Business Future under EU Green Taxonomy

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CHAPTER 7

Chapter 1

Nuclear in the EU Taxonomy: a boost or a taboo?

Marco E. Ricotti

1. Introduction

At the end of 2021, after the European Commission decided to include both nuclear energy and natural gas into the so-called Green Taxonomy[1], a lively discussion emerged in several European countries around both the atomic and fossil options, and the more general EU policy on the ecologic transition.

Then, when in February 2022 the Russian-Ukrainian war began, a further issue attracted the attention of the citizens as well as of the policymakers: the EU energy independence or, to better say, resilience.

First of all, a flash recap on what Green Taxonomy is: the document that 'will guide and mobilize private investments in the activities that are necessary to achieve climate neutrality in the next 30 years'[2]. In other words,

1 https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en

2 Valdis Dombrovskis, European Commission Executive Vice-President, Press Release,

it will be the financial guide for the energy policies of European countries. It indicates the criteria, requirements, characteristics that projects, initiatives, and achievements in the energy sector must possess, in order to be recognised as «green», therefore deserving financial support.

The European Commission sent its proposal to the Group of Experts of the Member States, then collected their comments, substantially confirmed the political line, and eventually shared the final document with the European Council. Afterwards, it will be sent to the Parliament. The Council and the Parliament will have from 4 to 6 months to object and, if necessary, vote for the cancellation of the Commission's proposal, the former by qualified majority and the latter by simple majority.

Nuclear energy like the Phoenix, is re-emerging, as part of the answer to both global warming and energy independence challenges. Are we ready to seriously evaluate that option?

2. Rationale and debate around nuclear into the Green Taxonomy

What are the motivations behind the choice of the Commission? A technical one and a political one. Anyway, the former – quite surprisingly – is not enough to justify the final decision. To identify the rationale, let us remember some data about global warming, the World situation, and the European contribution.

Brussels, 21 April 2021.
https://ec.europa.eu/commission/presscorner/detail/en/ip_21_1804

In 2015 in Paris (COP25) a binding agreement was reached, to be updated every five years, in which the signing Countries undertake to reduce their emissions of greenhouse gases (GHG). On that occasion, it was evaluated as essential to reduce the increase in the Earth's average atmospheric within 1.5 °C, to avoid catastrophic effects on the climate. Finally, the COP26 in Glasgow, in November 2021, confirmed the commitment to achieve the so-called Carbon Neutrality by 2050.

To reach those goals, on which aspects should States intervene to be more effective?

According to IPCC[3] (Intergovernmental Panel on Climate Change) and other studies, such as those of the World Resources Institute[4], energy consumption is by far the main anthropogenic cause of GHG emissions, responsible for 76% worldwide. The energy sector includes the production of heat and electricity (32% of total emissions), transport (14%), industry and construction (13%).

But which are the energy sources that make the world spinning? Today we mainly consume oil (31%), coal (27%) and gas (25%), i.e., fossil fuels for more than 4/5 of our needs, above all to move, to warm up, to produce. Then also water (7%), nuclear (4%), wind (2.5%), solar (1.3%). The rest are biomass and geothermal.

Is Europe substantially different? No, but we're slightly better. Fossil fuels are still largely predominant: oil (37%), gas (25%), coal (11%), then among the sources that practically do not emit GHG, nuclear (11%), water (6%), wind (6%), solar (2%) and the rest still biomass and geothermal.

The EU, responsible for less than 10% of GHG emissions in the World, has declared very ambitious objectives: the 'Fit for 55'[5] policy alias the

3 'Intergovernmental Panel on Climate Change' (2022), IPCC, www.ipcc.ch

4 World Resources Institute (2022), www.wri.org

5 European Commission, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality, COM (2021) 550 final, Brussels, 14.7.2021

reduction of emissions by 55% by 2030 (compared to 1990 levels) and carbon neutrality by 2050. While China, India and Russia, the main GHG emitters (42% in total, while the United States 14%) have set the target for 2060-2070.

After the data, the technical motivation: the differences between fossil fuels and other sources are significant, when concerning emissions. In the IPCC documents[6], values of about 12 grams of CO2-equivalent emitted for each kWh produced with nuclear power or wind power are reported, a value that rises to double for hydroelectric and quadruple for photovoltaics. But almost negligible, when compared with the 490 grams from natural gas and 820 grams from coal.

It is not necessary to be an expert in the energy sector to understand, from the simple reading of all these data, two key reasons: why the need of an 'energy transition' is perceived, and why this is so demanding, in terms of time, costs, and technology.

The massive use of renewable sources is considered the winning strategy, by almost all the players involved: governments, experts, public opinion. The other arrow in the bow is nuclear energy. Tertium non datur.

The contribution of nuclear is far from negligible. Today nuclear energy[7] – with its 441 reactors in operation and 52 under construction – provides 10% of the total electricity in the World, but represents 28% of all low-carbon electricity. In Europe, on the other hand, with its 106 reactors nuclear energy represents 26% of electricity generation, but as much as 47% of the sustainable electricity produced in our continent: it is therefore by far the first «green» source, ahead of wind (13%), hydroelectric (12%), biomass (6%) and photovoltaic (4%).

The endeavour of decarbonisation promises to be immense. It is

6 O. Edenhofer et al. (2014), 'Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change', Chapter 7, IPCC, Cambridge University Press, Cambridge, UK.

7 IAEA, Power Reactors Information System: https://pris.iaea.org/pris/home.aspx

necessary to attack as much as 80% of the energy consumption pie, represented by fossil sources. By means of renewables and nuclear, which are anyway essentially used to produce electricity. To reduce emissions and to limit global warming, it is therefore necessary to produce electricity without burning gas and coal, but it is also necessary to electrify sectors hard-to-abate that today are minimally so: transportation (by moving to electric mobility) and industrial uses, as well as heating and domestic uses, all today firmly linked to fossil fuels, mainly oil and gas.

It would then have been reasonable to assume that it was a pragmatic and realistic reading of this overall framework, which prompted the European Commission to propose the completion of its Green Taxonomy, in the Complementary Climate Delegated Act[8]: 'considering that there is a role for natural gas and for nuclear power, as means to facilitate the transition towards a future based mainly on renewables'.

In fact, in this context, it does not appear reasonable to preclude the use of half of the green options available, ostracising nuclear power. But this scientific-technical reason, apparently incontrovertible, was not enough.

Finally, the political motivation. Among the criteria to be included in the Green Taxonomy there is not only low greenhouse gas emissions, but also sustainability, a necessary as complex criterion, since it is difficult to translate into requirements and numbers. In this regard, the taxonomy requires that the adoption of a specific technology must not cause significant damage ('do no significant harm', DNSH) to the ecosystem.

Renewable energy sources were already included in the first Delegated Act (2021): while it was quite straightforward to justify these features for them (albeit a thorough Life Cycle Assessment for critical minerals could suggest caution[9]), it was not so easy to reach a consensus on

8 https://ec.europa.eu/info/publications/220202-sustainable-finance-taxonomy-complementary-climate-delegated-act_en.

9 R. Pell, et al. (2019), 'Mineral processing simulation based-environmental life cycle assessment for rare earth project development', Journal of Environmental Management, Vol. 249

nuclear energy, also or above all due to the political conflicts that this choice entails.

The Technical Expert Group (TEG) for Sustainable Finance, charged with evaluating this criterion also for nuclear, declared its inability to reach a result. The Commission therefore asked the EU scientific organisation, the Joint Research Center (JRC), to take care of it. The result was a 385-pages technical-scientific report[10], published at the end of 2021, which substantiated the assessment that the nuclear source does not involve higher risks for humans and the environment than the other energy sources provided for in the taxonomy. The document contains data and evidence, supporting the ability to prevent or avoid any potential harmful impact in the various activities and phases related to nuclear power, including the risks associated with radiation and the fuel cycle and final waste management, finally indicating the corresponding criteria (Technical Screening Criteria) to be adopted in the taxonomy.

In reality, in addition to the technical aspects, the content of the European Commission document appears to be dictated by a political agreement between the two main players, Germany and France. Earlier on, in the past months, there was a bitter battle. Each one headed a group of countries and sent its own

Old and new reactors may play a significant role in a (renovated) EU energy strategy. From what nuclear technologies will a contribution come?

10 S. Abousahl, et al. (2021), 'Technical assessment of nuclear energy with respect to the 'do no significant harm' criteria of Regulation (EU) 2020/852 ('Taxonomy Regulation')', EUR 30777 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-40538-2, doi:10.2760/207251, JRC125953.

letter to the Commission. The former, against nuclear power in the taxonomy, was also signed by Austria, Denmark, Luxembourg and Spain. The latter, in favour of the recognition of the role for the atom, was co-signed by Finland and the Eastern European bloc (Czech Republic, Bulgaria, Croatia, Hungary, Poland, Romania, Slovakia, and Slovenia).

Their interests are clear. France is fully committed in keeping up-to-date and active its reactor fleet, which today guarantees over 70% of the electricity. Indeed, it is determined to expand it, as recently declared by President Emmanuel Macron who has included the 'new nuclear' even at the first point of the French post-pandemic strategy[11]. Germany, the main sponsor of the European green deal, is dutifully interested in reducing its CO2 emissions, since it is by far the most polluting country in EU (doubling Poland's emissions). However, it is still heavily dependent on fossil fuels – lignite in the first place – to produce electricity, and therefore it intends to replace coal with gas, which is less polluting, and easier to use than renewables. The Russian-German North Stream 2 gas pipeline would have precisely served this purpose.

3. Investing in nuclear: risks and opportunities of the current technology

Nuclear energy seems, then, an option that would be very difficult to give up. But which nuclear are we talking about?

First of all, the reactors fleet currently in operation, which is on average reaching the limit of its authorized commercial life, usually in the order of 30-40 years - period after which the reactors should be shut down and then dismantled. However, the safety margins adopted in the design phase, the quality of construction and good operational management, often make these machines still suitable for continuing production for a further 10-20 years, usually after some updating of the safety systems and after replacing some components with others with

11 "France 2030" Plan, official website: https://www.elysee.fr/emmanuel-macron/france2030.

improved performance. The most important and rapid contribution of nuclear power to decarbonisation will therefore come from the life extension of the so-called second-generation plants, namely those built in the period between the 70s and 90s.

A further contribution will hardly come from Generation III[12] reactors made in the Western World if something will not change. Most of the 52 reactors currently under construction were designed at the beginning of the new millennium, with improved safety systems and strategies, so they rightfully belong to the new course. These plants are still under construction (France and United States) or were recently completed (Finland) in the Western World, while they have already been built and are operational in China, Russia, South Korea, Japan, and even in the United Arab Emirates.

Between the two experiences (Western vs others), there is a substantial difference: the plants built in the West, with American (AP1000, 1100 MWe) and French (EPR, 1600 MWe) technologies, initially designed to be built in 5 years and require investments of about 4 billion euros, are suffering embarrassing delays of over 10-12 years and cost increases of around 200-300%. While the identical Western reactors, as well as similar Russian (AES-2006, 1200 MWe), Chinese (HPR1000, 1100 MWe) and Korean (APR1400, 1400 MWe) technologies, are already in operation in the Eastern World and the Middle-East, after very contained, 'physiological' delays and extra costs, being also in that case First-Of-A-Kind realizations like the Western ones.

The heavy difference in performance between Europe-United States and the rest of the World, on the deployment of identical or similar nuclear reactors, shows that the problem is not mainly in the technologies used, or in the quality of the constructions and the safety controls. The former is at state-of-the-art, the latter are rigorous. Thus, the difference relies essentially on poor management and

12 A. Kadak, (2017), 'A comparison of Advanced Nuclear Technologies', Columbia Univ., energypolicy.columbia.edu/sites/default/files/A Comparison of Nuclear Technologies 20033017.pdf

implementation skills. An easily justifiable weakness, for the West, because of the lack of building new nuclear reactors in the last twenty-thirty years, an enormous period for such a complex technology and supply chain. In contrast, the Russians, Chinese, and Koreans have deployed at least one or even two units a year in recent decades.

3.1. Investing in nuclear: next generation technologies

Besides the old GenII and the current GenIII fleets, other new technologies will become available in the coming years: Small Modular Reactors[13],[14] (SMR), Generation IV[15] reactors, fusion reactors.

Before briefly describing the reasons of interest in these new technologies, two clarifications are necessary on specific issues often discussed around nuclear power: safety, and radioactive waste. A clear explanation of data and motivations is written in the same JRC report, so here just two brief considerations will be exposed.

Regarding the very high nuclear safety level, compared to that of all other energy sources, the analysis contained in the report substantially confirms what has already been highlighted by other studies, such as those of the Swiss Paul Scherrer Institute. Updated statistics can also be found on online sites, such as that of Our World in Data[16], fed with data collected by Oxford researchers.

Regarding the management of highly hazardous radioactive waste, a first solution will be implemented shortly: between 2023 and 2025 in Onkalo, Finland, the first definitive deep geological repository[17] in the World will become operational, for the safe disposal of long-lived and highly radioactive waste, i.e., the spent fuel. After more than 15 years of

13 'Advances in Small Modular Reactor Technology Developments SMR booklet' (2020), IAEA, aris.iaea.org/Publications/SMR_Book_2020.pdf

14 'Small Modular Reactors: Challenges and Opportunities' (2022), OECD-Nuclear Energy Agency, 14 February, www.oecd-nea.org/jcms/pl_57979/small-modular-reactors-challenges-and-opportunities.

15 'Annual Report' (2020), Gen IV International Forum, www.gen-4.org/gif/jcms/c_178290/gif-2020-annual-report.

16 R. Hannah (2020), 'Sector by sector: where do global greenhouse gas emissions come from?', ourworldindata.org/ghg-emissions-by-sector.

17 S. El-Showk (2022), 'Final Resting Place', Science, 2 February, https://www.science.org/content/article/finland-built-tomb-store-nuclear-waste-can-it-survive-100000-years.

studies and measurements, the Finns will start using the repository, created by drilling tunnels at a depth of 500 m into the granite rock, judged by geologists to be stable and 'dry' for several million years, and therefore able to guarantee the safety of the artifacts to be disposed of, for at least 100 thousand years. Similar solutions are already underway in France, in Bure, while the Swedish government recently authorised the construction at the Forsmark site. Canada is also preparing to follow this path.

Moreover, to put the whole waste issue under the correct light, from Eurostat[18] (2018 data), it appears that the annual production of EU waste is equal to 2 billion tons, 100 million of which correspond to highly hazardous or toxic-harmful waste that 'could pose a high risk to human health and environment, if not managed and disposed of safely'. Within this share, radioactive waste represents about 0.5% and among them the truly dangerous, highly radioactive, and long-lived ones are less than 1%.

Downstream of this premise, we can outline the interesting features of the three innovative nuclear technologies.

The first is that of SMRs, already available in Russia and China but destined to mature by 2030: they are reactors of reduced size, usually between 100 and 300 MWe for each module, compared to the GenIII reactors in operation or under construction today, typically between 1200 and 1600 MWe.

SMRs are designed to be built largely in the workshop, i.e., in a smoother and more controlled environment, and then transported and assembled on site. This would guarantee more certain and reduced times and costs, therefore a lower financial risk. The staggered deployment, allowed by modularity, will also allow the self-financing effect. Above all, they will be more easily integrated into an energy system and an electricity grid that will be more complex and more

18 Eurostat, Waste Statistics (2018), https://ec.europa.eu/eurostat/statistics-explained/index.php?title= Waste_statistics.

demanding to manage, due to the strong presence of renewables, which are not programmable and therefore require energy storage solutions. The SMRs will also open up opportunities for cogeneration, such as district heating, water desalination, the production of bio-fuels and, last but not least, the production of hydrogen. The electricity and heat produced by the small reactors can therefore also be used for these objectives, offering certainty of production, programmability, high reliability, and cost stability. And of course, without emitting GHG.

Finally, the small size makes it possible to think of 'transportable' reactors in remote areas, where the environmental conditions are such as to make it difficult to build energy infrastructures and traditional plants, whether they are fossil fuel or renewable sources. This is the case of the two small reactors (KLT-40S[19]) the Russians mounted on a ship in St. Petersburg and transported to Chukotka, a mining area in the far east of Arctic Russia: the ship has docked in the bay and is supplying electricity and heat for homes and the mining site.

The second technological innovation will instead be available around 2035-2040: Generation IV reactors, very different from the current ones, which promise a further step forward in terms of safety and sustainability of the fuel cycle, especially through the burning of high radioactivity elements, a sort of recycling of the most dangerous waste. In this way, the duration of waste radiotoxicity will be drastically reduced, from over 100,000 years to less than 300 years. To achieve these objectives, reactors are being developed that are no longer cooled with water but with lead or liquid sodium, or with molten salts. As a rule, they will still use uranium as a fuel, but they will also be able to exploit thorium, more sustainable than uranium because it is much more abundant on the Earth's crust, and it is capable of producing much less highly radioactive waste. The first demonstration of this new recycling solution, the "Proryv" project[20], is already under construction in Russia and is expected to be completed by 2030.

19 'Akademik Lomonosov begins commercial operation' (2020), Nuclear Engineering International, May, https://www.neimagazine.com/news/newsakademik-lomonosov-begins-commercial-operation-7938482/

20 Rosatom, PRORYV project, official website: https://proryv2020.ru/en/

So far, the opportunities. But what are the challenges?

The timing of these new technologies appears compatible with that of the ecological transition, provided that some critical items will be duly addressed. They are essentially:

- the process and the time required to obtain the design and construction license from the Safety Authority, in each country in which the reactor is to be built;
- the preparation of an international industrial supply chain for the mass construction of SMRs;
- the availability of new materials needed for GenIV reactors;
- last, and more importantly, the demonstration of the promises on the field: building the first units on-time and on-budget.

Finally, the third and definitive nuclear technology: fusion. An important step in the path leading to the future commercial phase of fusion energy will be taken around 2028, the year scheduled for the ignition of the ITER[21] reactor, the large international project under construction in Cadarache, France and in which Europe is collaborating with China, South Korea, Japan, India, Russia and the United States. In 2035, ITER will also start producing tritium, the radioactive isotope of

A pragmatic approach to the energy dilemma, leads to recognise a European Nuclear Energy Strategy as needed. What, and at what conditions?

21 'Annual Report' (2020), ITER Organisation, www.iter.org/org/team/odg/comm/annual-reports.

hydrogen which represents 50% of the fuel needed to power the machine, the other half being made up of deuterium, another isotope of hydrogen but not radioactive and easily obtainable from water. Realistically, it seems difficult to think of having the first deployed fusion nuclear power plant connected to the grid before 2050. But this technology will not produce highly radioactive nuclear waste and will not have the critical features of fission reactors, i.e., the need to guarantee at least two levels of safety: systems for rapid shutdown and those for the rejection of residual heat.

To complete the picture on nuclear innovation, the atomic start-ups – something never seen in nuclear history, since the nuclear sector has always been the preserve of state companies or large groups. The news is, in the recent years several nuclear start-up companies emerged, sometimes from universities (e.g., NuScale[22], SPARC[23]), sometimes from R&D teams (e.g., USNC[24]). Some SMRs, GenIV and fusion reactor concepts flourished outside the big players, supported and nurtured by venture capitalists or big investors, like Bill Gates with TerraPower[25].

4. A roadmap for Europe

The landscape has changed. The novelty is represented by a different, more complete awareness of the role of energy: it is now evident how important it is, for its repercussions on the geo-political dependence of nations and for its impact on the costs and availability of many goods (including the essential ones, from home heating to food).

Some lessons can be learnt from the previously depicted scenario, to shape some recommendations for the implementation of the EU Green Taxonomy about nuclear and in general for the EU energy strategy.

22 NuScale project, official website: https://www.nuscalepower.com/.

23 SPARC project, official website: https://www.psfc.mit.edu/sparc.

24 Ultra Safe Nuclear Corporation, official website: https://usnc.com/.

25 TerraPower, NATRIUM project, official website: https://www.terrapower.com/.

An energy roadmap for Europe, adapted to current times, shall implement three recommendations:

The energy game is tough, and requires a pragmatic approach: ecologic transition shall be maintained as a strategic goal – also because global warming will not be suspended because of the war in Ukraine – but the resilience of Europe on the energy side shall be addressed as well, as an equally important goal; for that purpose, suitable Technical and Strategic Screening Criteria shall be identified, similarly to Green Taxonomy, in a holistic way by duly considering a lifecycle assessment and all impacts on key sensible items, like welfare, occupation, economy, dependence on critical materials, system costs.

The just and inclusive approach, needed to solve the complex energy equation, shall implement a technology neutral European energy policy, having GHG reduction and resilience as double polar star.

The EU shall identify and financially support, similarly to any other solution able to target the above mentioned double polar star, a European Nuclear Energy Strategy for the short, medium, and long term, based on:

the life-extension of the current (Generation II) nuclear fleet;

the re-design, optimisation, and stable plan for deployment of large, Generation III reactors;

the development and deployment, also at international level, of new European reactor technologies, namely SMRs and Generation IV reactors, for cogeneration, and also waste management purposes;

the confirmation of the EU support to fusion initiatives (namely ITER), with due attention to time and budget.

The main challenge is not technical or financial: it is only political. The feasibility of such a roadmap relies on the common recognition of nuclear as part of the answer, but also on the overcoming of vetoes (often coming from Germany, Austria, and Luxemburg), on investments and initiatives to support the development and deployment of new nuclear technologies, especially GenIII, SMRs and Gen IV reactors.

A 20-year life-extension for more than 100 Generation II nuclear reactors in EU represents a competitive and profitable business, since some hundred million euros investment in refurbishment, replacement and uprate, to obtain the new license, is a limited capital expenditure. The fuel and operation and maintenance costs are usually limited, as well, thus a large amount of CO2-free electricity will be produced for Europe at affordable costs.

Learning from non-Western countries and their ability to deploy GenIII reactors on-schedule and on-budget, it will be essential to proceed in EU with well time-distributed implementation plans, adequately preparing a European-level industrial supply chain, skilled in manufacturing and building nuclear plants, to be engaged on the next two decades.

France offers an example of such a program, possibly to be shared with other EU countries. La Republique has included nuclear energy at the top of its long-term energy strategy[26]: in addition to renewables, it programs new nuclear power plants, as done in the 70s after the world oil crisis. The French President declared the life extension strategy for the 56 nuclear reactors and the possibility of closing a plant – if necessary – but only for reasons related to its safety. Moreover, he announced the plan to build 6 new large-sized EPR2 reactors, a modified project compared to the current EPR that has shown some shadows in terms of construction time and costs. The first reactor of the new fleet is due to go into operation in 2035. At the same time, the feasibility study for another 8 reactors will be launched. The plan to 2050, as envisaged by the French electricity grid operator RTE[27], would confirm nuclear power at least at 36% of electricity needs, an important

26 'France 2030' Plan, official website: https://www.elysee.fr/emmanuel-macron/france2030.

27 'Futurs énergétiques 2050', RTE, https://www.rte-france.com/analyses-tendances-et-prospectives/bilan-previsionnel-2050-futurs-energetiques".

share (about half of the current share) despite a strong push towards renewables.

Small modular reactors are considered as well: the French scenario, which provides a total of 25 GW of new nuclear power by 2050, includes also from 5 to 7 Nuward[28] reactors.

The French approach could be followed soon by other European countries (e.g., Netherlands, Belgium).

Similarly to North America, Russia, and China, Europe owns all the capabilities, competences, and innovative ideas to become the land of new reactor technologies, from SMRs (e.g., Nuward) to GenIV (e.g., ALFRED[29], Gemini[30]) to micro reactors (e.g., Newcleo[31], Seaborg[32], Copenhagen Atomics[33]).

5. Conclusions

Nuclear energy shall be seen not as the optional and questionable choice of a single nation, but as part of a European energy strategy, with the same awards and the same supports of the other environmental-friendly sources and solutions. Europe shall embrace a technology neutral approach both on the issue of GHG and on the issue of resilience, looking at the technical-scientific-economic data of each energy source and corresponding supply chain. In the end, each country will continue to be free to choose its own energy mix, but within the framework of a European energy strategy that must be common, as it must be for defence and foreign policy, as it already is for

28 'French-developed SMR design unveiled' (2019), World Nuclear News, September, https://world-nuclear-news.org/Articles/French-developed-SMR-design-unveiled.

29 'Ansaldo Nucleare signs contract for lead-cooled reactor' (2021), Nuclear Engineering International, November, https://www.neimagazine.com/news/newsansaldo-nucleare-signs-contract-for-lead-cooled-reactor-9277875.

30 Gemini initiative, official website: https://gemini-initiative.com/.

31 Newcleo project, official website: https://www.newcleo.com/.

32 Seaborg project, official website: https://www.seaborg.com/.

33 Copenhagen Atomics project, official website: https://www.copenhagenatomics.com/.

money, finance and in some ways the economy.

About resilience, the strategic dependencies of Europe shall be duly considered. A strong signal comes directly from the European Commission, which in February 2022 issued a second report dedicated to that critical topic[34]: as an example, referring to energy sector, the document highlights that China owns 96% of the world production of wafers for solar panels, as well as 89% of magnesium, and 93% of the production of rare earths for the magnets used in wind power (including metallurgical patents).

As a comparison, an investment in nuclear power could fall around 70-80% within Europe, since almost all the technology and the industrial cycle is owned by European nuclear companies: from the intellectual property rights for the design and manufacturing of nuclear power plants, to the corresponding industrial capabilities for the deployment, to the enrichment and fabrication of the nuclear fuel. The uranium ore, needed to supply the reactors (anyway needed in vastly smaller quantities than fossil fuels by fossil fire power plants), can be obtained on the market from non-critical countries like Canada and Australia, even if some uranium deposits are available in our continent.

A serious challenge for a common European Nuclear Energy Strategy may come from Germany. Today, the somewhat schizophrenic German approach is catching the eyes: while 3 nuclear power plants were shut down in December 2021 and the last 3 in the country are going to be closed by the end of the current year, they are forced to reactivate old lignite power plants, the dirtiest coal in terms of emissions, to supply enough energy and to reduce Russian gas import. Indeed, even to the point of razing 17 villages near Düsseldorf, including a monastery from the 1400s, to make way for the expansion of the Garzweiler open pit coal mine.

Before the war in Ukraine, Deutschland was planning to substitute,

34 'EU strategic dependencies and capacities: second stage of in-depth reviews' SWD (2022), Commission Staff Working Document, 41 final. https://ec.europa.eu/docsroom/documents/48878/attachments/2/translations/en/renditions/native.

sooner or later, lignite with natural gas: not fully clean, but definitely a net gain in terms of GHG emissions. Now that geopolitics and energy resilience are two new keywords, how to solve the complex equation, without nuclear?

France may launch and foster a political as well as technological initiative, to set up and develop a European Nuclear Energy Strategy. Starting, for example, from the signatory countries of the letter supporting nuclear in the Green Taxonomy, opening to other EU nations available to consider innovative nuclear options, interested in finding a common solution to a common problem.

In the '70s the French, after the oil crisis, decided to seriously invest in nuclear power: in around just a decade, they developed their technology, creating the largest reactor fleet in Europe. Today, we can clearly see the benefits: they are the country that is furthest ahead in the ecological transition and owns the cheapest electricity production cost across Europe. Electricity that they use in their homes also for cooking and heating. They will not suffer like others in Europe, from the stratospheric cyclical increase in the price of natural gas.

This does not mean that we must retrace the example of the French. But at least draw some lessons from it.

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