII plants... Are they safe or not?

Massimo Garribba – I think the question is a little misleading. There is no conflict between competitiveness and safety; plants cannot continue to operate without both. The recession is likely to be severe, both in Europe and the United States. No one has said that GII plants aren't safe. We operate on a continuous improvement basis. You should look at things as a process – we are always increasing the level of safety. Right now, the market is an oligopoly, and it's not fully competitive because there

are very few sellers. I think they have all understood that if they don't meet the most stringent of safety standards, they will be left behind. In China, anti-nuclear sentiment is very strong, because people believe it's not safe. Furthermore, nuclear energy must not be played off against renewables. We should use all the means we have to reduce carbon emissions. It is important to adapt to local circumstances and to adopt systematic approaches to things like electromobility for example.

Jukka Laaksonen – The decision to continue with GII plants is part of our continuous improvement policy. That is one of the fundamental principles of the nuclear safety directive. It doesn't exist in Japan; some still use criteria from the 1990s. We often talk about this with European operators. Adopting these practices would be a death sentence for the United States.

Bertrand de l'Epinois – We make decisions based on past experience and feedback. There are questions that need to be answered regarding safety, there are risks connected with the fuel itself. We tackle these questions through progress, research and development. It's not all that different from the automotive industry: this year's model will be better than last year's, even if last year's was already very safe. The same applies to aviation: there are several generations of planes in the sky. Progress is important. We must monitor the implementation of these approaches carefully, taking care not to go too far in the other direction and create tools that are overly complicated. We must upgrade plants regularly. At first the changes are significant, then we approach the point where, if we go too far, things become too complicated and safety is undermined. If we go beyond that point, we upset the balance and our actions become counter-productive. It's all a question of balance, and the same thing applies to all industries. We can also considerably improve quality through better organisation. That's what WANO does: we are more interested in the operational aspects than design. We need to improve behaviours, training and the decision-making process, leadership. There are accident management specialists in every team: when an accident happens, we sometimes get all sorts of images going through our heads that prompt us to act in a certain way, which is not necessarily the right way; the accident manager makes sure we respond to the actual situation, not to the images in our head. That's what we have learned from previous accidents.

Solidarity as an aspect of competitiveness

Chaired by **Yves Desbazeille**, Director General at FORATOM

With

Jan Bartak, Director, Nuclear Development, ENGIE

Guy Buckenham, Head of Generation Policy, EDF Energy, UK

Tuomo Huttunen, Senior advisor, nuclear and hydro power production, FINNISH ENERGY, Finland

Jukka Laaksonen, ROSATOM International

Laurent Schmitt, Secretary General, ENTSO-e

Round table

Yves Desbazeille – I feel honoured to be chairing this panel of experts. A few words about FORATOM: we represent the European nuclear industry and have 50 members – representing around 8,000 jobs – with revenues of over €70 billion. Nuclear is a strategic sector for the European economy, with real innovation capability. We produce one half of the decarbonised electricity in Europe. That puts nuclear at the heart of the European decarbonisation policy. There are other benefits: security of supply, energy independence, a small footprint to fit available land, and we are at the heart of European investment. It is an absolutely crucial industry. How can we cooperate more closely? Let us consider the lifecycle as a whole: research and development, innovation, education and training are aspects that are all crucial to the industry. Jan Bartak, ENGIE has sold its stake in a major project, NuGen. What happened? And what impact will it have on competitiveness?

Jan Bartak – Obviously, having partners is crucial for running projects properly. Withdrawing from the NuGen project was a difficult decision because we had been involved in it since 2008. We had several partners. At the outset, the project was attractive because the prices were guaranteed. We worked with Toshiba, the main shareholder in Westinghouse from 2014. We opted for the most advanced technology at the time, which forced us to grapple with the problems of «young» technology. Then the development started to take off: 2015 and 2016 were very good years, all the permits were obtained, we worked with the regulator and put the company structure into place. Then GDA certification (survey report prior to installing the reactor) was received.

But at the same time challenges were mounting on the funding front. In spite of the availability of a negotiated fixed price and good risk allocation between the contractor and the owners, it was very difficult to win over the financial institutions, because of the lack of any real government support. Discussions started between the British and Japanese governments. We feared an adverse decision from the European Commission on state aid grounds. Then other difficulties piled up including financial problems at Toshiba, which decided it no longer wanted to take any risk. We lost the contractor APC and had to try to find a

replacement. Then Westinghouse went bust and the group sought Chapter 11 protection. This left us with a defaulting partner and the job of looking for a new technology. ENGIE had sunk substantial resources into understanding the technology for which it was to be the future operator, because changing technology in an industry of this type is not something that can be done overnight. We sold our stake that year. It was a difficult decision.

After that, rumours started to circulate on the market saying that ENGIE was getting out of nuclear. This is absolutely untrue, we produce almost 35% of the nuclear energy in Belgium. We are committed, we have obligations, and we have over 50 years' experience as an operator. ENGIE is ready to continue its collaboration and management so long as the technical, financial and legal conditions are right. Nuclear energy has a role to play in the energy transition, it's the most direct and effective way of keeping down CO2 emissions into the atmosphere. We have 9,000 employees and partners. The installations in Belgium are starting to age, but we think the industry will grow because it has a high value added and needs a lot of expertise. We would like to be part of it. It is difficult to set up investment structures, even in a market where there is a guaranteed price.

Yves Desbazeille – Guy Buckenham, my first question is about Brexit. What impact does it have on the industry's competitiveness? Could the contract for difference (CfD) model become more widespread in Europe? Is there potential for reforming the market on the basis of this CfD principle?

Guy Buckenham – Everybody is worrying about the impact of Brexit. There will be a problem in accessing human skills. The United Kingdom has recruited throughout Europe, but today this is becoming increasingly difficult because ever fewer Europeans want to come to the United Kingdom to work.

We are members of EURATOM but the government thinks that staying in it is not consistent with the Brexit philosophy. We are therefore going to leave it, which raises two main challenges. First, thanks to EURATOM the United Kingdom has links not only with its European partners, but also its worldwide partners. This is crucial. It means that alternative measures will have to be found. Bringing fuel into the UK from abroad will raise a number of difficulties and have an adverse impact on the development of an industry that is profoundly international, and that involves people and organisations from the whole world over. The government needs to find a solution urgently. The second major challenge is that the nuclear industry depends on cooperation and coordination, particularly for research and development. We need to build close links between the United Kingdom and the rest of Europe. We are international right down to our DNA. Cooperation must be maintained and continue after Brexit, taking into account the consequences of our leaving EURATOM.

We all face different geographical conditions, which shape the industry. A colleague went on a training course in China, and the whole of the first day was devoted to Chinese culture. You need to know the country's culture first, before working there. We cannot copy and paste what we do, even though it's essential to share our experience. We need to recognise the need for a correct price for carbon, to limit use of coal-fired power plants and recognise the value of nuclear power plants. Regarding safety, we need mechanisms that ensure safety in terms of market access and price. This is linked to security of supply. We also need to keep down the carbon intensity of new plants.

Yves Desbazeille – The energy market is currently in a state of disarray. What place will nuclear have in it?

Tuomo Huttunen – The energy market is in complete disarray and a reasonable carbon price could benefit all emissions-neutral technologies. I think it makes no sense to replace one type of CO_2-free production with anything other than another type of CO_2-free production: it would be better to replace the coal-fired power plants in Poland. We should be proud of our nuclear industry and make sure we defend it!

To keep electricity prices at reasonable levels, it's still produced from fossil fuels. We have surplus capacity and electricity costs are so low that there can be no new investment without state aid. We could have a floor price, more stringent CO2 reduction targets and a more reasonable ETS system. We could base the market on marginal costs, which means fuel costs. When the pe-

netration rate of CO2-free energy generation rises high enough it starts to cannibalise itself. If you increase wind power by 10% to 15%, the remaining 20% will not be viable because the investment will have reduced prices. That is something to think about.

In Finland there is no public-sector nuclear industry but we have excellent knowledge of regulating power plants and handling waste. Work needs to be done on the business case. There are other ways of expanding nuclear. Nuclear needs to be recognised as a source that can combat climate change. The industry stays within its comfort zone. We discuss things among ourselves and agree on many of them, but this in no way changes the perception of nuclear by the general public or by the politicians. We need to reduce costs, both for existing installations and for new installations. This requires collaboration among everyone involved, and the GRC task force can help with this. Politicians also have a role to play. The industry needs to renew itself. Finland is reforming the law on nuclear energy, but a wider ranging reform is needed if we want to build SMRs: we need impact assessments and a review of the law on energy. We need to discuss the fourth generation, and the closed fuel cycle. Most of all we must not work in isolation, we need to talk to the legislators.

Yves Desbazeille – What role should nuclear energy have in current European energy policy? How can we work towards decarbonising Europe and combating climate change? ROSATOM is involved in many cooperation projects, could you tell us about them?

Jukka Laaksonen – We need nuclear energy to attain the climate agreement targets, but unfortunately the importance of nuclear energy is not recognised by either politicians or the general public. It needs support, and we need to have the courage to say that nuclear energy is good for the climate and to promote its use in combating climate change. The companies that run the power plants can speak for its strengths. Nuclear power plants give off almost no radiation. Two conditions need to be met to ensure nuclear holds its place in the energy mix: its economic competitiveness and safety, meaning public confidence. It needs cooperation to improve the way in which the building and operation of power plants are managed. Risk management has been the main source of delays and cost overruns on many occasions.

Practical cooperation between Russian nuclear energy and its customers in Europe started during the 1970s with the building of a power plant in Finland based on the principles of the time, which were the international standard for nuclear regulations. The Russian supplier applied these principles and used Finnish and international subcontractors in cooperation with foreign partners. Many components of this power plant were acquired from outside the Soviet Union. This resulted in reliable energy production over many years. This was repeated for over 70 power plant and reactor projects. It had results, since there were no accidents. Russian scientists concentrated particularly on developing their own nuclear technology to start with, then in the 1980s active cooperation was initiated with international organisations and bilaterally with many countries to increase the safety of Russian power plants and to cooperate in developing safer power plants for future generations. During the first year of cooperation, Russia had a safety evaluation mission. In the 1990s Russia became – and still is – the foremost country through its nuclear research programme, even though it's no longer an ANEA member. The research programmes were carried out by international groups, experiments took place in Russia and the results were assessed by international teams. This collaboration was held in high regard by all these safety experts.

We have many power plants on the international markets. We sometimes hire foreign subcontractors to work on them. The turbines for a power plant being built in Finland went to Alstom, while the control systems went to General Electric.

Yves Desbazeille – How do the transmission systems need to be modified for the production mix, particularly given the rise of renewable energies? How do you ensure that all technologies can be competitive at the same level?

Laurent Schmitt – There are many system operators in Europe, Switzerland, Norway and Turkey. We have three roles. 1. Develop pan-European energy systems. This is what's called the ten-year development plan, the purpose being to calculate the places in which infrastructure should be built in Europe depending on the Euro-

pean energy mix. 2. Work on designing the market (prices and flexibility). 3. Ensure the security of European suppliers, and know how to manage system stability. ENTSO-e facilitates exchanges of technical know-how between system operators, and we are a sort of legal agency for the European Commission. For example, we have calculated generation and grid development projections. New grid codes that have just been agreed by the European Commission need to be introduced. They lay down the codes of conduct for all new-generation hook-ups to the European grid. We are also working with the Commission on the Winter Package, or the clean energy package. I am surprised that nuclear is mentioned so seldom in the clean energy package: people really need to know about it! The system needs to be decarbonised and nuclear can play a role because it's preferable to coal.

Renewable energies are volatile, there is no concept of a standard load unit. We need to be able to cover peaks. Is nuclear flexible? As an industry we need a straight answer, even though it may vary from country to country. If nuclear is not flexible it will disappear from the system of the future. It is therefore a matter of urgency to design flexible power plants. Congestion is another important consideration. Renewable energies have become competitive but only in areas of the system that are suitable – offshore in northern Europe or in sunny countries – but connections are needed to balance out the system. Renewables do not work on big networks. We have congestion in the system, especially at the German border. There is a shortage of transmission capacity.

We should not make plans that are too grandiose because it might be difficult to find the right role for them. We need medium-sized power plants that could rebalance the congestion. Medium-sized projects are easier to incorporate into the system. The markets have very weak price signals because, to be frank, nuclear is not really very transparent on cost, even though there may be recycled fuel, but then the same applies to photovoltaic and wind power. We need a price signal that gives the right price for the appropriate moment so that we can build in the future, but capacity payments are also needed. The market will have a shortage of medium and long-term capacity. It is urgent that we begin discussions and decide our role. How much should be paid for the missing capacity? What storage should be provided? We need a level playing field as regards resources that is as neutral as possible for CO_2 emissions.

Georges Sapy – ENSO-e makes fine projections about the balance of the grid in the medium term, and rightly so. In 2017 there was a provisional report which showed that over a time scale of three or five years there was a risk of failure of supply in Great Britain and France, although in its final version things were not as bad. Regarding network security, Belgium is to shut down 6 GW in 2025, France is to shut down nuclear power stations, and Germany still has 6 or 8 GW of nuclear power that it is to shut down in 2022. I would also point out that the German regulator has indicated a risk of failure. I would ask very bluntly, when are we planning to plunge Europe into darkness.

Laurent Schmitt – It is true that we are currently playing with fire. I have not read this report, but within ENTSO-e we take production calculations country by country, then we compile them on a Europe-wide basis. We try to harmonise them to reflect capacities at the borders, and attempt to bring out a consensus on energy mixes to prevent countries over-investing and to produce a constructive dialogue. This is a very sensitive discussion, because the scenarios are very close to reality. We try to have the clearest view possible on the sequencing of these shutdowns but the situation is not clear, and therefore difficult. We produce seasonal outlooks that indicate the risk of failure of supply in certain regions. This is becoming ever more frequent and we are worried about the situation. We are working on new capacity market designs to try to give price signals.

Bertrand de l'Epinois – But who is responsible for ensuring that we have enough capacity in Europe to avoid such blackouts? Who is responsible for the scheduling?

Laurent Schmitt – That is the state's responsibility. Countries have differing strategies on security of supply. There is a dialogue between the regulator and the grid operator at national level. Each government takes its own view of the importance of assuring five-hour critical power. What price are they prepared to pay for it? They do not all agree. There are reports that summarise what exists in the way of interconnections but there is no clear overview of these electricity outages. No one has a clear overview in the case of a major outage or the failure of power plants. The clean energy package includes

a debate on the adequacy of production capacity. But this is very sensitive information, as hackers could have an impact on our system. Some TSOs do the calculations for their ministry. We do this for the Commission.

Bertrand de l'Epinois – Today our only motivation is the massive expansion of renewables. But we cannot have one single objective.

Laurent Schmitt – This is linked to the RTE work schedule. They are scenarios for identifying the right energy mix in ten years' time. FORATOM should have come to these meetings more regularly. We try to be as open as possible, to hold a dialogue with all stakeholders. We can carry out analyses of stress tests and identify needs for investing in grids. This is a bottom-up exercise, and nuclear has its place in these scenarios.

Jukka Laaksonen – You spoke of the need for flexibility in the grid. I went to northern Germany a few years ago. They were 100% up and running but there were sometimes peaks showing that high winds were blowing in northern Germany. What will happen if they close by 2022?

Laurent Schmitt – Unfortunately, given the trend, we know that we are in a cycle of overcapacity. We can expect breakdowns and failures in the older power plants. We are going to try to achieve as much flexibility in the future as possible. I hope this message can be passed on to the market. Make the most of the energy package, it's now or never!

Yves Desbazeille – Guy, what is the impact of the latest proposal put forward on the position of nuclear in the United Kingdom?

Guy Buckenham – It is much cheaper than anything wind power can offer. We should mention the costs and management of intermittency in the system. We have learned lessons from renewables in the United Kingdom. We can design technology and learn lessons to apply them to development, to lower costs. If there is competition for winning contracts, it's always conducted on the basis of lowering costs. You need to be as big as possible to keep costs down, even in renewables. Moreover, we have to demonstrate that we can deliver our promises and can do the building. The next power plant will obviously be cheaper. We need to learn the lessons of these projects to improve efficiency. We need to think more carefully about how funding can lower the costs of capital.

Yves Desbazeille – Thank you, everyone. I suggest that each speaker have a few minutes to sum up.

Jan Bartak – Our message is not getting through, we need NGOs and people outside the industry to help us get it through. Should we do more lobbying, collaborate with NGOs, or improve our own public relations message? I leave the question open.

Guy Buckenham – We need the right mix, which may vary from one country to another. Nuclear will have a major role to play.

Tuomo Huttunen – Market dysfunctionality is forcing the nuclear industry to revitalise itself. That is a good thing. The technicalities of building a nuclear power plant are complex and delays can mount up, resulting in high costs. The ETS market may benefit us, but it also benefits transport with the electrification of vehicles and even heating.

Jukka Laaksonen – We need to get the right message across to journalists and the general public. To do that we need to simplify our message to make it more accessible.

Laurent Schmitt – Transparency should prevail throughout the industry. Safety comes at a high price, we need to understand the costs. We need to stop thinking from the point of view of our own little world, and reinvent our business model. There is plenty to do, over to you to make it happen!

Provisional conclusions

Claude Fischer-Herzog, Director of ASCPE
Massimo Garribba, Nuclear Director in the European Commission's DG Energy

Claude Fischer-Herzog – First of all, I would like to say a big THANK YOU to the European Commission, which has supported the *Entretiens Européens* from day one. We don't always see eye to eye, but our biggest concern when discussing Community policies has always been to raise awareness of them and to offer a critical but constructive point of view. Once again, I would like to stress the importance of the work done by economists, who have provided us with some very interesting analyses and forward-looking proposals; however, I also want to underline the responsibility of operators in what is an excellent comparative debate between countries. The variety of countries represented (Germany, Belgium, Finland, France, Hungary, the United Kingdom, Russia, Sweden, and so on) is an asset; so too is the broad range of actors involved, as evidenced recently by the talks with ENTSO-e, the European Network of Transmission System Operators. These talks were so successful that I would like to suggest organising another session of the *Entretiens Européens* on the role of networks in diversifying low-carbon energy sources, and on the place of nuclear power as the jewel in the energy industry's crown.

Everyone agreed that nuclear energy must continue to form the fundamental energy base, upon which we develop renewables, reduce the use of gas, and eliminate coal altogether. But the base must be more flexible. Eliminating coal may seem an unrealistic goal, another option would be to help Poland diversify its energy mix. It has no suitable rivers and not enough sunshine or wind to develop renewables, so it will have to build a nuclear industry. But it is still waiting for investors to help it begin work in Pomerania[4].

Regarding nuclear and renewables, it is difficult to build a balanced model in Europe, let alone in the USA where fracking and Trump's attitude

[4] *See The 2013 Entretiens Européens held in Warsaw and decentralised to Krokowa in Pomerania.*

to climate change are upsetting targets, or in Africa, which will need all of its energy sources to «catch up» with other parts of the world. (Forbidding Africa from building nuclear plants while Germany has reopened seventeen and Europe is subsidising its coal until 2018 seems very arrogant on the part of northern countries, which voted against World Bank lending to build a plant in Burkina Faso). Africa, which is already working with China, will need Europe and its expertise to help its companies develop nuclear technology. Assuming that we manage to maintain that expertise!

As for costs and prices, we will need further clarification on those. We have made some progress, but more is needed. It's important because our economy and our industries depend on electricity prices, as Peter Claes, who represents electro-intensive industries, pointed out. These industries are demanding a balanced mix and incentives to stay in Europe. But what kind of incentives? When the IFIEC opposes a regulated market and advocates a liberalised market, there is a sense of looming conflict between market players who don't trust governments, and governments who don't trust market players! Yet Finland provides clear proof that it is better when they work together. As Tuomo Huttunen said, nuclear operators are private but they benefit from a strong legal framework. It is a good model, but is not easily transferable. In France, our companies are either state-run or parastatal; they depend upon the law which, let's face it, no longer promotes technology. The objective of halving the share of nuclear power in the energy mix by 2025 is unattainable, and it sends out the wrong political signal to companies and to the industry in Europe as a whole, which is also being discouraged! Unlike Russia's nuclear industry, which benefits from government subsidies and could not, according to Andrey Rozhdestvin, develop either internally or externally without them. ROSATOM has a strong presence in the European Union, and is pushing for greater cooperation.

I will end by talking about the market model. I would like to say thank you to Graham Weale who clearly, and without doublespeak, condemned the German model with some very revealing figures. We do not want that model: it's expensive and it pollutes the environment. We suggest a solidarity pact that shows due regard for our national assets and for European climate objectives: this means building a diversified, low-carbon energy mix, in which there is room for nuclear power to grow. What do operators need? Long-term visibility, which is not compatible with a liberalised market. In America, several states – which have reintroduced market regulations to protect their plants and jobs – are being hauled before the Court of Justice for breaching the Constitution. In Europe, the Commission allows contracts to be negotiated on a case by case basis, but this demands a lot of time and money. We are proposing a new market model with long-term contracts and a price signal that encourages investment, alongside the spot market and the capacity market.

Massimo Garribba – If Europe had as much energy as Claude, it wouldn't need energy! But I hope she won't mind if I don't entirely agree with everything she has just said.

First, I would like to remind you that the President of the European Commission said in his State of the Union address that the Commission was in the process of drafting a report that will be delivered to the European Council next spring. The report will discuss the role of the EURATOM treaty, how the treaty can be made more democratic, and how it fits in with the European system as a whole. At the same time, discussions are being held on the energy system. EURATOM has played a very important role in European energy regulation. Some of the key principles in the treaty must be incorporated into our European *acquis.*

I still believe that safety and competitiveness are not incompatible; you can't have one without the other. Some think the Commission does not concern itself with nuclear generation, but they are ignoring the facts. Mr Aszodi explained that the Commission voted on two projects, performed all possible verifications, and concluded that the project was right for Hungary's energy network. The project was therefore able to proceed.

The ITER project represents the future. It involves a completely different technology, and is the

largest project funded by the European Commission. It is therefore wrong to say that there have been no such debates within the Commission. Why proceed with ITER anyway? It's a kind of insurance policy against a world dominated exclusively by renewables. The nuclear industry lacks transparency, that's a fact; it's also the way many people feel. You have to relate to people at their level. That does not mean swamping them with technical information. It's a difficult path to follow, but it's very important that we do. We will review the industry at a later date, to see if it has changed or not. The industry must be safe to survive.

A few speakers have mentioned SMRs. Laurent Schmitt encouraged us to build smaller plants, and SMRs are smaller. Mr Huttunen explained that Finland is adjusting its regulatory framework to incorporate SMRs into its network, but many European countries are lagging behind in this area. Lastly, we are debating what should happen to the market over the next few years. The Commission has advised FORATOM to speak out and make its voice heard, as you are an important part of the electricity network. What would happen if nuclear energy were to disappear? We can't change overnight. The market should be shaped by operators, not by industry. Operators, generators and designers must all be involved in the debate, just as they are in other sectors. It's important that we get personally involved in the debate.

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ASCPE Les Entretiens Européens &Eurafricains

Rapprocher - Débattre - Fraterniser

ASCPE's main objective is to **bring closer** civi society players to discuss the issues surrounding the European construction, energy in particular, which is vitalin underpinning the development of our societies, and to discuss relations between Europe and Africa, putting our "otherness" to the test.

A consulting and training firm set up by Claude Fischer-Herzog, ASCPE debates questions facing society by bringing together the different economic and social players firstly at meetings and conferences and secondly by organising film viewings through film festival « Une semaine Eurafricaine au cinéma » (A Euro-African week for cinema).

The use of various communication channels, speaking at debates, images and the imaginary in the world of film are all part of ASCPE's desire to understand the challenges facing Europe and the world, to contribute towards finding solutions for them and allowing our societies to work together and **fraternize.**

Forming a network

The method used by ASCPE is to work on subjects upstream of the public debate, within working groups that bring together its various partners (companies, associations, regional authorities, universities or national and community institutions…). Problems are approached by examining the strategic and political decisions made by Europe and especially its aim to build an Energy Union, and its external relations, with Russia and Turkey in particular, and with Western Africa.

The ASCPE team heads up working groups and prepares *Les Entretiens Européens et Eurafricains* as well as publications with steering committees which are open to its partners. **This network formation** makes the most of the benefits of the skills and expertise brought by civil society players and opens up potential schools of thought and ideas for action in the public domain so as to contribute towards public policy reform and to create a Europe based on competitiveness and solidarity that is open to the world.

Les Entretiens Européens et Eurafricains

Les Entretiens Européens were created in 2002 to address the scientific, economic and social challenges of managing nuclear waste and, from 2007 onwards, those of the nuclear renaissance and safety stakes, in Europe and in the world. Then, the scope broadened to include societal questions associated with sustainable development: food and public health; sustainable mobility and clean cars; sustainable agriculture. Since 2010, the question of "societal ownership of nuclear energy" has been the subject of annual conferences (in Hungary, in Brussels with Russia, in Poland, in France in 2015 and in Brussels in 2016 on investment in nuclear with the support of the European Commission and numerous other players in the sector).

Les Entretiens Eurafricains were created in 2014 following the Civil Society Summit held on 6 March in partnership with Confrontations Europe on the subject of "Public/private dialogue for a new economic partnership between Europe and Western and Central Africa". The aim is to contribute towards forging new commercial and cooperation-based relations between stakeholders on both continents. The first meeting took place on 3 and 4 February 2016 in Ouagadougou: "Investing in Western Africa – developing and financing of projects on organised markets" and will be extended the 6th and 7th of March 2017 in Paris.

EURAFRIQUE 21 was born in Ouagadougou for all of West Africa: the association organizes «Eurafrican Meetings» and participates to the Entretiens Eurafricains.

EURAFRIQUE 21

La Lettre des Entretiens et Les Cahiers

La Lettre des Entretiens Européens was created in 2003. Eleven editions have been published upstream and downstream of the Entretiens Européens between 2003 and 2011 (in both French and English versions). From 2012 to 2014, ASCPE has helped to publish a number of issues of "L'Option" by Confrontations Europe, in association with the Entretiens Européens organised by ASCPE.

The new edition of *La Lettre des Entretiens Européens* appeared in June 2015.The issue of October 2016 was published on the subject «Investment in nuclear in Europe».

La Lettre des Entretiens Eurafricains is published twice a year.The first issue came out in January 2016, for the Entretiens Eurafricains in Ouagadougou on 16 and 17 December 2015. An issue « Supplément cinéma » was published.The third edition of La Lettre is in preparation for les Entretiens Européens in Paris on the 6th and 7th of March 2017

Les Cahiers restore the colloquiums organized every year on Energy and UE/Africa relations

Cinema and Eurafrique 21 supplements of the Letter are published.

Cinéma

Cinema is an excellent vector of knowledge of men and women in society, of their suffering and their aspirations. It helps us to be more open to the world. It was therefore only natural for cinema to find its way into ASCPE's initiatives, into discussions and action for a Europe that is reconciled and open to the world.

ASCPE is a partner of the **film festival "L'Europe autour de l'Europe"** produced by Evropa Film Akt, and directed by Irena Bilic.

A Euro-African week at the cinema in Paris: created by ASCPE in 2015 as part of the Entretiens Eurafricains, this mini festival is sponsored by « Vues d'Afrique » in Montreal and partenered with FESPACO. It will be organized in june by EURAFRICALP, the brand new association created by the Euro-African week's friends.»

The EUROPE 21 Seminar

ASCPE is a partner in this new seminar led by Philippe Herzog to exchange reflections on the future of Europe and its civilization in the context of globalization.

It is within this framework that ASCPE publishes the Essays and Notes in the form of books:

- The identity of Europe, towards a Refounding, by Philippe Herzog
- Combating inequality, a contribution by Philippe Herzog, followed by a text by Penda Mbow, the Spirit of Sant'egidio.

Website

For all updates and information, dates and times of group meetings and events, projects run by the Entretiens, minutes from meetings and conferences, publications, archives, and those of our partners, visit:

www.entretiens-europeens.org

The team

Headed by **Claude Fischer-Herzog**, the team is made up of an assistant director and editorial staff of the Lettres des Entretiens, staff in charge of missions and research, and advisors…

André-Franck Ahoyo, assistant director of the Entretiens Eurafricains;

Anaïs Bézanger, project manager, les Entretiens Européens;

Jacques Bosc, cultural advisor;

Aminata Kébé, research analyst, Les Entretiens Eurafricains;

Juliette Munsch, editorial secretary;

Catherine Véglio-Boileau, executive director of La Lettre des Entretiens Eurafricains;

Partners in 2017

ASCPE concludes agreements with its partners.The partners take part in the working groups, receive the synthesis reports and proceedings, speak at the conferences, write articles in the publications…

Partners Energy / Environment: ANDRA, CEA, DG Energie de la Commission européenne, EDF, ENGIE, FORATOM, INSTITUT DU BOSPHORE, ROSATOM, Sauvons Le Climat

Partners EU / Africa (s): 2iE, ABPCD, AGF, ANF (association du Notariat francophone), BPI France, ECOBANK, EIFFAGE, FNTP, IAM, L'OREAL, MABUCIG, MEAE (Ministère de l'Europe et des Affaires étrangères), OIF, ORANGE, Cabinet ORRICK, RTE, SCHNEIDER ELECTRIC, SEFI, SOCIETE GENERALE, SONAR

Cinema Partners: AfricaCultures, EVROPA FILM AKT, Le Studio des Ursulines, VIDEOSPHERE

Media and Civilisation Partners: AFRICA N°1, Business Africa, IC Publications, Leaders League, OV5TV, UP FOR HUMANNESS

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Nuclear Energy: Special Issue

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Les Entretiens Européens since 2003

- October 2016 in Brussels:
Investements in nuclear energy in Europe. 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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Penly nuclear plant, Normandy.

** Source: PWC report: The European Carbon Factor – Comparison of CO_2 emissions by Europe's largest power utilities. European average in 2014: 313 kg of CO_2/MWh – EDF France: 20 kg of CO_2/MWh.*