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Monitored this issue:

The Swedish Government disregards the opinion of the Environmental Court and approves the repository for spent nuclear fuel

On 27 January 2022, the Swedish government took the decision to approve the planned repository for spent nuclear fuel in Forsmark without the nuclear power industry having been able to show that the copper canisters that are to guarantee safety for at least 100 000 years will work as intended. The Swedish NGO Office for Waste Review (MKG) as well as the member organisations the Swedish Society for Nature Conservation (SSNC), the Swedish Friends of the Earth and the local organisation “Oss” in Östhammar Community regret the decision and considers it irresponsible. The uncertainties that have been highlighted for decades about the chosen method’s most important barrier - the copper canister - have not been taken into due account in a serious way. This will probably result in a setback both economically and practically for industry in the future when the uncertainties can no longer be denied.

The Swedish Minister of Climate and Environment Annika Strandhäll (Social Democrat) announced on 27 January 2022 that the government had approved the license application from the nuclear waste company (SKB) from 2011 to build a repository for spent nuclear fuel at the Forsmark nuclear power plant, i.e., given permissibility according to the Environmental Code and permission under the Nuclear Activities Act. The continued legal process is that the application according to the Environmental Code must now be processed further by the Land and Environmental Court for a decision on a permit with conditions. In parallel the Swedish Radiation Safety Authority (SSM) must review a new safety analysis before a permit is granted to start construction of the repository. The spent nuclear fuel repository system also includes the construction of a copper encapsulation plant in connection to the intermediate storage facility for spent nuclear fuel, Clab, at the Oskarshamn nuclear power plant.

The decision means that warnings from independent and highly regarded corrosion researchers and the government’s own advisory scientific body, the Swedish Nuclear Waste Council, that more research is needed to ensure that the copper canister works have not been taken seriously by the government. This means that government decision was made despite uncertainties that are so great that radioactive leaks that affect humans and the environment can occur as early as in before 1 000 years. When the nuclear fuel repository is supposed to isolate the waste for at least 100 000 years.

The protective capacity of the copper canister is the most important feature of the method for a spent nuclear fuel repository chosen by the nuclear power industry. The uncertainties that the copper canister will function as intended in the planned repository have not been accepted by the Land and Environmental Court. In an opinion to the government according to the Environmental Code in January 2018 the court said that the application cannot be approved until it is shown that a number of degrading processes affecting the copper canisters are not a problem for long-term safety.

The regulatory authority SSM has since the summer of 2016 considered that the repository has “prerequisites to meet” the requirements for long-term safety. This is because there are also barriers of clay and rock in the repository system, so it does not matter exactly how the copper capsule functions in the repository environment. This also explains why SSM has not been so interested in following up the reporting of the results from the extensive corrosion in the LOT experiment in the Äspö Hard Rock Laboratory. The regulator SSM’s principal position that the function of the copper canister in in the repository for spent nuclear fuel is not necessary for the long-term safety also means that SSM’s approval of the supplement that the nuclear waste company SKB made to the government in the spring of 2019 on canister issues is not surprising. The approval was made even though SSM had access to its own review material from corrosion researchers at KTH who rejected the supplement.

The Swedish Society for Nature Conservation (SSNC) and the Swedish NGO Office for Nuclear Waste Review

(MKG), with the backing from opinions of independent scientific experts submitted to the government, is of the understanding that no fundamental new information on corrosions processes has been added by the nuclear waste company SKB in the government review. The supplementary information submitted was only a rehash of previous information and positions. Thus, the requirements of the Land and Environmental Court as defined in the opinion to the government have not been met. This means that the government has made a primarily political decision without regard to significant scientific shortcomings, which is worrying. The safety of the copper canister should have been a priority issue for the government and there was no reason to speed up a decision. Continued operation of the nuclear power plants is only dependent on the existence of an industry research plan for radioactive waste management. The nuclear power industry believes that the spent nuclear fuel can be stored safely in the intermediate storage facility Clab for a hundred years or more.

The Swedish Council for Nuclear Waste has in an opinion to the government in the beginning of December 2021 stated that requirements for continued research regarding the copper canister in a repository environment should be linked to a government decision on permissibility according to the Environmental Code. The council believes that new experiments are needed to study copper corrosion and cast-iron processes under repository conditions. The Minister of Climate and Environment did not mention the council's proposal when she announced the Government's decision, but stated more generally that further research can take place even after the decision. How such research can be carried out in a serious way when both the industry and the regulatory body lack interest in important issues is an obvious problem.

Severe copper corrosion on a copper plate after 20 years exposure to a repository environment in the LOT experiment in the Äspö Hard Rock Laboratory near the Oskarshamn nuclear power plant. The nuclear waste company SKB has refused to publish detailed corrosion results from the experiment and the regulator SSM has endorsed this unscientific behaviour. (Source: SKB report TR-20-14)

Annika Strandhäll took office as the new Minister of Climate and Environment on 30 November 2021. At the end of August, the government with the former Minister of the Environment and Climate Per Bolund (Green Party) took a separate decision to allow increased capacity in the intermediate storage facility for spent nuclear fuel, Clab, at the Oskarshamn nuclear power plant. Despite the decision, which ensured that there will be sufficient storage capacity so as not to threaten the continued operation of nuclear power, pressure remained on the previous government to take a quick decision on the nuclear fuel repository. The political opposition threatened with a motion of censure against Minister Per Bolund and continued to threaten Minister Annika Strandhäll. This should not have affected such an important decision as the nuclear fuel repository decision that affects so many generations to come. The nuclear fuel repository must be safe for 100,000 years.

The government should have taken more account of independent scientific criticism and the evidentiary requirements of the Environmental Code. As science continues to work independently of political decisions, MKG and its member organisations believe that it is likely that the project will still be stopped in the future. The risk that the money needed to find a better long-term waste management option will be wasted on the wrong technology is evident.

When it turns out that the project cannot be continued, a focus must be placed on both investigating alternative canister materials and quickly investigating the possibilities of instead using the method deep boreholes with deposition of the spent nuclear fuel at a depth of between 3-5 km. The method can be environmentally safer, gives less risk of intrusion and can also be less costly than storage in mined tunnels.

Johan Swahn, director MKG,
Swedish NGO Office for Nuclear Waste Review

Nuclear power's future is grimmer than it has ever been

Nuclear power declined in 2021 and the industry's future is grimmer than it has ever been.

The decline was marginal (<1 percent): a net loss of two power reactors (six start-ups and eight permanent closures)[1] and a net loss of 2.5 gigawatts (GW) of nuclear capacity.[2]

The marginal decline makes for a striking contract with renewables. The International Energy Agency calculates that new renewable capacity added in 2021 amounted to nearly 290 GW.[3]

Nuclear power's contribution to global electricity supply has fallen from a peak of 17.5 percent in 1996 to 10.1 percent in 2020.[4] Renewables reached an estimated 29 percent share of global electricity generation in 2020, a record share.[5]

The ageing of the world's reactor fleet is a huge problem for the nuclear industry, as is the ageing of its workforce – the silver tsunami.[6] The average age of the world's reactor fleet continues to rise and by mid-2021 reached 30.9 years.[4] The mean age of the 23 reactors shut down between 2016 and 2020 was 42.[6] years.[4]

Primarily because of the ageing of the reactor fleet, the International Atomic Energy Agency estimates up to 139 GW of lost nuclear capacity from 2018–2030 due to permanent reactor shutdowns, and a further loss of up to 186 GW from 2030–2050.[7]

So the industry needs about 10 new power reactors (or 10 GW) each year just to maintain its 30-year pattern of stagnation. And there were indeed 10 reactor construction starts (8.8 GW) in 2021, six of them in China.[8]

But the average annual number of construction starts since 2014 has been just 5.1. Thus, slow decline of nuclear power is the most likely outcome. An extension of the 30-year pattern of stagnation is possible, if and only if China does the heavy lifting. China has averaged just 2.5 reactor construction starts per year since 2011 (26 in 11 years).[9]

Phasing our nuclear power

The number of countries phasing out nuclear power steadily grows and now includes the following:

- Germany: Fourteen reactors have shut down since the 2011 Fukushima disaster and the final three reactors will close this year.[10]
- Belgium: The country's seven ageing reactors will all be closed by the end of 2025.[11]
- Taiwan: Final reactor closure scheduled for 2025. Four reactors were shut down from 2018 to 2021 and only two remain operational.[12]
- Spain: Nuclear power capacity is expected to decline from 7.1 GW in 2020 to 3 GW in 2030 with the final reactor closure in 2035.[13]
- Switzerland: The government accepted the results of a 2017 referendum which supported a ban on new reactors and thus a gradual phase-out is underway.[14] The Mühleberg reactor was shut down in 2019 and most or all of the remaining four ageing reactors are likely to be shut down over the next decade.

South Korea: Long-term (2060) phase–out policy with concrete actions already taken including the shut-down of the Kori-1 and Wolsong-1 reactors in 2017 and 2019 respectively, and suspension or cancellation of plans for six further reactors.[15] The current plan is to reduce the number of reactors from a peak of 26 in 2024 to 17 in 2034.

Too cheap to meter or too expensive to matter?

Despite the abundance of evidence that nuclear power is hopelessly uncompetitive compared to renewables, the nuclear industry and some of its supporters continue to claim otherwise.

Those economic claims are typically based on implausible cost projections for non-existent 'Generation IV' reactor concepts.[16] Moreover, the nuclear lobby's claims about the cost of renewables are just as ridiculous.[17]

The nuclear lobby's claims don't square with reality Lazard's October 2021 report on levelised costs of electricity provides these figures:[18]

	Levelised cost of electricity US$ / MWh
Nuclear	131–204
Wind – onshore	26–50
Solar PV – rooftop residential	147–221
Solar PV – rooftop commercial and industrial	67–180
Solar PV – community	59–91
Solar PV – crystalline utility scale	30–41
Solar PV – thin film utility scale	28–37
Solar thermal tower with storage	126–156
Geothermal	56–93

(The nuclear cost is comparable to rooftop residential solar PV, but the latter does not require large downstream costs such as transmission from a power plant.)

Claims about 'cheap' nuclear power certainly don't consider real-world nuclear construction projects. Every power reactor construction project in Western Europe and the US over the past decade has been a disaster.

The V.C. Summer project in South Carolina (two AP1000 reactors) was abandoned after the expenditure of at least US$9 billion leading Westinghouse to file for bankruptcy in 2017.[19] Criminal investigations and prosecutions related to the project are ongoing[20], and bailout programs to prolong operation of ageing reactors are also mired in corruption.[21]

The only remaining reactor construction project in the US is the Vogtle project in Georgia (two AP1000 reactors). The current cost estimate of US$27–30+ billion is twice the estimate when construction began.[22] Costs continue to increase[23] and the project only survives because of multi-billion-dollar taxpayer bailouts.[24] The project is six years behind schedule.

In 2006, Westinghouse said it could build an AP1000 reactor for as little as US$1.4 billion[25], 10 times lower than the current estimate for Vogtle.

The Watts Bar 2 reactor in Tennessee began operation in 2016, 43 years after construction began.[26] That is the only power reactor start-up in the US over the past quarter-century. The previous start-up was Watts Bar 1, completed in 1996 after a 23-year construction period.[27]

In 2021, TVA abandoned the unfinished Bellefonte nuclear plant in Alabama, 47 years after construction began and following the expenditure of an estimated US$5.8 billion.[28]

There have been no other power reactor construction projects in the US over the past 25 years other than those listed above. Numerous other reactor projects were abandoned before construction began, some following the expenditure of hundreds of millions of dollars.

Western Europe

The only current reactor construction project in France is one EPR reactor under construction at Flamanville. The current cost estimate of €19.1 billion is 5.8 times greater than the original estimate.[29] The Flamanville reactor is 11 years behind schedule: construction began in 2007, and the original estimated start-up date of 2012 has been pushed back to 2023.

The only reactor construction project in the UK comprises two EPR reactors under construction at Hinkley Point. In the late 2000s, the estimated construction cost for one EPR reactor in the UK was £2 billion.[30] The current cost estimate for two EPR reactors at Hinkley Point is £22–23 billion[31], over five times greater than the initial estimate of £2 billion per reactor.

In 2007, EDF boasted that Britons would be using electricity from an EPR reactor at Hinkley Point to cook their Christmas turkeys in 2017, but construction didn't even begin until 2018.[32] One EPR reactor (Olkiluoto-3) is under construction in Finland. The current cost estimate of about €11 billion is 3.7 times greater than the original estimate of €3 billion.[33] Olkiluoto-3 is 13 years behind schedule.[34]

Nuclear power is growing in a few countries, but only barely. China is said to be the industry's shining light but nuclear growth has been modest over the past decade and it is paltry compared to renewables: 2 GW of nuclear power capacity added in 2020 (and 2.3 GW in 20219) compared to 135 GW of renewables added in 2020.[35]

There were only three power reactor construction starts in Russia in the decade from 2011 to 2020[36], and only four in India.[37]

Small modular reactors

Small modular reactors (SMRs) are heavily promoted but construction projects are few and far between and have exhibited disastrous cost overruns and multi-year delays.[38]

It should be noted that none of the projects discussed below meet the 'modular' definition of serial factory production of reactor components, which could potentially drive down costs. Using that definition, no SMRs have ever been built and no country, company or utility is building the infrastructure for SMR construction.

In 2004, when the CAREM SMR in Argentina was in the planning stage, Argentina's Bariloche Atomic Center estimated an overnight cost of US$1.0 billion / GW for an integrated 300 megawatt (MW) plant, while acknowledging that to achieve such a cost would be a "very difficult task".[39] Now, the cost estimate is more than 20 times greater at US$23.4 billion / GW (US$750 million for a 32 MW reactor).[40] The project is seven years behind schedule and costs will likely increase further.

Russia's 70 MW floating nuclear power plant is said to be the only operating SMR anywhere in the world (although it doesn't fit the 'modular' definition of serial factory production). The construction cost increased six-fold from 6 billion rubles to 37 billion rubles, equivalent to US$7.0 billion / GW.[41] The construction project was nine years behind schedule.

According to the OECD's Nuclear Energy Agency, electricity produced by the Russian floating plant costs an estimated US$200 / MWh, with the high cost due to large staffing requirements, high fuel costs, and resources required to maintain the barge and coastal infrastructure.[42] The cost of electricity produced by the Russian plant exceeds costs from large reactors (US$131–204 / MWh18) even though SMRs are being promoted as the solution to the exorbitant costs of large nuclear plants.

SMRs are being promoted as important potential contributors to climate change abatement but the primary purpose of the Russian plant is to power fossil fuel mining operations in the Arctic.[43]

A 2016 report said that the estimated construction cost of China's demonstration 210 MW high-temperature gas-cooled reactor (HTGR) is about US$5 billion / GW and that cost increases have arisen from higher material and component costs, increases in labour costs, and project delays.[44] The World Nuclear Association states that the cost is US$6 billion / GW.[45] Those figures are 2–3 times higher than the US$2 billion / GW estimate in a 2009 paper by Tsinghua University researchers.[46]

China's HTGR was partially grid-connected in late-2021 and full connection will take place in early 2022.[47]

China reportedly plans to upscale the HTGR design to 655 MW (three reactor modules feeding one turbine). China's Institute of Nuclear and New Energy Technology at Tsinghua University expects the cost of a 655 MW HTGR will be 15–20 percent higher than the cost of a conventional 600 MW pressurised water reactor.[48]

NucNet reported in 2020 that China's State Nuclear Power Technology Corp dropped plans to manufacture 20 additional HTGR units after levelised cost of electricity estimates rose to levels higher than a conventional pressurised water reactor such as China's indigenous Hualong One.[49] Likewise, the World Nuclear Association states that plans for 18 additional HTGRs at the same site as the demonstration plant have been "dropped".[50]

The World Nuclear Association lists just two other SMR construction projects other than those listed above.[51]

In July 2021, China National Nuclear Corporation (CNNC) New Energy Corporation began construction of the 125 MW pressurised water reactor ACP100.[52] According to CNNC, construction costs per kilowatt will be twice the cost of large reactors, and the levelised cost of electricity will be 50 percent higher than large reactors.[53]

In June 2021, construction of the 300 MW demonstration lead-cooled BREST fast reactor began in Russia. In 2012, the estimated cost for the reactor and associated facilities was 42 billion rubles (US$560)[54], but the cost estimate has more than doubled and now stands at 100 billion rubles (US$1.3 billion).[55]

SMR hype

Much more could be said about the proliferation of SMRs in the 'planning' stage[56], and the accompanying hype.[57] For example a recent review asserts that more than 30 demonstrations of 'advanced' reactor designs are in progress across the globe.[58] In fact, few have progressed beyond the planning stage, and few will. Private-sector funding has been scant and taxpayer funding has generally been well short of that required for SMR construction projects to proceed.[59]

Large taxpayer subsidies might get some projects, such as the NuScale project in the US[60] or the Rolls-Royce mid-sized reactor project in the UK[61], to the construction stage. Or they may join the growing list of abandoned SMR projects.[62]

A failed history of small reactor projects.[63] A handful of recent construction projects, most subject to major cost overruns and multi-year delays. And the possibility of a small number of SMR construction projects over the next decade. Clearly the hype surrounding SMRs lacks justification.

Everything that is promising about SMRs belongs in the never-never; everything in the real-world is expensive and over-budget, slow and behind schedule. Moreover, there are disturbing, multifaceted connections between SMR projects and nuclear weapons proliferation[64], and between SMRs and fossil fuel mining.[65]

Enthusiasts hope that nuclear power's cost competitiveness will improve, but in all likelihood it will continue to worsen. Alone among energy sources, nuclear power becomes more expensive over time, or in other words it has a negative learning curve.[66]

Dr Jim Green is the national nuclear campaigner with Friends of the Earth Australia and the author of a recent report on nuclear power's economic crisis, posted at https://nuclear.foe.org.au/economics

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Ignoring feedback, the European Commission left the Taxonomy Draft Delegated Act contaminated with nuclear and gas

Nuclear in the taxonomy – first review of the Complementary Delegated Regulation

The European Commission took its decision on the Complementary Delegated Act to set up the criteria for including nuclear energy and gas. Both have not made it into the Green but at least the transitional category. With this decision the European Commission contradicts the very idea of the Green investment guide; a scientific process ended with a dirty political compromise.

The EU Taxonomy which was supposed to give clear guidance on sustainable investments now includes nuclear and gas unless the European Parliament or EU member states block this proposal put forward by the EC today.

The first part of this paper gives an overview, the second looks in greater detail into the regulation and the criteria for nuclear.

Next steps before the Draft Regulation will be final and could enter into force

The European Parliament is expected to start the debate in preparation for the voting in plenary in the upcoming weeks, simple majority is sufficient to block the CDA. Since in the EU Council on the other hand only a few countries oppose the draft and will vote against, the draft might simply be accepted without being put up for voting in the next four month of the scrutiny period. Amendments are not possible in the procedure of passing a Delegated Regulation.

Legal challenges ahead

1. With this inclusion of nuclear energy, the EC might have decided on a highly contested and certainly not minor issue and thus exceeded its competence with this delegated act according to Article 290 TFEU: "*A legislative act may delegate to the Commission the power to adopt non-legislative acts of general application to supplement or amend certain non-essential elements of the legislative act.*

   The European Parliament already raised this issue and several Members of Parliament consider taking the CDA the European Court of Justice (ECJ).

2. As already announced in the past weeks, the Austrian government intends to challenge the CDA for including nuclear energy which is violating the Taxonomy Regulation (EU) 2020/852. The arguments will be based on nuclear energy not fulfilling the provisions, e. g.: "(…) *the first criterion of Article 10(1) and (2) TR set out three exhaustive categories of activities that may be considered as contributing substantially to climate change mitigation. Generating nuclear power does not fall under any of these categories. Although it is frequently considered a low-carbon activity, this is as such not sufficient to satisfy the criteria laid down by the Union legislature.*[1]

Strong criticism of stakeholders and little enthusiasm in the financial sector

Th process started with the TEG's (Technical Expert Group) report suggesting scientifically substantiated Taxonomy Regulation criteria in 2020: *"[…] it was not possible for TEG, nor its members, to conclude that the nuclear energy value chain does not cause significant harm to other environmental objectives on the time scales in question. The TEG has therefore not recommended the inclusion of nuclear energy in the Taxonomy at this stage*." Since then, massive nuclear lobbying has been ongoing to include nuclear energy production in the taxonomy.

Several members of the EP from all political groups, NGOs but also member states made clear they are not satisfied with the process the EC chose, they complained about the lack of public consultations, as did Finland and Sweden in their joint letter dated February 1 stating "*that a public consultation concerning the draft would have been justified. We would like to stress the importance of a more transparent and inclusive process in future work, to ensure trust in and the usefulness of the Taxonomy.*"

The EC's advisory body, the Platform on Sustainable Finance, outright declared in its 24 January statement, that "*the draft CDA activities are not in line with the Taxonomy Regulation"* and the experts continued by saying that "(…) *Platform members have doubts about how the draft criteria would work in practice and many are deeply concerned about the environmental impacts that may result*."

Will the taxonomy start a nuclear power investment boom?

This may be doubted for several reasons. On the one hand the well-known risks of nuclear have not been solved (high investment cost, enormous construction overrun, technical problem even with existing NPP as in France currently, etc.). On top the new conditions make the operators even more dependent on the political conditions in their country, e. g. reliable plan and funding of search and construction of the final repository until 2050. This risk will also be passed on to the financial institutions who will have to ensure that their investments and financial products are taxonomy-aligned. The EC announced that some supervision systems, external auditors, as well as national authorities and finally fines or sanctions will be involved. It is possible that there will be sanctions if the repository plan announced at first will be withdrawn later a few years later, thus the NPP is retro-actively not taxonomy compatible. Reporting will have to be two-fold, investment with gas and/or nuclear or without. The goal of having clear rules and a large liquid Green investments market was the goal, which the EC now abandoned. Many asset managers, banks and even the EU's own bank, the

European Investment Bank (EIB) already announced they will not apply the taxonomy, because they don't intend to finance nuclear energy projects.

EU Taxonomy

The taxonomy established an EU-wide classification system for sustainable activities by introducing criteria for sustainable investment.

For an activity or project to be taxonomy-aligned it needs to make substantial contribution to at least one of the six environmental objectives, and to fulfil the "Do No Significant Harm (DNSH)" criteria when it comes to other goals:

- Climate change mitigation
- Climate change adaptation
- The sustainable use and protection of water and marine resources
- The transition to a circular economy
- Pollution prevention and control
- The protection and restoration of biodiversity and ecosystems

Nuclear in the Complementary Delegated Regulation - overview

The European Commission approved in principle and issued the "*COMMISSION DELEGATED REGULATION (EU) …/... of XXX amending Delegated Regulation (EU) 2021/2139 as regards economic activities in certain energy sectors and Delegated Regulation (EU) 2021/2178 as regards specific public disclosures for those economic activities. Brussels, XXX C(2022) 631/3*" (in short: CDA) on 2 Feb 2022.

Three types of nuclear activities are included in the EU Taxonomy:

- 4.26: Pre-commercial stages of advances technologies to produce energy from nuclear processes with minimal waste from the fuel cycle:
  This activity includes **new reactor technologies**, also the often mentioned SMR
- 4.27: Construction and safe operation of new nuclear power plants, for the generation of electricity or heat, including for hydrogen production, using best-available technologies:
  New NPP for which the construction permit has been issued by 2045 by Member States' authorities as well as their safety upgrades are included.
- 4.28: Electricity generation from nuclear energy in existing installations:
  Modifications of existing NPP with the purpose of extending their service time authorized by Member States' authorities by 2040

Some criteria for nuclear activities in detail:

1. Member States have to comply with applicable legislation

According to general criteria defined in the CDA, Member States need to fulfil the following legislation: EURATOM Treaty and its secondary legislation, in particular the **Nuclear Safety Directive** 2009/71/Euratom, **the Nuclear Waste Directive** 2011/70/Euratom and the Basic Safety Standards Directive 2013/59/Euratom; also EU environmental law, in particular the **EU EIA-Directive** 2011/92/EU and the Water Directive 2000/60/EC.

Assessment: It should go without saying that Member States comply with applicable law. But this is not the case. The high number of infringement procedures on non-compliance shows that most Member States cannot fulfil this criterion[2]:

- 35 active cases on the transposition of the Nuclear Waste Directive 2011/70/Euratom
- 19 active cases on the transposition of the Basic Safety Standards Directive 2013/59/Euratom

Missing criteria: Sustainable activities should have undergone an assessment of their impact on the environment beforehand. For this, legal instruments exist that have not been included in the CDA yet. These legal instruments are – besides the EU Environmental Impact Assessment (EIA) Directive – the Strategic Environmental Assessment (SEA)-Directive of the EU, and on international level the Espoo Convention and the Aarhus Convention (the EU and all of its Member States are parties to both Conventions).

This would be especially important concerning the environmental impacts of life-time extensions of NPP and the nuclear waste management strategies of Member States.

- Life-time extensions of NPP have to be subjected to an EIA according to the Espoo Guidance from Dec 2021; the provisions of the Espoo Convention have to be fulfilled by the Member States. The Espoo Convention has to be listed in the CDA as a legal document that has to be fulfilled by Member States as a precondition to have their life-time extended NPP in the scope of the taxonomy; Member States have to conduct an EIA before life-time extension of their NPP is authorized.
- Nuclear waste management programmes are plans in the scope of the EU SEA Directive. Nevertheless, many Member States have not conducted a SEA on their national programmes. Therefore, environmental impacts of the programmes were not assessed adequately, and the public was not able to participate.

2. Final repository for high radioactive waste (HLW) until 2050

New NPP, pre-commercial advanced NPP and NPP which underwent life-time extension that are authorized after 2025 are obliged to have a plan to have an operating HLW repository by 2050. The CDA describes this criterion more in detail that the draft CDA. Member states have to describe concepts and technical solutions for spent fuel and radioactive waste from generation to disposal; concepts for the post-closure period; the responsibilities for the implementation and key performance indicators; and the cost assessments and financing schemes.

Assessment: Putting more pressure on Member States to work on solving their nuclear waste problems is per se welcomed as the management of nuclear waste in the EU is in general characterized by missing realistic plans, unclear responsibilities, hefty delays and lack of funding.

There is no operating final repository for spent fuel and other HLW yet. According to the EC's assessment report of 2019 on Member States' implementation of their national nuclear waste management programmes[3], only four member states with NPPs are planning to have a final repository in operation by 2050: Finland, France, Sweden and Germany, however, this cannot be seen as a fact. The other EU Member States plan to have a final repository for HLW ready long after 2050 or do not have any plans at all yet.

Clearly this criterion is meant only for existing NPP which will be granted a life-time extension after the year 2025.

3. Nuclear safety

The CDA sets a criterion for nuclear projects fully to apply the best available technology and accident tolerant fuel; accident-tolerant fuel however is not commercially available in the EU and led the EC to change the deadline to 2025 on, both for new and existing NPP.

Assessment: Besides the unsolved nuclear waste problem which will last for one million years, severe nuclear accidents can never be excluded, thus making nuclear power generation unsustainable. Severe nuclear accidents result in significant long-term health consequences, amongst them latent fatalities. But even when cancer or other severe illnesses do not cause premature death, loss in quality of life occurs. Especially old NPP have higher risks for severe accident. "*Reasonably practicable safety improvement*", as required in the CDA, is a very vague description as old reactor designs cannot be brought to today's safety standards.

While unintentional man-made hazards are included in the set of general criteria, nuclear security is not included in the CDA. Terroristic acts cannot be excluded when it comes to nuclear safety.

4. Funds for nuclear waste management and Deep Geological Repository construction

Member States need to have established a radioactive waste management fund and a decommissioning fund when a new NPP, a new pre-commercial advanced NPP or a life-time extension of an existing NPP is approved. Moreover, the Member States need to demonstrate that these resources will be available at the end of the operation time.

Assessment: As no final repository for HLW is in operation yet, the costs for such a facility are not clear and can only be estimated for the time being. With its 2019 report on Member States' implementation of the Nuclear Waste Directive, the EC confirmed what is widely been known by independent experts and suspected by the public: many member states do not have reliable data about the future costs of their nuclear programmes´ back-end and certainly do not have the financial means to cover them. That the necessary funding for the construction of the DGR (Deep Geological Repository) would be available cannot be guaranteed even if starting today the funds were sufficiently financed.

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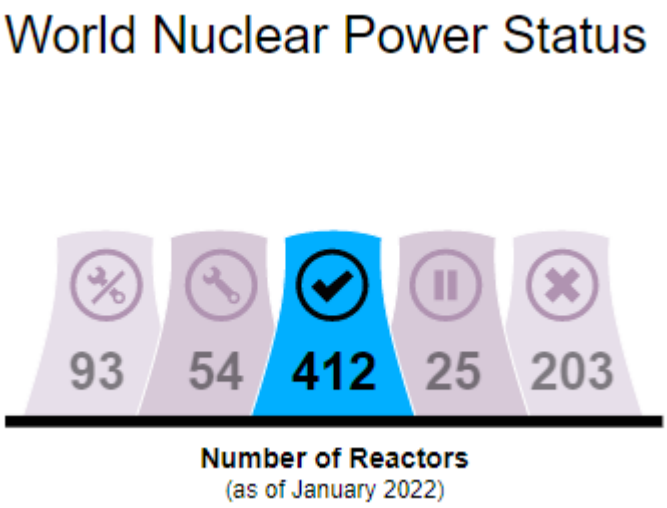
2. https://ec.europa.eu/atwork/applying-eu-law/infringements-proceedings/infringement_decisions/?lang_code=en, search on 2 Feb 2022
3. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019DC0632&from=EN

Conclusion of the World Nuclear Industry Status Report on 2021: Highest number of reactor closures in a decade.

“ Six reactor startups, ten less than planned at the beginning of the year. Eight closures plus two closure announcements. Ten construction starts. Three reactors in Long-Term Outage (LTO) restarted, two closed. As of 1 January 2022, 412 reactors in operation, 25 in LTO, and 55 under construction.”

https://www.worldnuclearreport.org/Highest-Number-of-Reactor-Closures-in-a-Decade.html



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