

THE CHALLENGES TO NUCLEAR ENERGY AS A RENEWABLE ENERGY SOURCE

OS DESAFIOS DA ENERGIA NUCLEAR COMO FONTE DE ENERGIA RENOVÁVEL

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ABSTRACT: This paper discusses the decision not to stop the generation of electric energy by nuclear plants and the restart of coal plants in the European Union (EU) countries due to the interruption of the supply of natural gas from wells in Russia. Russia is the supplier of natural gas to the EU. Due to economic sanctions defined as a reaction to the Russian invasion of Ukraine, the Russian government decided to reduce and interrupt supplying EU countries with natural gas. Simultaneously, the United Nations classified nuclear energy as a sustainable energy source, and representatives from several countries opposed the decision. The outcomes presented reasons to disagree with the United Nations' classification and the World Nuclear Association's position.

Keywords: Renewable and clean energy; Nuclear energy; Invasion of Ukraine by Russia.

RESUMO: Este artigo discute a decisão de não interromper a geração de energia elétrica por usinas nucleares e o reinício de usinas a carvão nos países da União Europeia (UE) devido à interrupção do fornecimento de gás natural de poços na Rússia. A Rússia é o fornecedor de gás natural para a UE. Devido às sanções econômicas definidas como uma reação à invasão russa da Ucrânia, o governo russo decidiu reduzir e interromper o fornecimento de gás

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natural aos países da UE. Simultaneamente, as Nações Unidas classificaram a energia nuclear como uma fonte de energia sustentável, e representantes de vários países se opuseram à decisão. A conclusão apresentada razões para discordar da classificação das Nações Unidas e da posição da Associação Nuclear Mundial.

Palavras-chave: Energia renovável e limpa; Energia nuclear; Invasão da Ucrânia pela Rússia.

INTRODUCTION

The countries of the European Union are going through a period of shortage of energy sources due to Russia's current invasion of Ukraine. In retaliation against Russia, the member countries of the North Atlantic Treaty Organization - NATO decreed an economic blockade against Russia, which, as a consequence, temporarily paralysed and then reduced the gas supply to Europe. The gas sold by Russia supplies the industry and the population of the European Union (EU).

On the Green Deal, natural gas is the primary energy source to replace electricity-generating plants using highly polluting coal. Using natural gas supplied by Russia is also part of the European Union's program to discontinue nuclear power plants. Emphasis is also given to installing wind and photovoltaic power plants in substitution to non-renewable sources to reduce the emission of greenhouse gas - GHG, as part of the program, to reduce particulate pollutants, and to achieve climate neutrality.

The research analyses the news related to the use of nuclear energy in various locations around the world. The method is deductive to analyse the issue. To this do so, the first chapter presents the changes in Nuclear policies by the news; the second chapter presents the risks of nuclear power and how it functions with Spain's case study. And the third chapter, both info will be addressed.

The outcomes are: (i) there needs to be more agreement about classifying nuclear energy as a sustainable energy source due to the care required in the uranium storage process after use in nuclear plants, and (ii) nuclear energy is a non-renewable energy source. Although atomic energy plants do not emit many greenhouse gases when it is in operation generating electric energy, nuclear fuel is not unlimited and does not regenerate.

1 THE NEWS ANALYSIS

1.1 European Union Approves Nuclear and Gas as Sustainable Sources (DW, 2022)

The European Commission points out that nuclear plants should not stop electric energy generation. The proposal seeks a solution for the bloc to gradually achieve climate neutrality by 2050. The text, however, arouses criticism from environmentalists and countries like Germany, Austria, Luxemburg, Spain and others.

Despite criticism from the population, environmentalists and countries as appointed before, the European Commission approved on February (2022) the project that conceptualises nuclear energy and natural gas as sustainable energy sources - at least under certain conditions - within the bloc. Both will be included in the so-called taxonomy regulation, a UN classification system that aims to direct investments in the sector towards green energies.

Specifically, natural gas power plants, for example, will only be considered “green” if they do not exceed a CO₂ emission limit of 270 grams per kWh (kilowatts/hour) by the beginning of the 2030s to reduce their emissions by no later than 2035.

To be classified as green, new nuclear plants will have to obtain a construction and development permit before 2045. Furthermore, by 2050 the countries where they are built will have to have a plan and the necessary financial resources to dispose of radioactive waste safely.

1.2 In the absence of Russian gas, Germany resorts to “dirty energy”. (WREDE, 2022)

Since proposing the draft, the European Commission has made some adjustments to the text at the end of 2021. From approval to the entry into force of the legislation in two years, the member states of the European Union now have the opportunity to change points that they consider crucial. But that is unlikely, as it would require vetoes from 20 of the bloc’s 27 countries or an absolute majority in the European Parliament.

Environmental organisations view the text with skepticism and argue that the proposal could rightly compromise the EU’s goal of achieving climate neutrality by 2050. Climate Action Network Europe criticised that the Commission “sacrifices the scientific integrity of the taxonomy for the fossil and nuclear gas lobbies” and failed to “redirect financial flows towards genuinely climate-positive investments”.

And it’s not just climate activists criticising the project: energy experts

are concerned about “the environmental impacts it could result in”, as in the case of a nuclear accident. They also object that building new nuclear plants would take too long to contribute to the projected 2050 climate neutrality goals.

1.3 Germany rejects EU plan, calling nuclear energy ‘dangerous’ (EURO NEWS, 2022)

In the case of Germany, the main criticism is directed at nuclear energy since gas continues to be fundamental for the gradual replacement of coal, being classified as a “bridge” until green sources - such as solar and wind - can meet the country’s energy demand.

In recent decades, Germany has been at the scene of growing opposition to nuclear power since the disaster at Japan’s Fukushima plant in March 2011. On December 31, the country closed three of the six plants still in operation.

When it was announced in December that the project would be brought to the European Commission for consideration and vote, Germany’s Federal Deputy Chancellor Robert.

Habeck accused the EU of planning a “greenwash”, using climate-friendly policies to cover up destructive practices. “We cannot foresee approval for the European Commission’s new proposals,” said Habeck, affiliated with the Green Party.

Habeck called the intention to classify nuclear energy a sustainable mistake, pointing out the long-term effects of nuclear waste. “It is more than doubtful. It is questionable whether this ‘greenwashing’ will find any acceptance in the financial market.”

The green environment minister, Steffi Lemke, also criticised the plan: “I think it is completely wrong that the European Commission intends to classify nuclear energy as a sustainable economic activity.”

1.4 ‘Dangerous’: Germany, Spain and Austria Reject EU Nuclear Power Plant (TESSIER, 2022)

Throughout this news, it is possible to verify that while many talk about green and renewable energies, there is still considerable interest in nuclear sources in power generation and few exceptions.

According to Benoit Tessier, Germany, Spain, and Austria were against including nuclear power plants in the EU’s sustainable energy program in January 2022.

German government spokesman Steffen Hebestreit told a news

conference with a journalist in Berlin that Germany considers nuclear energy dangerous. Germany plans to shut down the three existing plants by the end of the year and 2030 to finish the coal plants, investing in the exploration of natural gas and other non-polluting alternatives.

However, environmentalists have criticised Germany for investing in natural gas, which, despite being cleaner than many alternatives, still produces carbon dioxide.

In response, the German spokesman said that natural gas will act as a “bridge” as Germany reaches carbon neutrality, set for 2045.

Austria’s Environment Minister Leonore Gewessler also criticised the proposal saying that nuclear plants are “the energy of the past” and “slow and expensive”.

Spain’s Minister of Ecological Transition said that regardless of whether or not investments will continue to be made in nuclear energy or natural gas, Spain does not consider these types of points green or sustainable.

For three EU countries, there is uncertainty about radioactive waste resulting from nuclear energy production, which is still the subject of scientific discussions. Consensus has yet to be reached on how to dispose of or reuse it (WORLD ENERGY COUNCIL, 2019).

2 IS IT POSSIBLE TO REDUCE THE POTENTIAL DISASTERS AND THEIR RESULTS IN THE CASE OF ACCIDENTS IN NUCLEAR PLANTS?

To generate electricity with nuclear energy, the so-called technological routes are defined. They use different techniques, have different implementation and production costs and depend on the geopolitical location.

Four are the characteristics of the technological routes used by nuclear power plants in operation:

1. Energy from fission neutrons, which use thermal neutrons or fast neutrons;
2. Neutron moderator, it is necessary to set the moderator to use thermal neutrons;
3. Fuel used, which may be enriched uranium or natural uranium
4. Reactor coolant, water or gas is used to reduce the core temperature.

Since the end of the Second World War, efforts have been applied to

increase the safety of these plants used to generate electricity.

Reducing the probability of nuclear accidents, regardless of causes such as equipment failures, external events to nuclear plants, and human recklessness, has been the main objective to ensure the expected operation of these facilities (ABRAM & ELSHAHAT, 2011).

Research is carried out on detecting leaks in the reactor's cooling systems, such as studying alternatives for emergency electrical and independent water supplies. Measures to avoid the concentration of explosive hydrogen mixtures in the containment dome and constant review of norms, procedures and operating practices of nuclear facilities are always the focus of the strategic and tactical management of those responsible and the sectoral associations (ABRAM & ELSHAHAT, 2011).

In the 1950s, with the launch of Generation I reactors, work began on research seeking the operational safety of nuclear plants. Currently, Generation IV reactors are in the final stage of development (ABRAM & ION, 2008). Now, Generation IV is in worldwide use. The 434 nuclear power plants that were operating in the world in 2013 had the following characteristics:

1. Pressurized Water Reactor - PWR is cooled and moderated with light pressurised water and uses enriched uranium as fuel.
2. Boiling Water Reactor - BWR is cooled and moderated in light boiling water and uses enriched uranium as fuel.
3. Light Water Graphite Reactor - LWGR cooled by boiling, graphite-moderated and using enriched uranium as fuel.
4. Heavy Water Reactor - HWR or Pressurized Heavy Water Reactor - PHWR cooled by light or heavy water, moderated by heavy water and using natural uranium as fuel.
5. Gas-Cooled Reactor - Gas-cooled and graphite-moderated GCRs.
6. Fast Breeder Reactors - FBR does not use moderators, and fissions happen with fast neutrons (ABRAM & ELSHAHAT, 2011).

The PHWR technology of nuclear reactors has comparative advantages regarding atomic plants' safety and reducing risks related to releasing radioactive material into the environment. Moreover, the cost of this technology is higher than other technologies (SANTOS, 2014).

2.1 SPANISH NUCLEAR POWER PLANTS' CASE STUDY

Spain currently has five active nuclear plants and seven inactive two nuclear plants in the decommissioning process. Spain's official site of Nuclear Energy is listed below.

1. Active Nuclear power plants:

1.1. Cofrentes Nuclear Plant located in Cofrentes, Valencia, with one reactor;

1.2. Trillo Nuclear Plant (Guadalajara), located between the cities of Trillo and Cofrentes, with two reactors;

1.3. Almaraz I and II Nuclear Plant, located in Almaraz, Cáceres, with two reactors; and

1.4. Vandellós-2, located in Tarragona, Catalonia, with one reactor.

2. Nuclear plants stopped, inactive or under construction:

2.1. Garoña Nuclear Plant, located in Santa Maria de Garoña, Burgos, was closed in 2015, with one reactor;

2.2. Lemóniz I and II Nuclear Plant, located in Lemóniz, Vizcaya. Built and paralyzed with one reactor;

2.3. Valdecaballeros I and II Nuclear Plant, located in Badajoz, paralyzed with one reactor;

2.4. Escatrón I and II Nuclear Plant, located in Zaragoza, approved in 1977, is not in production, with one reactor;

2.5. Santillan Nuclear Plant, located in Cantabria, paralyzed with one reactor;

2.6. Redola Nuclear Plant, located in Lugo, a construction permit was blocked with one reactor; and

2.7. Curriculo Nuclear Plant, located in Zamora, paralyzed with one reactor.

3. Nuclear power plants already dismantled or in the process of dismantling:

3.1. José Cabrera Nuclear Plant, located in Almonacid de Zorita, Guadalajara, dismantled, with one reactor; and

3.2. Vandellós Nuclear Plant, located in Tarragona, is dismantled with one reactor (ENERGIA NUCLEAR, 2018).

The primary production sources of the Spanish electricity system are

natural gas, nuclear energy, other energy sources (such as cogeneration, mini-hydro energy, biomass or waste) and finally, other renewable energies: hydraulic energy and wind energy. As informed by Oriol Planas (Dec 2021), Spain is one of the fourteen member states of the European Union that has nuclear power plants in operation (WORLD NUCLEAR ASSOCIATION, 2021). Nuclear energy represents more than 20% of the total electricity generation in Spain.

Nowadays, Spain imports all uranium nuclear fuel. However, Spain had several uranium mines managed by ENUSA, which have already been dismantled. According to World Nuclear Association (2021), most of the radioactive waste generated in Spain is of shallow, low and medium activity. Nuclear waste management is carried out in the centralized warehouse in El Cabril, on Córdoba.

According to the case study, be evident that EU countries do not want nuclear plants on their energy matrix. Spain prefers to follow renewable energy standards such as eolic or photovoltaic generation (SPAIN, 2020).

3 NUCLEAR ENERGY DISCUSSIONS ON THE TABLE

According to World Nuclear Association (2021), the contribution of nuclear energy to achieving the United Nations Sustainable Development Goals, particularly on SDO 7 - Affordable and clean energy. Nuclear power plants provide large amounts of clean, reliable, affordable energy; electricity demand is increasing, driven by a growing global population, increasing electrification of energy supply, and the needs of the billions of people who still don't have access to affordable and reliable electricity supplies; meeting this increasing demand for electricity by burning fossil fuels is not sustainable.

Switching to clean technologies such as nuclear energy is vital. If the world is to help lift people out of poverty and meet energy demand, then significant investment in low-cost, low-carbon nuclear power is needed (WORLD NUCLEAR ASSOCIATION, 2021).

Besides, the gas price increased in Spain. In the first months of 2022, gas prices in Europe rose fourfold and coal more than threefold from the same period in 2021, resulting in wholesale electricity prices more than tripling in many markets (DW, 2022). The price index for major global electricity wholesale markets reached twice the first-half average from 2016 to 2021. Europe is gearing up to reduce its reliance on Russian fossil fuel imports by

accelerating its clean energy transition (EURO NEWS, 2022).

Implementing the European Commission's REPowerEU plan would significantly accelerate the deployment of renewables in the coming years, doubling their share in EU gross final energy consumption from 2020 to 2030 and significantly reducing fossil fuel use. The continued energy price crisis is fueling debate on wholesale electricity market design, while governments are trying to cushion high electricity prices with various support schemes (ABNETT & JESSOP, 2022). As of beginning-2022, the EU expects global electricity demand growth in 2023 to remain on a similar path as this year.

The economists calculated those strong renewables growth of 8% and recovering nuclear generation could displace some gas and coal power, resulting in the electricity sector's CO₂ emissions decline by 1% (ABNETT & JESSOP, 2022). Due to the Russian invasion of Ukraine in February 2022 and the reactive actions taken by NATO countries, new events are changing the geopolitical energy scenario in the EU.

What is the impact? The EU resorts to "dirty energy" without Russian gas.

OUTCOMES AND FINDINGS

A review of current news about the United Nations' decision regarding the declaration of nuclear energy as clean energy was made, and the news point to the opposite reaction of representatives of the European Union member countries. The technical processes for constructing the types of nuclear reactors used in the plants were also reviewed. Nuclear fuel, primarily uranium, is a radioactive metal with severe implications for human health.

Therefore, it needs special care in its storage after use in nuclear power plants. EU member countries were already shutting down nuclear power plants and coal-fired power plants, with the replacement of these fossil fuels by natural gas, which, even being a fossil fuel in the process of generating electricity, generates less gas from the greenhouse effect than coal.

Due to the Russian invasion of Ukraine and the consequent economic restrictions imposed on Russia, the natural gas supply through the gas pipelines connecting Russian wells to EU countries was reduced and even interrupted. Therefore, the use of nuclear energy has been reconsidered, as well as coal for electricity generation, at least temporarily, in EU countries.

Despite World Nuclear Association's (2021) conclusion, all this does not mean that nuclear energy becomes a clean source of electricity generation.

Not even that the energy source used by nuclear power plants becomes renewable, but natural gas in thermoelectric power plants should only be used as a transition to clean and renewable sources. And the use of nuclear fuel (uranium) and mineral coal should be replaced in the medium and long term by renewable and clean sources, according to the agreements signed to achieve climate neutrality goals.

EU also planned actions to expand the use of renewable sources such as wind and photovoltaic generation, but the improvements are in the medium and long term worldwide.

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