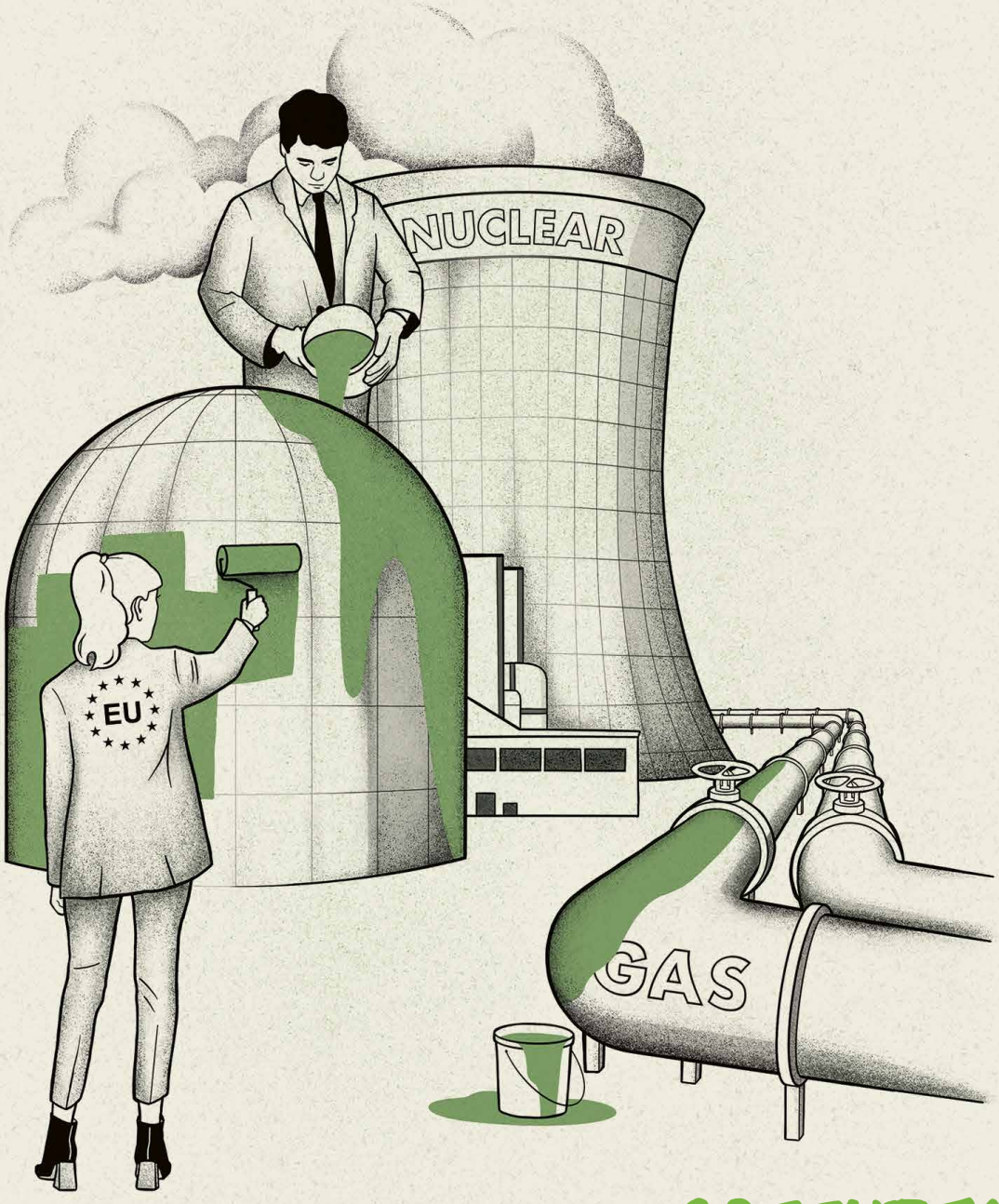
Report

GREENWASHING IN THE EU TAXONOMY

Why fossil gas and nuclear power should not be classified as green investments



GREENPEACE

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Why fossil gas and nuclear power should not be classified as green investments

Hamburg, October 2024

Prepared by:
Marie Kuhn
Finance and taxonomy expert
Greenpeace e.V.

Edited by:
Rachel Tansey

Peer reviewed by:
Tsvetelina Kuzmanova,
Senior Policy Advisor,
Cambridge Institute for Sustainable Leadership

Steve Thomas,
Emeritus Professor of Energy Policy,
University of Greenwich

Greenpeace is an independent campaigning network that uses non-violent, creative confrontation to expose global environmental problems and force solutions that are essential for a green and peaceful future.

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Greenpeace e.V., Hongkongstraße 10, 20457 Hamburg, T 040 30618-0 **Media Relations** T 040 30618-340, presse@greenpeace.de, greenpeace.de **Political Representative Berlin** Marienstr. 19-20, 10117 Berlin, T 030 308899-0 **Legally responsible for content (V.i.S.d.P.)** Marie Kuhn **Editor** Michelle Bayona, Rachel Tansey **Illustration Title Page** © Michael Brose/Greenpeace **Photos** © Felix Schmitt/Greenpeace, Clive Shirley/Signum/Greenpeace, DigitalGlobe/ CC BY-NC-ND 2.0, IMAGO/Erik Romanenko, Sven Simon/imago, Victor Point/Greenpeace, Philip Reynaers/Greenpeace, Robert Keziere/Greenpeace, Julius Schrank/Greenpeace, Paul Langrock/Greenpeace **Production** Maria Ljungdahl **Layout** Klasse 3b **Stand** 10/2024 **S 04611**

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Contents

1 Introduction

Since January 2023, investments in fossil gas and nuclear power have been officially classified as sustainable in the European Union (EU). Despite widespread opposition, the European Commission included both technologies in the EU taxonomy for sustainable activities – the EU's rules on what counts as a 'sustainable' investment. In doing so, the EU is signalling to investors that they may channel billions of euros of supposedly sustainable investments into these polluting and environmentally damaging technologies.

The EU hopes that categorising these technologies as 'sustainable' will enable it to achieve the two main climate goals of the European Green Deal: reducing emissions by 55 per cent by 2030 and achieving climate neutrality by 2050. However, neither climate-damaging fossil gas nor high-risk and slow-to-deploy nuclear power will help Europe to achieve these goals. On the contrary, investments in these activities diverts capital away from much needed renewable energy solutions and slows down the energy transition. Fossil gas and nuclear power are not green activities, and by including them in the EU taxonomy, the European Commission is turning a blind eye to the latest scientific evidence and the recommendations of its own experts.

As a result, the EU taxonomy – a key component of the European Green Deal – has been reduced to an exercise in greenwashing. The European Commission is undermining the original objectives of the taxonomy: to establish clear criteria that make it possible to identify and channel money towards genuinely green investments and to protect investors from greenwashing. Additionally, including unsustainable activities in the taxonomy robs it of the power to generate broad support for green finance, with knock on effects for all other sustainable finance efforts.

Greenpeace believes that the inclusion of fossil gas and nuclear power in the taxonomy is a breach of EU law. Accordingly, the Greenpeace national offices in Germany, Spain, France, Italy, Luxembourg and Belgium, along with the Central and Eastern Europe regional office and the EU office, have joined forces to take action against the European Commission at the Court of Justice of the EU. The goal is to reverse the decision to classify fossil gas and nuclear power as sustainable investments under the EU taxonomy.

This report provides a fact-based overview of the problems and risks associated with fossil gas and nuclear power, and explains why these issues prohibit their inclusion in the EU taxonomy. To set the context, however, this report will first present an overview of the EU Taxonomy Regulation – as well as the delegated act on certain fossil gas and nuclear activities – and the diverse lawsuits filed against it.

2 The EU taxonomy for sustainable activities

2.1 A guide to green investments

The word 'taxonomy' refers to categorisation or classification, and this is precisely the concept behind the EU taxonomy for sustainable activities: it classifies which economic activities and technologies are environmentally friendly.[1] The EU taxonomy currently applies to 16 sectors and includes activities such as the production of chemicals, consumer goods and energy, as well as various services. Accordingly, an assessment is made of whether a particular economic activity advances specific environmental goals – including climate protection and the protection of biodiversity and water resources – based on current scientific evidence. The result is a list of sustainable investments that contribute to these environmental objectives, without causing any significant harm.

The EU taxonomy is designed to provide investors with information on how best to channel their money into green technologies and economic activities. After all, to reach its own European Green Deal objectives and achieve climate neutrality, the EU needs to transition to a more environmentally friendly economy.[2] To accomplish this, investors and the entire financial sector require clear and scientifically sound guidance to distinguish between sustainable and unsustainable investments.

> **The EU taxonomy should prevent greenwashing – but including fossil gas and nuclear power in the taxonomy instead turns it into a tool for greenwashing,** helping to finance new dirty energy projects.

The EU taxonomy could have revolutionised the European financial sector. It is a key component of the EU's sustainable finance legislation and will gradually impact all sectors of the economy.[3] Banks and investors are already labelling billions of euros of investments as 'sustainable', but the lack of a uniform classification system has meant these investments are not always good for the environment or climate.[4] Meanwhile, there has been a growing demand for sustainable investment opportunities from both private and institutional investors. The EU taxonomy is meant to address this issue by making investments in environmentally-friendly and climate-compatible activities – which might otherwise fail to attract funds – more visible and thus attractive to investors.

The EU taxonomy has far-reaching impacts. Although the taxonomy is currently only intended as a guiding classification for private investments in the EU, public banks like Germany's KfW Development Bank and the European Investment Bank (EIB) are also expected to adopt the EU standard in future – even though both have expressed their caution with regard to the inclusion of fossil gas and nuclear power.[5] What's more, governments all over the world – from the UK[6] to Indonesia[7] and Australia[8] – are following the EU's example to develop their

1 European Commission, EU taxonomy for sustainable activities, https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_de
2 European Commission, The European Green Deal, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en
3 European Commission, Renewed sustainable finance strategy and implementation of the action plan on financing sustainable growth, March 2018, https://finance.ec.europa.eu/publications/renewed-sustainable-finance-strategy-and-implementation-action-plan-financing-sustainable-growth_en
4 One example of this is Germany's biggest asset manager and Deutsche Bank-subsidiary DWS, which is involved in a greenwashing scandal over mislabelling its investment funds as "sustainable"; see Financial Times, Deutsche Bank's DWS to pay $25mn to settle SEC probes, September 2023, https://www.ft.com/content/02b19456-d3ed-4c3f-9c39-ec95d81a62ae
5 The KfW Development Bank has already commissioned a study of this issue with regard to "green start-ups", and states that the designing of the EU Taxonomy "is taking place within a political process. It is a consensus solution between the EU member states and thus also subject to particular interests. A substantive inference of 'green' based on the EU Taxonomy could consequently prove to be less ambitious and a less effective driver of the green transformation in Germany than alternative definitional approaches." See https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-Fokus-Volkswirtschaft/Fokus-2023/Fokus-Nr.-433-Juli-2023-Gruene-Gruendung.pdf (in German)
The EIB, in its most recent 'Climate Bank Roadmap', justifies not using the EU Taxonomy Complementary Climate Delegated Act because of the ongoing legal challenge: "In 2022, the Commission adopted a Complementary Climate Delegated Act covering natural gas and nuclear energy. Further, during the Roadmap's mid-term review process, the Commission proposed a further Delegated Act covering the four non-climate environmental objectives." Both these delegated acts are excluded from this review due to either ongoing legal challenge or co-decision scrutiny.
See https://www.eib.org/en/publications/20230176-eib-group-climate-bank-roadmap-mid-term-review
6 ESG Today, UK Classifies Nuclear as "Environmentally Sustainable" in Green Taxonomy, March 2023, https://www.esgtoday.com/uk-classifies-nuclear-as-environmentally-sustainable-in-green-taxonomy/
7 Eco-Business, Indonesia signals it could abandon science-based taxonomy for coal power plants, September 2023, https://www.eco-business.com/opinion/indonesia-signals-it-could-abandon-science-based-taxonomy-for-coal-power-plants/
8 Investment Magazine, Australia moving ahead with sustainable finance taxonomy, May 2023, https://www.investmentmagazine.com.au/2023/05/australia-moving-ahead-with-sustainable-finance-taxonomy/

own taxonomies.[9] Consequently, the EU taxonomy is already having an impact on the entire financial sector, well beyond Europe's borders – which means that the stakes of getting it right are even higher.

Infobox A

Why is the EU's 2050 climate neutrality goal too late?

In 2019, the EU agreed on a long-term climate target, pledging to achieve a climate neutral economy by 2050. But to be in line with the Paris climate agreement's goal of limiting global temperature rise to 1.5° C, and to make a fair contribution in light of its wealth and its substantial share in historic greenhouse gas emissions, the EU should be reaching climate neutrality by 2040. What's more, research shows that a climate neutral EU in 2040 is possible and can be powered by 100 % renewable energy.[10]

2.2 The requirement for scientifically conclusive evidence

For an activity to be considered sustainable in the EU taxonomy, it must contribute to at least one of six defined EU environmental objectives and do no significant harm to any of the others (see Infographic 1).

The EU taxonomy contains strict standards about how to assess whether economic activities meet this requirement, including that the criteria must be based on scientifically conclusive evidence:

> *"The technical screening criteria [...] shall [...] be based on conclusive scientific evidence and the precautionary principle enshrined in Article 191 TFEU."*
>
> Taxonomy Regulation 2020/852, Article 19(1) (f)[11]

This is a dual requirement demanding a new and higher standard for the assessment and management of risks than the application of the precautionary principle alone. Under the EU Taxonomy Regulation, the precautionary principle must be applied taking into account the availability or absence of 'conclusive scientific evidence'. **In Greenpeace's view, the demanding standard of 'conclusive scientific evidence' requires a broad consensus based on current and available scientific knowledge** – and therefore leaves little room for the discretion of the Commission in the assessment of sustainable activities. This means that the available scientific evidence must clearly conclude that an economic activity – such as fossil gas or nuclear power – makes a significant contribution to an environmental objective and does not seriously harm any other environmental objective.

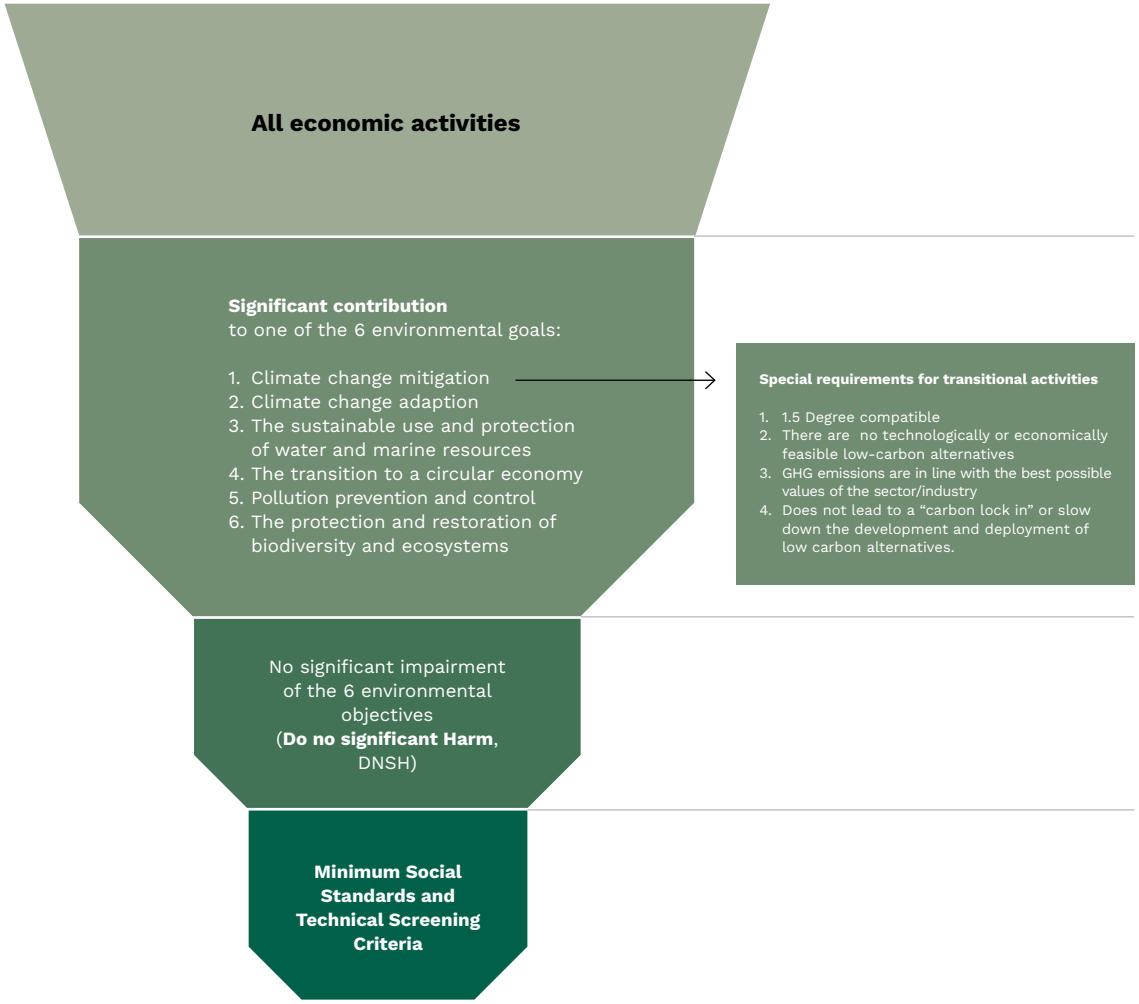
Infographic 1 illustrates the specific conditions for an activity to be classed as sustainable in the EU taxonomy, and how these conditions are interrelated.

9 Bellona Europa, The EU Sustainable Finance Taxonomy's spillover effects on International classification mechanisms for sustainable economic activities, Policy Brief, October 2023, https://network.bellona.org/content/uploads/sites/3/2023/10/The-EU-Sustainable-Finance-Taxonomys-spillover-effects-on-International-classification-mechanisms-for-sustainable-economic-activities-2.pdf

10 The PAC project – Paris Agreement Compatible Scenarios for Energy Infrastructure, https://www.pac-scenarios.eu/

11 Official Journal of the European Union, Taxonomy Regulation 2020/852, June 2020, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0852&from=EN

Infographic 1: Why fossil gas and nuclear power fail to meet the conditions of the EU taxonomy



Construction and operation of new nuclear power plants Extension of the operation of old nuclear power plants Development and research on innovative nuclear power plants

Does nuclear energy comply?

NO, because:
- slows the expansion of renewable energy (RE)
- Not compatible with RE
- Not CO_2-neutral
- Alternatives (RE) exist and are economically feasible

NO, because:
- Danger of accident, war, terrorism
- Nuclear waste
- Polutes the environment and water

Existing and new gas-fired power plants that comply with certain limit values and meet other requirements

Does fossil gas comply?

NO, because:
- Not compatible with 1.5 degrees
- Slows the expansion of renewable energy (RE)
- Leads to carbon lock-in
- Alternatives (RE) exist and are economically feasible

NO, because:
- Highly climate damaging

Source: Greenpeace

Neither fossil gas nor nuclear power meet the criteria for transitional activities, and thus make the transition more difficult (see Infographic 1).

The EU taxonomy labels both fossil gas and nuclear power as 'transitional activities', in other words, technologies that may be used until sustainable solutions are available. This, the European Commission argues, is necessary to achieve the primary environmental goal of combating the climate crisis. Transitional activities in the taxonomy do, nonetheless, have to fulfil certain conditions, to ensure that they do not stand in the way of future-oriented and sustainable technologies – which both fossil gas and nuclear power fail to do (see Infographic 1). The Commission's classification of nuclear power as a transitional activity in the taxonomy (meaning it should only be used during the transition and until 2050 at the latest) is, furthermore, contradicted by recent statements from the Commission that nuclear power will also be needed beyond 2050.[12]

2.3 Implications for transparency and standards

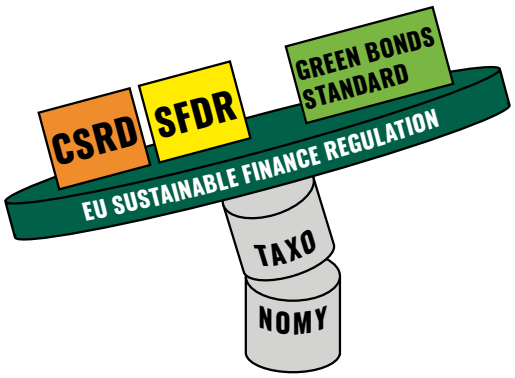
The EU taxonomy is a stepping stone in the European Commission's plan for financing sustainable growth, which is intended to gradually extend to all areas of green finance.[13] The taxonomy already has implications for transparency rules and will also set standards in the financial industry such as clear requirements for green bonds.[14]

On the subject of transparency, there are two main EU disclosure laws that hinge upon the EU taxonomy. Firstly, the Corporate Sustainability Reporting Directive (CSRD), which requires large companies in the EU – such as consumer goods manufacturers and chemical groups – to annually report on the extent to which their current business activities and their future-oriented capital expenditures are in line with the taxonomy.[15] Secondly, the Sustainable Finance Disclosure Regulation (SFDR), which applies a similar rule to financial institutions like banks and investment funds.[16] The evaluation of how green particular financial products are is based on how sustainable the activities of the companies they finance and invest in are, according to the taxonomy. Banks and asset managers must thus disclose to what extent their loan portfolios and financial products (e.g. investment funds) are taxonomy-aligned.

In terms of new standards that are based on the EU taxonomy, a key example is the European Green Bond Standard (EuGBS).[17] Green bonds are financial instruments designed to finance climate-related and environmentally-friendly projects. The EU introduced a definition of green bonds in February 2023. This new standard, which creates a uniform, albeit voluntary, certification scheme for the entire financial industry, aims to put a stop to the proliferation of allegedly green innovative financial products that flourished in the regulatory vacuum, but were, in some cases, pure greenwashing.[18] The EU green bond standard is closely tied to the taxonomy: if a bond is to bear the official EU green bond label, then the investments that are financed with money from the bond must be taxonomy-aligned, or prove how they will become taxonomy-aligned over time. The inclusion of fossil gas and nuclear power in the EU taxonomy, however, means that the green bond standard has lost credibility due to being associated with these industries (see Infographic 2).

12 See pages 72–73 of the Annex to European Commission's Reply to the Request for internal review, No. 69, which can be consulted in the Repository of requests for internal review lodged with the European Commission pursuant to Article 10 of Regulation (EC) No 1367/2006 ("Aarhus Regulation").
13 European Commission, Renewed sustainable finance strategy and implementation of the action plan on financing sustainable growth, ibid.
14 Green bonds are fixed-income instruments used to finance projects and initiatives in the environmental and climate protection sector, and promote the transition to a more sustainable economy. See e.g. Investopedia, Green Bond, https://www.investopedia.com/terms/g/green-bond.asp
15 European Commission, Corporate sustainability reporting, https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_de
16 European Commission, Sustainability-related disclosure in the financial services sector, https://finance.ec.europa.eu/sustainable-finance/disclosures/sustainability-related-disclosure-financial-services-sector_de
17 European Commission, European green bond standard, https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/european-green-bond-standard_en
18 European Parliament, Green bonds: more transparency, no greenwashing, October 2023, https://www.europarl.europa.eu/news/en/headlines/society/20230928STO06003/green-bonds-more-transparency-no-greenwashing

Infographic 2: EU regulation of green finance balances on a shaky foundation



In theory, a science-based taxonomy for defining 'green' investments is a big step forward. But by including fossil gas and nuclear power, the European Commission has severely tarnished the credibility of the EU taxonomy. This is a big problem: if the basis for the definition of sustainable investments is poor, the credibility of all regulations that are built upon it is undermined.

2.4 A 'sustainable' label for fossil gas and nuclear power

The Taxonomy Regulation entered into force in the EU in July 2020.[19] **However, all of the technical criteria for identifying the activities to be classified as sustainable were still missing at that time.** On New Year's Eve 2021, the European Commission presented an initial draft for the inclusion of certain fossil gas and nuclear activities, aiming to complement the initial Delegated Act on climate change mitigation and adaptation that had been adopted in April 2021.[20] In February 2022, the Commission published its final proposal in the form of a complementary delegated act, which could only be accepted or rejected in its entirety, but not modified, by the European Parliament and European Council. A motion presented in the European Parliament to reject the proposal fell just short of the required absolute majority.[21] Consequently, **the complementary delegated act classifying fossil gas and nuclear energy as environmentally sustainable** entered into force automatically upon adoption, and **has been applicable since 1 January 2023.**

The delegated act sets out a number of fossil gas and nuclear activities that are compliant with the EU taxonomy, as follows.

Taxonomy-compliant fossil gas power activities:[22]

- Electricity generation from fossil gas;
- The generation of heating and cooling, and power, from fossil gas (via co-generation or district heating).

19 European Commission, EU taxonomy for sustainable activities, ibid.

20 European Commission, Sustainable Finance and EU Taxonomy: Commission takes further steps to channel money towards sustainable activities, April 2021, https://ec.europa.eu/commission/presscorner/detail/en/ip_21_1804

21 At least 353 of the 705 Members of European Parliament (MEPs) would have had to oppose it; there were 328 votes against, 278 votes in favour and 33 abstentions. See European Parliament, Taxonomy: MEPs do not object to inclusion of gas and nuclear activities, July 2022, https://www.europarl.europa.eu/news/en/press-room/20220701IPR34365/taxonomy-meps-do-not-object-to-inclusion-of-gas-and-nuclear-activities. For the MEP voting results see European Parliament, Results of roll-call votes, July 2022, page 19 https://www.europarl.europa.eu/doceo/document/PV-9-2022-07-06-RCV_FR.pdf

22 European Commission, EU Taxonomy Navigator: Electricity generation from fossil gaseous fuels, https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/191/view; High-efficiency co-generation of heat/cool and power from fossil gaseous fuels, https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/192/view; and, Production of heat/cool from fossil gaseous fuels in an efficient district heating and cooling system, https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/193/view

These types of fossil gas activity must also comply with one of two sets of criteria, namely that:

1. Currently operating and newly constructed fossil gas-fired power stations must produce no more than 100g CO_2-equivalent emissions CO_2e) per kilowatt hour throughout their entire life cycle;

2. New gas power stations for electricity generation (with construction permits granted by the end of 2030) must:

   - produce direct emissions of no more than 270g CO_2e per kilowatt hour generated, or 550 kg CO_2e per kilowatt of capacity on average over 20 years;
   - replace existing high-emitting electricity generation (e.g. coal, oil or less efficient gas power plants) that cannot be replaced by renewable energies in a manner that is "cost-efficient or technically feasible";
   - not increase overall capacity by more than 15 per cent, and ensure that the replacement of the old power stations leads to a 55 per cent reduction in emissions over the lifetime of the new power station. Notably, this is only possible in EU countries that still operate coal-fired power stations and have committed to phase out coal;
   - include provisions for the new fossil gas-fired power station to switch completely to "renewable and/or low-CO_2" gases by the end of 2035. This must be accompanied by a commitment and verifiable plan that has been approved by the operator's management.

Taxonomy-compliant nuclear activities:[23]

- Research, development, testing and deployment of innovative nuclear technologies with "minimal" waste from the fuel cycle;
- Construction and safe operation of new nuclear power plants (for which the construction permit has been issued by 2045) to produce electricity, heat, or hydrogen, using "best available technologies";
- Extension of the operating life of existing nuclear power plants authorised by the relevant authorities of the member states until 2040, in accordance with applicable national laws.

There is a further list of criteria that these types of nuclear activity must meet, including that:

- Nuclear power plants plan to use accident-tolerant fuels from 2025. Notably, the nuclear industry has called for this requirement to be scrapped, arguing that accident-tolerant fuels are still under development;[24]
- Nuclear plants have a waste management plan, together with a detailed plan – and funding – for a final repository for high-level radioactive waste by no later than 2050.

23 European Commission, EU Taxonomy Navigator: Pre-commercial stages of advanced technologies to produce energy from nuclear processes with minimal waste from the fuel cycle, https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/188/view; Construction and safe operation of new nuclear power plants, https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/189/view; and, Electricity generation from nuclear energy in existing installations, https://ec.europa.eu/sustainable-finance-taxonomy/activities/activity/190/view

24 Nuclear Europe, FORATOM proposes improvements to taxonomy complementary delegated act, January 2022, ttps://www.foratom.org/press-release/foratom-proposes-improvements-to-taxonomy-complementary-delegated-act/

2.5 Legal action against EU greenwashing of fossil gas and nuclear power

Greenpeace activists in front of the Court of Justice of the EU in Luxembourg on the day the case was filed (18 April 2023).

© Felix Schmitt / Greenpeace

As soon as the delegated act on the inclusion of fossil gas and nuclear power in the EU taxonomy was announced, a number of stakeholders declared that they would take legal action against the European Commission. These lawsuits have taken various legal routes and had different areas of focus (fossil gas and/or nuclear), as follows:

- **Austria filed a lawsuit directly challenging the European Commission's delegated act on fossil gas and nuclear energy before the EU General Court** (part of the Court of Justice of the EU).[25] Luxembourg intervened in the case in favour of Austria;[26]
- **Eight Greenpeace national offices in Europe jointly requested that the European Commission revise the delegated act on fossil gas and nuclear power, under the Aarhus Regulation's internal review procedure** (see Infobox B).[27] These include Greenpeace in Germany, France, Italy, Luxembourg, Belgium, Spain, Central and Eastern Europe, and the EU office.[28] The European Commission considered the request admissible but unfounded. As a result, the same Greenpeace national offices have filed a lawsuit before the EU General Court against the Commission's decision. On 19 April 2024, the Court suspended the case until the Austrian government's case is heard;[29];
- **ClientEarth, WWF European Policy Office, Transport & Environment (T&E), and Friends of the Earth Germany (BUND) have filed a lawsuit to challenge the inclusion of gas in the EU Taxonomy.**[30] This case has also been filed with the General Court, following an internal review procedure under the Aarhus Regulation, and has also been stayed by the Court.

25 Austrian Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, Nichtigkeitsklage EU Taxonomie-Verordnung, https://www.bmk.gv.at/green-finance/finanzen/eu-strategie/eu-taxonomie-vo/nichtigkeitsklage.html (in German). See also, Climate Change Litigation Databases, https://climatecasechart.com/non-us-case/austria-v-european-commission/

26 ZDF, „Grüne" Atomkraft: Wien zieht vor EuGH, October 2022, https://www.zdf.de/nachrichten/politik/eu-atomkraft-taxonomie-100.html (in German)

27 Greenpeace EU Unit, Greenpeace files lawsuit against the European Commission to end gas and nuclear greenwashing, April 2023, https://www.greenpeace.org/eu-unit/issues/climate-energy/46630/greenpeace-files-lawsuit-against-the-european-commission-to-end-gas-and-nuclear-greenwashing/; and, Greenpeace Germany, EU-Taxonomie: Greenpeace verklagt EU-Kommission, April 2023, https://presseportal.greenpeace.de/225098-eu-taxonomie-greenpeace-verklagt-eu-kommission (in German)

28 Represented by lawyer Dr Roda Verheyen and German law firm Günther.

29 When the Austrian case has reached its conclusion, the Court will decide whether to resume the Greenpeace case, starting by assessing whether all of Greenpeace's arguments have been fully addressed in the Austrian case.

30 ClientEarth, EU Taxonomy: Environmental groups take EU to court over 'green' gas label, April 2023, https://www.clientearth.org/latest/press-office/press/eu-taxonomy-environmental-groups-take-eu-to-court-over-green-gas-label/; and, Klage gegen EU-Kommission: Fossiles Gas gehört nicht in die Taxonomie, April 2023, https://www.bund.net/service/presse/pressemitteilungen/detail/news/klage-gegen-eu-kommission-fossiles-gas-gehoert-nicht-in-die-taxonomie/ (in German)

Infobox B:

Who is entitled to sue?

EU member states can directly challenge the validity of EU acts – such as the Taxonomy Regulation delegated act – before the Court of Justice of the European Union, under Article 263 of the Treaty on the Functioning of the EU (TFEU).[31] Access to justice for natural and legal persons, however, is more limited, as they cannot take legal action in the general interest under Article 263 TFEU.

However, legal recourse for environmental non-governmental organisations (NGOs) against EU acts that violate EU environmental law was established by the Aarhus Regulation.[32] Under the Aarhus Regulation, environmental NGOs and other members of the public that meet certain criteria can request an internal review of acts adopted, or omissions, by EU institutions and bodies.[33] Internal reviews are an accountability procedure intended to ensure that EU decisions comply with environmental law. If the applicants are not satisfied with the outcome of the internal review (which is carried out by the EU institution that adopted the act), they can challenge the decision before the European General Court (EGC).

Which court has jurisdiction?

The Court of Justice of the European Union (CJEU) – the judicial branch of the EU – is composed of the General Court and the Court of Justice (commonly referred to as the European Court of Justice).[34] The General Court is responsible for lawsuits filed against decisions of EU institutions that pertain to requests for internal review. It is then possible to appeal the rulings of the General Court before the Court of Justice (see Infographic 3).[35]

Infographic 3: Jurisdiction of the Court of Justice of the EU in the Greenpeace Taxonomy complaint

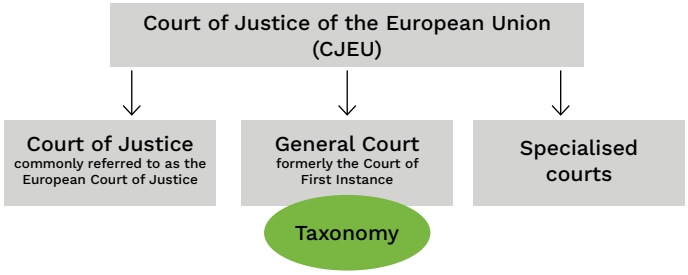


Image Greenpeace. Source: Court of Justice of the European Union, https://european-union.europa.eu/institutions-law-budget/institutions-and-bodies/search-all-eu-institutions-and-bodies/court-justice-european-union-cjeu_en

31 Official Journal of the EU, Consolidated Version of the Treaty on the Functioning of the European Union, October 2012, https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:12012E/TXT:en:PDF
32 Official Journal of the EU, Aarhus Regulation 367/2006/EU, September 2006, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32006R1367
33 European Commission, The Aarhus Convention and the EU, https://environment.ec.europa.eu/law-and-governance/aarhus_de
34 The General Court was formerly known as the Court of First Instance.
35 EUR-LEX, Appeal, https://eur-lex.europa.eu/EN/legal-content/glossary/appeal.html

3 Why fossil gas should not be in the EU taxonomy

3.1 The thresholds for gas-fired power plants are too high

Fossil gas is a major source of the greenhouse gas emissions that are fueling the climate crisis. In order to comply with the Paris Climate Agreement,, a rapid reduction in fossil gas consumption is needed.[36] On the one hand, the European Commission recognises the need to reduce fossil gas consumption by 2030,[37] while on the other, it includes fossil gas in its taxonomy for sustainable activities. Yet even the Commission's own experts, the Platform on Sustainable Finance, considered the emission threshold values in the taxonomy's criteria for gas to be incompatible with European climate goals. More recently, the European Scientific Advisory Board on Climate Change, an independent body providing the EU with scientific knowledge and advice on climate change, recommended that the EU treats investments in fossil gas as non-sustainable.[38]

The European Commission set three thresholds in the EU taxonomy for the construction of new – and the continued operation of existing – gas-fired power plants:

- **First, a threshold of 100g CO_2e per kilowatt hour (kWh) over the entire life cycle.** A fossil gas-fired power plant whose emissions are below this threshold throughout its lifetime does not need to meet any additional criteria. This value was originally proposed by the EU's Technical Expert Group (TEG) on sustainable finance,[39] which recommended it as a technology-neutral sectoral threshold.[40] This value is already a compromise between science and politics – it does not represent the greatest effort possible, but the minimum considered feasible to achieve the Paris climate targets.[41] The TEG also recommended that the 100g CO_2e threshold be reduced every five years, reaching zero grams by 2050.[42] However, the EU taxonomy does not prescribe this continuous reduction over time, which means that huge amounts of CO_2 may still be emitted after 2030 – and even after 2050.
- **Second, and alternatively, a threshold of 270g CO_2e per kWh in direct emissions.**[43] This threshold does not refer to the total life cycle emissions, but only the direct emissions from the energy production phase. This means that a large proportion of emissions caused by fossil gas power plants are not taken into account (see 5.2); and it is precisely the so-called upstream emissions – the emissions caused by leakages, venting, and flaring during extraction and transport, for example – that make fossil gas particularly harmful to the climate. This second threshold value, therefore, is both incomplete and far higher than what is acceptable to address the climate crisis.
- **Third, operators can instead calculate direct emissions over a period of 20 years, with a threshold of 550 kg CO2e per kilowatt (kW) of capacity.** However, if the power plant is operated more in its early years (known as frontloading – see 3.4), this 20 year timeframe can lead to a significant concentration of emissions at the beginning of the period, when it runs on fossil gas, before it shift to a (theoretically) lower-carbon fuel in line with the 2035 deadline. Currently, peak load gas power plants (which operate only during periods of high-demand for electricity) are

36 IEA, Net Zero by 2050, https://www.iea.org/reports/net-zero-by-2050
37 European Commission, COM/2018/773 final, Fig. 2, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0773, and, COM/2020/562 final, p. 9, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0562
38 European Scienctific Advisory Board on Climate Change, EU climate Advisory Board: focus on immediate implementation and continued action to achieve EU climate goals, January 2024, Page 60 https://climate-advisory-board.europa.eu/news/eu-climate-advisory-board-focus-on-immediate-implementation-and-continued-action-to-achieve-eu-climate-goals
39 The Technical Expert Group on sustainable finance was set up by the European Commission in 2018 to help develop the taxonomy framework.
40 TEG, Taxonomy: Final report of the Technical Expert Group on Sustainable Finance, March 2020, https://finance.ec.europa.eu/system/files/2020-03/200309-sustainable-finance-teg-final-report-taxonomy_en.pdf p.21
41 TEG, Taxonomy Report: Technical Annex, March 2020, https://finance.ec.europa.eu/system/files/2020-03/200309-sustainable-finance-teg-final-report-taxonomy-annexes_en.pdf p. 206 states that the threshold is based on "political targets for future allowed emissions".
42 ibid.
43 For facilities for which the construction permit is granted by 31 December 2030, see Chapter B / Taxonomy / Nuclear and Gas

allowed to operate for a maximum of 500 hours/year, and modern gas-fired power plants in many EU countries already run much less than the maximum 500 hours/year allowed for 'peaking' plants.[44] What this means is that the taxonomy's 20 year threshold – which does not include any provisions for an annual cap on emissions within this 20 year period – allows a taxonomy-compliant gas-fired power plant to operate three to four times longer per year than permitted in the current rules for gas 'peaking' plants. In other words, the practice of 'frontloading' – operating as much as possible in the years before having to switch away from fossil gas – means that this taxonomy threshold allows for even worse performance of gas power plants – and higher annual emissions up to 2035 – than current best practice.

Significance for the EU taxonomy

The taxonomy allows gas-fired power plants to produce far more emissions than is compatible with achieving the 1.5°C climate target. Both the second and third thresholds also represent preferential treatment of fossil gas compared to renewables, violating the technological neutrality principle and all of the requirements for transitional activities. The inclusion of fossil gas in the EU taxonomy is therefore both an obstacle to meeting Europe's emissions reduction targets, and a violation of the taxonomy's stricter requirements for transitional activities.

3.2 Methane is a real climate killer

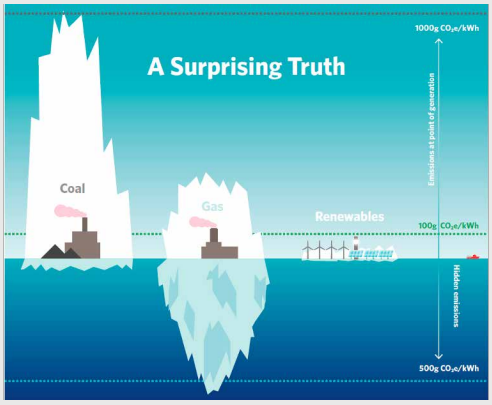
In addition to CO_2 emissions from the combustion of fossil gas in a power plant, methane emissions must also be considered. Methane emissions can occur during the extraction, venting, processing, refining, transmission, distribution and storage of fossil gas.[45] A realistic calculation of the climate impact of fossil gas power plants therefore means taking into account the greenhouse gas emissions of their entire life cycle. Methane is a particularly potent greenhouse gas[46] – and a large part of the reason that **in Europe, fossil gas power generation already causes more emissions over its entire life cycle than coal.**[47]

44 EU Platform on Sustainable Finance, ibid., p.30
45 Deutsche Umwelthilfe, Market survey: methane emissions from natural gas companies, 2021, https://www.duh.de/fileadmin/user_upload/download/Projektinformation/Energiewende/Positionspapier_Markabfrage_Gas_2021_ENG_20210316_FINAL.pdf;
Climate Bonds Initiative, The Hidden Emissions from Gas-Fired Power, 2021, https://www.climatebonds.net/files/files/eu-gas-briefing-220221.pdf;
Client Earth, Open Letter - Gas Attack in Taxonomy, 2021, https://www.clientearth.org/latest/documents/open-letter-gas-attack-in-taxonomy/;
IEA, Net Zero by 2050, ibid.
46 BGR, Klimabilanz von Erdgas, 2020, https://www.bgr.bund.de/DE/Themen/Energie/Downloads/bgr_literaturstudie_methanemissionen_2020.pdf;jsessionid=AFF673372EC8193D40EBF2E1F7E71942.internet992?__blob=publicationFile&v=2
47 IEA, Global CO2 emissions in 2019, https://www.iea.org/articles/global-co2-emissions-in-2019

Infobox C

Methane's deadly impacts on the climate

Fossil gas consists mainly of methane (CH4). The European Commission itself recognises that methane has an 84 times greater global warming potential than CO_2 on a 20 year timescale.[48] Methane is the second most important greenhouse gas after CO_2, in terms of contributing to climate change, yet the use of fossil gas goes hand in hand with large quantities of methane escaping into the atmosphere. Whether through leaks or venting, at the drilling site, during transport or at the place of use, these so-called upstream emissions are mostly unmonitored and undocumented. Large quantities of the fossil gas used in the EU is imported from overseas and transported over long distances, making it difficult to monitor emissions over the entire life cycle. Liquified Natural Gas (LNG), although not part of the EU taxonomy, adds substantial additional energy requirements (for cooling, storing, transporting, and regasification) to the problem of methane leakage, making it even worse for the climate.[49]



In order to meet our climate targets and limit global warming to 1.5°C, Greenpeace demands an immediate abandonment of all new fossil gas projects, and a complete phase-out of fossil gas by 2035.

Source: https://www.climatebonds.net/2022/10/eu-taxonomy-fossil-gas-criteria-not-exactly-free-pass-gas

Significance for the EU taxonomy

The EU taxonomy only takes greenhouse gas emissions from the complete life cycle of a gas-fired power plant into account for one of its three fossil gas thresholds (the 100g CO_2e per kWh threshold). The other two thresholds exclude all upstream methane emissions, and only count direct emissions from gas combustion. As a result of this omission, fossil gas activities that have significant greenhouse gas emissions during production and transport are classified as 'environmentally sustainable'. This is in complete contradiction to the environmental goals of the taxonomy (see 2.1 and 2.2).

48 European Commission, Methane emissions, https://energy.ec.europa.eu/topics/oil-gas-and-coal/methane-emissions_en#:~:text=On%20a%20100%2Dyear time scale,on%20a%2020%2Dyear time scale%20.

49 E3G, When is gas "green" according to the EU Taxonomy? September 2022, https://www.e3g.org/news/when-is-gas-green-according-to-the-eu-taxonomy/

3.3 Fossil gas slows down the energy transition

The promotion of gas-fired power plants leads to a further increase in emissions. The inclusion of gas generation in the EU taxonomy means that it will be easier for developers of gas projects that meet the criteria of the taxonomy to raise capital. As a result, the weighted average cost of capital (WACC) of these gas-fired power plants is lower. Lower financing costs in turn reduce the levelised cost of electricity (LCOE) for gas-fired power plants, improving their profitability. This higher profitability leads directly to more gas power stations being built – and more gas-fired capacity in the electricity market – ignoring how these will become stranded assets.[50]

Gas-fired power plants are displacing more future-proof flexibility technologies. As renewable energy capacity increases, greater flexibility is needed in the power system (see 5.1).[51] If incentives are created for the use of fossil gas, as in the taxonomy, gas power plants displace a more diverse mix of truly low-carbon flexibility measures. Since gas turbines – which unlike nuclear, are quick to turn on and off – can at least partially improve the flexibility of the power system, they are in direct competition with alternative flexibility technologies such as batteries, storage and demand-side measures. However, gas power plants have various disadvantages as providers of flexibility in the power system, including that they are not able to absorb power when renewable energy production is high and exceeds demand. Lithium-ion batteries and other long-term storage capacities, on the other hand, can absorb electricity and store it for later, while demand-side management measures can shift demand to hours when renewable energy production is higher.

Incentives for gas reduce the profitability of renewables. The better we are able to use the energy from sun and wind when it is available, the more profitable renewables become. Low-carbon flexibility measures are thus the key to profitability: above all, better energy storage and intelligent demand management make it possible to use renewable energy sources optimally in times of high output, instead of having to curtail them because demand may be low at the time. The result: a stabilisation of prices, more predictability for operators, more attractiveness for investors and thus more capital for the necessary expansion of renewables. However, if the incentives for such flexibility measures are replaced by incentives for gas-fired power plants under the pretext of balancing the system, there will be less money for the expansion of a renewable energy system, and the fight against the climate crisis will be slowed down.

The European Commission does not provide conclusive scientific evidence that additional investments in gas-fired power plants are necessary.[52] **Across Europe, 59 GW of coal-fired capacity is scheduled to close by 2035**[53] **– with plans to replace this capacity likely already arranged. The taxonomy criteria, however, do not require an assessment of whether a coal-fired power plant that was already facing closure will now be replaced by fossil gas (instead, for example, of renewables). This incentivises countries and regions already phasing out coal to go back to fossil fuels instead of investing in renewables. It is therefore unclear what – if any – actual benefit the incentives for switching to gas-fired power plants will have on net emissions.**[54]

50 This holds true for both power market systems with capacity markets, such as Belgium, France and Poland, and those without capacity markets, such as Germany. For more details, see Aurora Energy Research, Impact of lower financing costs of gas on low-carbon alternatives

51 In a separate study, Aurora Energy Research examined the effects of long-term energy storage on the electricity system. Three main positive impacts were identified: higher use of renewable energy, lower fossil gas consumption, and lower demand for hydrogen in the power sector. None of these can be achieved with gas-fired power plants. See: Aurora Energy Research, Prospects for Long Duration Energy Storage in Germany, July 2022, https://auroraer.com/insight/prospects-for-long-duration-energy-storage-in-germany/

52 UFZ, Atom- und Gaskraftwerke künftig nachhaltig?, November 2021, https://www.ufz.de/index.php?de=36336&webc_pm=57/2021

53 EU Platform on Sustainable Finance, ibid. p.7

54 ibid.

Significance for the EU Taxonomy

Gas-fired power plants cannot be considered transitional activities, as they hinder the development of renewable energies and the corresponding flexible energy system. This is in direct contradiction to the principle of technological neutrality and the requirements of the taxonomy for transitional activities.

3.4 Inclusion of fossil gas leads to carbon lock-in

The EU taxonomy is intended to help guide investments for the transition from our current energy system to a net-zero energy system. It is therefore crucial to avoid carbon lock-in during this transition. Carbon lock-in happens when money is invested in power plants (or other energy infrastructure – see Infobox E) that will produce significant greenhouse gas emissions, and which we will be stuck with for a long time due to technical and economic barriers to making the switch to low-carbon technologies.[55] This is the case with gas-fired power plants for three reasons:

1. New or retrofitted gas-fired power plants generally have a long service life – with an expected operating period of about 35 years.[56] This means that a gas power plant built today will still be in operation long after 2050. And if that power plant meets the 100g CO_2e per kWh life cycle threshold set in the EU taxonomy, it would not even be obliged to change fuel, and would consequently continue to burn fossil gas in 2050. Greenpeace, however, argues that the EU should rely on 100 per cent renewable energy in 2040 (see Infobox A and 5.1).

2. The question of fuel switch is uncertain. The taxonomy may require new fossil gas-fired power stations to plan to switch to "renewable and/or low-CO_2" gases by 2035 (see 2.4), but whether such a switch actually takes place is unknown. The assessment of whether a power plant is 'transitional' is made at the beginning of a project, but the question of whether its conversion is actually feasible, on the other hand, can only be answered many years later. There is, furthermore, a great deal of uncertainty as to whether the supply of 'low-carbon fuels' such as green hydrogen[57] will be technologically and economically feasible in future, since they are not today.[58] There is also a danger that operators will rely on cheaper, climate-damaging fossil gas for as long as possible, and delay or not implement the switch at all, eventually giving up the taxonomy-compliant label after the power plant has been paid for by greenwashed investments. [59]

3. Profitability considerations will encourage gas-fired power plants to frontload emissions. A report by Aurora Energy Research has demonstrated that the taxonomy's criteria do not correspond with a realistic business case.[60] Using the 20-year average 550 kg CO_2e per kW of capacity criterion as an example, the report shows that if a profit-maximising gas-fired power plant enters the market in 2028 and switches to low-carbon fuel after eight years – i.e. by the end of 2035 – it will exceed the 20-year threshold of 550 kg. This is because, to maximise profit, the power plant will frontload its emissions by running at full load as much as possible in its early years – ie during the conventional, fossil-gas operating phase – resulting in CO_2 emissions so high that they cannot be offset in the later, low-emission phase. If gas-fired power plants enter the market at an even later date, or the

55 The term 'carbon lock-in' was coined by Gregory C Unruh in 2000, see Gregory C Unruh, 'Understanding Carbon Lock-in, in Energy Policy, Vol. 28, Iss. 12, 1 October 2000, Pages 817-830, https://www.sciencedirect.com/science/article/abs/pii/S0301421500000707?via%3Dihub

56 Institute of Energy Economics and the Rational Use of Energy, Arbeitsbericht: Lebenszyklusanalyse Ausgewählter Stromerzeugungstechnike, as of 2005, https://www.ier.uni-stuttgart.de/publikationen/arbeitsberichte/downloads/Arbeitsbericht_01.pdf p.2

57 Green hydrogen is produced using renewable electricity. Converting existing gas-fired power plants to 100% green hydrogen does not make sense, when the electricity produced by the gas plant can instead be directly replaced with electricity from renewables. Green hydrogen should only be envisaged for those applications for which there are no other alternatives.

58 Aurora Energy Research, Impact of lower financing costs of gas on low-carbon alternatives, ibid. p.16

59 Aurora Energy Research, Impact of lower financing costs of gas on low-carbon alternatives, ibid. pp.12-16

60 ibid.

fuel switch is delayed, this profitability calculation will be even worse, leading to an even stronger frontloading of emissions, and weaker financial feasibility in the long run.

The taxonomy's rules give fossil gas power plant operators a lot of leeway, by setting requirements that are far into the future, when it is highly speculative whether the plants will actually comply. Unfortunately, the worst-case scenario – namely, that of investor deception – is also the most likely. Operators are likely to either simply refrain from using the taxonomy-compliant label after they've been commissioned, drop the label when they realise they cannot meet the thresholds, or actively frontload their full-load hours in the first years of operation and drop the taxonomy label when the fuel switch is due. Leaving investors – who believed they were making a sustainable, taxonomy-compliant investment – with little recourse, stuck with non-taxonomy-aligned assets that failed to comply with the criteria over time, and the climate much worse off.

Once a project is approved and financed as taxonomy-compliant, the investment is made, regardless of whether it stays compliant. Verification and monitoring of compliance over time, although considered in the taxonomy, are ambiguous at best. There is no effective mechanism to reverse the classification of the original investment as being taxonomy-compliant, or to reclaim any benefits that accrued to the fossil gas plant operator if it doesn't subsequently meet the taxonomy's criteria (see Infobox D).

Infobox D

Uncertainties and a lack of recourse for investors

Most capital is needed in the construction phase of a fossil gas power plant, with little or no capital required during the operating phase. Yet the taxonomy-compliant 'environmentally sustainable' label is assigned and verified at the beginning of a project – leaving major uncertainty as to what happens if, during the operation phase, it does not meet the taxonomy's criteria. The European Commission has not established sanctions in the case of a classification that proves to be incorrect – even though this would have been possible. This also creates problems for investors, as the EU's own sustainable finance experts write:

„There are several usability issues for financial markets from these limitations, but the key issue is that all performance improvements for the financeable facility would only occur in future years (2026, 2030, 2035 or after) even though Taxonomy alignment of the activity would be recognised immediately. For example, if the plant has been financed as taxonomy aligned via sustainable finance instruments but fails to achieve the improvements, it would not be possible re-classify the already invested funds as not taxonomy aligned retrospectively. Further there is a dependency on the availability of low carbon fuels to meet the performance criteria, and the lifecycle emissions of using such fuels are not included in the criteria." [61]

— EU Platform on Sustainable Finance

61 EU Platform on Sustainable Finance, ibid. p. 8

Significance for the EU taxonomy

The long lifetime of gas-fired power plants, the uncertainty regarding their transition to low-carbon fuels, and the fact that gas plants cannot profitably meet the taxonomy criteria leads to a carbon lock-in that threatens the transition to a climate neutral energy system. This is in direct contradiction to the taxonomy's requirements for transitional activities and is likely to result in far more emissions than anticipated.

Infobox E

Build-out of gas and LNG infrastructure adds to carbon lock-in

Just as new fossil gas-fired power plants contribute to carbon lock-in, so too does the build-out of new fossil gas production and liquefied natural gas (LNG) infrastructure - even when not directly included in the taxonomy. Plans for new fossil gas production in the Dutch and German North Sea, for example, have met with extensive protest.[62] Twenty kilometres northwest of the North Sea island of Borkum – in the immediate vicinity of the Wadden Sea, a UNESCO World Heritage Site – Dutch company ONE-Dyas wants to develop a new fossil gas field.[63] The planned site of the production platform is surrounded by nature conservation areas.

These plans have been made in the context of Russian fossil gas no longer flowing to Germany – the same reason that the import of LNG (fossil gas in its liquid form) from all over the world is booming, and that the expansion of LNG infrastructure is being heavily promoted. Three new coastal LNG terminals came online in Germany at the end of 2022 and early 2023, with eight more to follow. Yet at the same time, several studies on gas supply – including those by the New Climate Institute[64] and the German Institute for Economic Research (DIW)[65] – show that the additional LNG capacity planned far exceeds current gas demand in Germany. Despite this, the LNG Acceleration Act currently in force in Germany allows the almost unrestricted operation of the new and planned LNG terminals until the end of 2043.

62 Greenpeace Germany, Gas zerstört!, https://www.greenpeace.de/klimaschutz/energiewende/gasausstieg/kein-neues-gas
63 Greenpeace Germany, Oasen Der Artenvielfalt: Tauchuntersuchungen an Riffstrukturen auf dem Borkum Riffgrund im April 2023, June 2023, https://www.greenpeace.de/publikationen/OasenDerArtenvielfalt_Gutachten.pdf
64 New Climate Institute, Deutsche LNG-Ausbaupläne führen zu Überkapazität und gefährden Klimaschutzziele, March 2023, https://newclimate.org/sites/default/files/2023-03/newclimate_lng_uberkapazitat_deutschland_0.pdf
65 DIW, Deutschlands Gasversorgung ein Jahr nach russischem Angriff auf Ukraine gesichert, kein weiterer Ausbau von LNG-Terminals nötig, February 2023, https://www.diw.de/de/diw_01.c.866810.de/publikationen/diw_aktuell/2023_0086/deutschlands_gasversorgung_ein_jahr_nach_russischem_angriff___ine_gesichert__kein_weiterer_ausbau_von_lng-terminals_noetig.html

September 2023: 30 Greenpeace activists protested against the laying of a 50 km gas pipeline between the German Baltic sea port of Lubmin and the port of Mukran, on the German island of Rügen. On the pipeline-laying ship Castoro 10, activists moored themselves to one of the pipes lying on deck, held banners reading “Gas destroys!” from the loading crane, and sat on the pipeline that was being lowered into the sea at the stern of the ship.

4 Why nuclear power should not be in the EU taxonomy

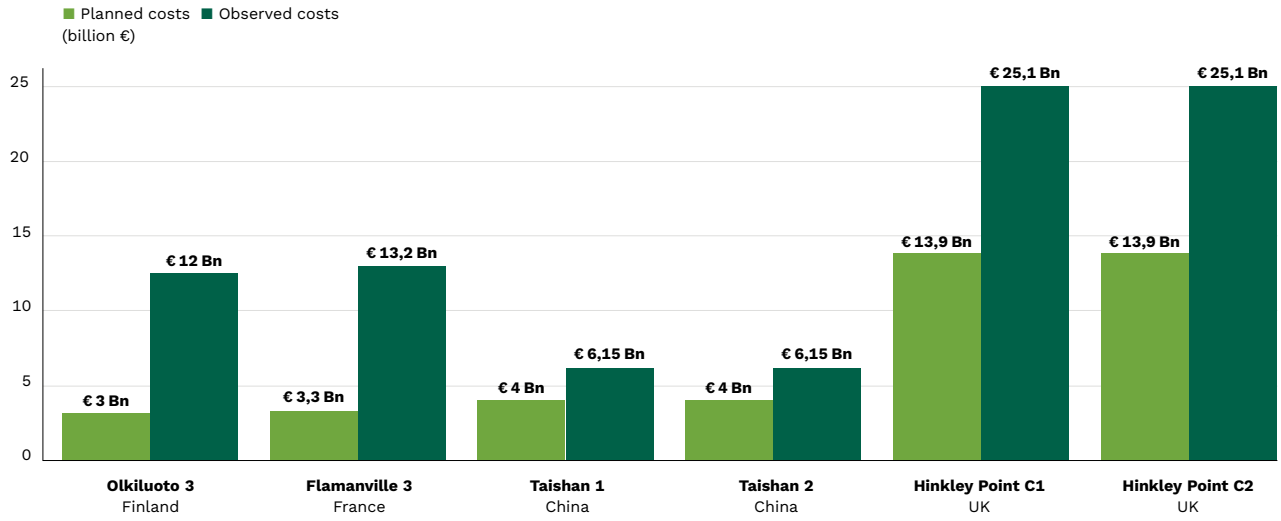
4.1 Nuclear power slows down the energy transition

(i) Nuclear slows down the development of renewables

Nuclear energy keeps us locked into a costly energy system and slows down the shift to renewable energy. The construction of nuclear power plants is a lengthy and capital-intensive process, and in order to be economically feasible, nuclear reactors often have to operate for decades. When technologies with decades-long lifespans are heavily subsidised, this leads to an economic and technological lock-in effect. Even if other technologies – such as renewable energy – become more advanced and cost-efficient during this period, the market still clings to the more costly technology as the initial investment is only amortised after several decades. This means the market can remain distorted for a considerable length of time, with the result that the potential of lower-cost renewables remains underutilised.[66]

Upfront costs of nuclear power plants are high and often underestimated, as the graph below illustrates.[67]

Infographic 4: Comparison of planned/observed EPR construction costs

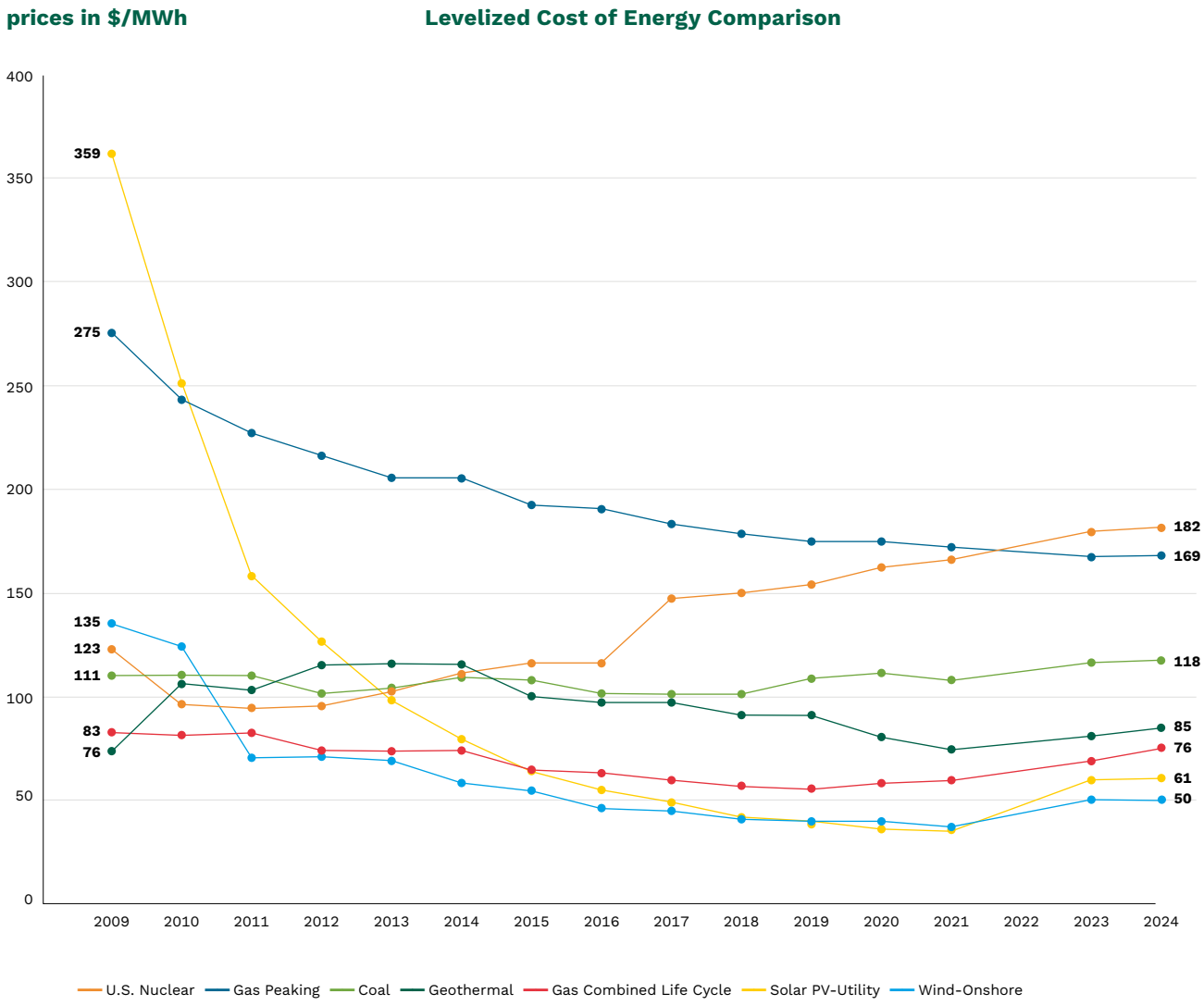


Sources: EDF, Cour des comptes, Greenpeace France; https://www.greenpeace.fr/cout-nouveau-nucleaire-insoutenable-legerete-edf/

This dynamic is not merely theoretical: the costs of renewable sources of energy are already significantly lower than the costs of new nuclear power. Not only have renewables become significantly cheaper over the last ten years, the costs for additional nuclear reactors have increased significantly.[68] An analysis by US investment bank Lazard, for example, calculated that between 2014 and 2024 the average unsubsidised power generation costs of utility-scale solar and onshore wind have dropped steadily: solar from $79 to $61 per MWh, and onshore wind from $59 to $50 per MWh. Over the same period, the cost of generating electricity from nuclear power plants has jumped from $112 to $182 per MWh.[69]

66 Austrian Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology, EU Taxonomy Regulation, https://www.bmk.gv.at/en/green-finance/finances/eu-strategy/eu-taxonomy-regulation.html
67 Greenpeace France, The cost of "new era" nuclear: the unbearable lightness of EDF, March 2024, https://www.greenpeace.fr/cout-nouveau-nucleaire-insoutenable-legerete-edf/
68 Taking into account the levelised cost of energy (LCOE). See Lazard, LCOE+ report, June 2024, https://www.lazard.com/research-insights/levelized-cost-of-energyplus/ P. 16
69 Lazard, ibid.

Infographic 5: Analysis of the levelised cost of energy (LCOE) in USD per megawatt hour – selected historical mean costs by technology.



Source: Lazard 2024 LCOE+ Report[70]

Nuclear power plants are expected to become even more expensive in the future,[71] while many renewable energy technologies continue to benefit from economies of scale driven by rising global demand. The construction of small modular reactors (SMRs) cannot offer a compelling alternative to renewables either, as their cost per kilowatt hour is estimated to be even higher than other types of nuclear plant (see Infobox F).[72]

70 Lazard, ibid.

71 Austrian Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology, Does Nuclear Power Comply With the DNSH Criteria of the EU Taxonomy for Sustainable Activities? – A Literature Review, September 2020, Sigrid Stagl, https://www.bmk.gv.at/dam/jcr:99797b88-5794-4ffc-abdb-f74eff865cb7/Metastudie_Nuklear_Taxonomie_2020.pdf (in German)

72 German Federal Office for the Safety of Nuclear Waste Management (BASE), Expert response to the report by the EU Commission's Joint Research Centre "Technical assessment of nuclear energy with respect to the 'Do No Significant Harm' criteria in Regulation (EU) 2020/852, the 'Taxonomy Regulation'", 2021, https://www.base.bund.de/SharedDocs/Downloads/BASE/EN/reports/2021-06-30_base-expert-response-jrc-report.pdf.pdf?__blob=publicationFile&v=6

Infobox F

Small Modular Reactors are not the answer

The idea of small modular reactors (SMRs) goes back to efforts in the 1950s to use nuclear reactors to power military submarines.[73] SMRs are reactors with a power capacity of up to 300 MW(e) per unit.[74] The vast majority of the various SMR concepts being considered today, however, are still in the planning stages or on the drawing board.[75] Nearly all are at least 300 MW(e) and in some cases significantly more, for example, the Rolls Royce SMR is expected to generate 470 MW. The size difference between these new SMRs and existing nuclear reactor designs, therefore, is much less than the lobbying surrounding them implies.

Nonetheless, SMR concepts have been receiving renewed attention in the context of debates about the use of nuclear energy as a means of mitigating the climate crisis. The assumption is that SMRs could be developed more quickly. It is worth noting, however, that while SMRs are about the same size as early nuclear reactors, reactors became larger over time because bigger reactors were more cost-effective. A recent analysis that takes into account economies of scale and learning effects within the industry concludes that more than 1,000 SMRs would need to be produced (at enormous expense) before SMR production could become cost-effective.[76] The structural cost disadvantages of low-capacity reactors cannot, therefore, be expected to be overcome any time soon, as both recent research[77] and market developments[78] have shown.

The vital role that renewables play in the energy transition, in contrast to gas and nuclear, is immediately apparent in the 6th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).[79] The IPCC's report examines various options that could contribute to reducing global emissions by 2030 – from different types of energy production, to better forest conservation and energy efficiency measures for industry.[80] It also explicitly compares the net costs over the entire lifetime of a given project. Whereas wind and solar power can each achieve reductions of approximately 4 Gt CO_2e per year at costs that are in some cases lower than existing fossil energy production, the IPCC calculates that nuclear power, which is considerably more expensive, can only achieve annual net emissions reductions of less than 1 Gt CO_2e.[81] This means that the combined use of wind and solar energy could be almost ten times more effective in reducing net emissions by 2030 – and at a far lower cost.

73 BASE, Sicherheitstechnische Analyse und Risikobewertung einer Anwendung von SMR-Konzepten (Small Modular Reactors), 2021, https://www.base.bund.de/SharedDocs/Downloads/BASE/DE/berichte/kt/gutachten-small-modular-reactors.html (in German). Abstract in English available at https://inis.iaea.org/search/search.aspx?orig_q=RN:52097919

74 World Nuclear Association, Small Nuclear Power Reactors, https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors.asp

75 BASE, Sicherheitstechnische Analyse und Risikobewertung einer Anwendung von SMR-Konzepten (Small Modular Reactors), ibid.

76 BASE, Sicherheitstechnische Analyse und Risikobewertung einer Anwendung von SMR-Konzepten (Small Modular Reactors), ibid.

77 BASE, Expert response to the report by the EU Commission's Joint Research Centre, ibid.

78 EnergyWire, NuScale cancels first-of-a-kind as costs surge, September 2023, https://www.eenews.net/articles/nuscale-cancels-first-of-a-kind-nuclear-project-as-costs-surge/

79 IPCC, AR6 Synthesis Report Climate Change 2023, https://www.ipcc.ch/report/ar6/syr/

80 IPCC, AR6 Summary graph of relative potentials and costs of different mitigation options, https://www.ipcc.ch/report/ar6/wg3/figures/summary-for-policymakers/IPCC_AR6_WGIII_FigureSPM7.png

81 IPCC, AR6 Summary graph of relative potentials and costs of different mitigation options, ibid.

"The political, economic, social, and technical feasibility of solar energy, wind energy and electricity storage technologies has improved dramatically over the past few years. In contrast, the adoption of nuclear energy and CO_2 capture and storage (CCS) in the electricity sector has been slower than the growth rates anticipated in stabilisation scenarios. Emerging evidence since AR5 [IPCC's 5th Assessment Report] indicates that small-scale technologies (e.g., solar, batteries) tend to improve faster and be adopted more quickly than large-scale technologies (nuclear, CCS)."[82]

– IPCC's 6th Assessment Report

Renewables are cheaper and more effective at reducing emissions than nuclear power.[83] **They can also be more quickly deployed. Nuclear energy thus contributes less to protecting the climate than is often assumed.**

This means that if we want systematic and swift climate action, we cannot rely on more nuclear power, or invest in new nuclear power plants, which only serves to delay decarbonisation and the uptake of renewables.[84] To meet Europe's 2030 climate goals, the European Commission estimates that annual investments of 350 billion euros are needed[85] – which the EU taxonomy is intended to help mobilise. However, we cannot spend one euro twice: we can either invest it in the cost-effective and rapid expansion of renewable energies, or in expensive nuclear power projects that won't be connected to the grid for another decade or two.[86]

(ii) Nuclear delays the phase out of fossil fuels

The lengthy construction times of new nuclear reactors are, furthermore, delaying the decommissioning of coal and gas-fired power stations. It takes 10 to 19 years for nuclear power plants to get from the planning stage to operation.[87] During this period, existing fossil fuel power plants continue to operate – because the financing that would have been needed to replace the electricity they provide with renewable electricity has instead gone into the slow process of building new nuclear reactors. Every major expansion of nuclear energy thus delays the shutdown of these major sources of fossil fuel emissions, making it more difficult to achieve the goal of mitigating climate change. The EU's own European Scientific Advisory Board on Climate Change agrees that this is a major problem.[88]

82 IPCC, AR6 Mitigation of Climate Change Technical Summary, 2022, https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_TechnicalSummary.pdf p. 67

83 IPCC, AR6 Summary graph of relative potentials and costs of different mitigation options, ibid.

84 „Every euro invested in new nuclear plants thus delays decarbonization compared to investments in renewable power. In a decarbonizing world, delays increase CO2 emissions". Haywood, L., Leroutier, M., and Pietzcker, R., 'Why investing in new nuclear plants is bad for the climate', in Joule, Vo.7, Iss.8, 2023, https://www.cell.com/joule/fulltext/S2542-4351(23)00281-7

85 Euractiv, EU spells out criteria for green investment in new 'taxonomy' rules, April 2021, https://www.euractiv.com/section/energy-environment/news/eu-spells-out-criteria-for-green-investment-in-new-taxonomy-rules/

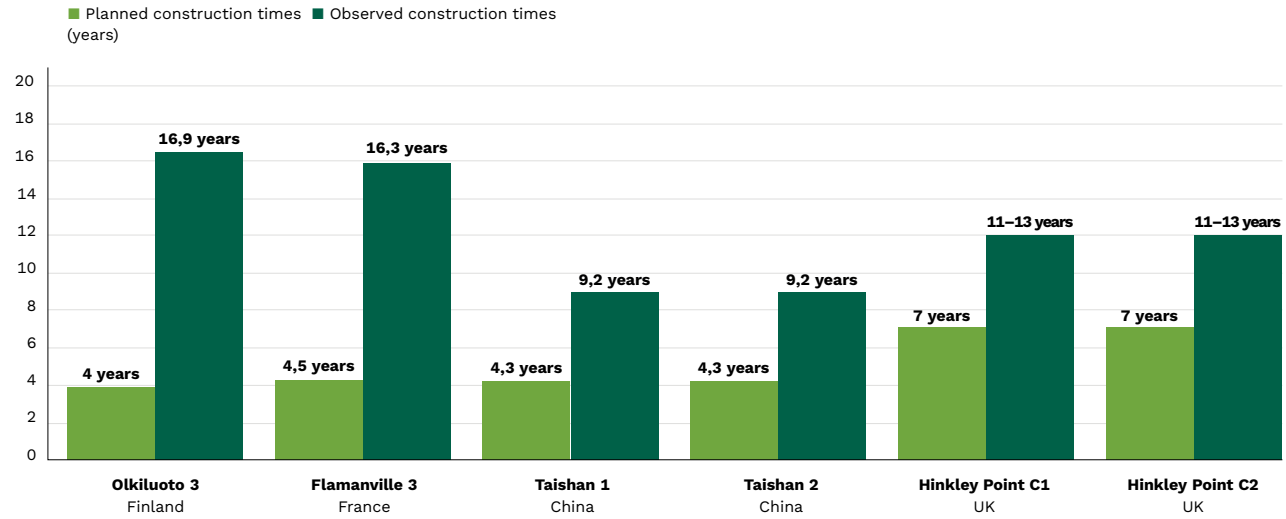
86 See Myth 9 in The Ecologist, Renewable energy versus nuclear: dispelling the myths, 2016, https://theecologist.org/2016/apr/19/renewable-energy-versus-nuclear-dispelling-myths, and IEA, The Cost of Capital in Clean Energy Transitions 2021, https://www.iea.org/articles/the-cost-of-capital-in-clean-energy-transitions

87 Jacobson, M.Z., 'Evaluation of Nuclear Power as a Proposed Solution to Global Warming, Air Pollution, and Energy Security', in 100% Clean, Renewable Energy and Storage for Everything, Cambridge University Press, 2020, https://web.stanford.edu/group/efmh/jacobson/Articles/I/NuclearVsWWS.pdf

88 European Scientific Advisory Board on Climate Change, EU climate Advisory Board: focus on immediate implementation and continued action to achieve EU climate goals, ibid.

In addition to being lengthy, construction times are generally underestimated, as shown by the graph below.[89]

Infographic 6: Comparison of planned/observed EPR construction times



Sources: EDF, Cour des comptes, Greenpeace France

The expansion of renewables can also be artificially slowed down by political decisions that earmark financing for new nuclear power plants – sometimes in response to pressure from the nuclear industry. Back in 2009, for example, utilities E.ON and EDF – which both then operated nuclear power plants – demanded restrictions on the proportion of energy from renewables.[90]

If renewable energies were instead consistently expanded, coal and gas-fired power stations could be shut down much earlier, thereby reducing emissions faster. In fact, utility-scale solar or onshore wind power can be built five to 17 years sooner than new nuclear power plants, according to the World Nuclear Industry Status Report 2019.[91] Thus, existing fossil fuel power stations could emit CO_2 for up to 17 years longer if they're waiting to be replaced by nuclear reactors rather than by renewables.

89 Greenpeace France, The cost of "new era" nuclear: the unbearable lightness of EDF, ibid.
90 FrankfurterRundSchauStromriesen contra Windkraft, March 2009, https://www.fr.de/wirtschaft/stromriesen-contra-windkraft-11479534.html
91 World Nuclear Industry Status Report 2019, https://www.worldnuclearreport.org/The-World-Nuclear-Industry-Status-Report-2019-HTML.html

Infobox G

Spotlight on Poland and Germany – nuclear vs. renewables

Back in 2005 Poland decided to build nuclear power reactors, with the expectation that the first nuclear plant would be online by 2020, an ambition that was not met. Poland now plans to build at least six new nuclear reactors, delivering 6 to 9 GW of power, by the middle of the 2040s.[92] Following years of announcements – and taking into account the required preparation and planning time, and a construction period of at least ten years – the Polish government expects the first nuclear power plant to be completed in 2033.[93] Delays are likely to make the completion date much later, however, especially given that by early 2024, the site for the first reactor had not been finalised and no order for a reactor had been placed.[94] The goal of starting construction in 2026 is therefore unlikely to be met even if, this time, Poland's nuclear ambitions go ahead. Until then, Poland's coal-fired power stations (and new gas-fired plants) will continue to operate, and the phase-out of coal – together with the overall decarbonization of the country – will be delayed even further.[95] In other words, Poland's new nuclear reactors will contribute absolutely nothing to achieving the EU's 2030 climate targets, and instead justify continued fossil fuel power plant emissions.

Germany, on the other hand, substantially increased its share of renewable energies in 2023. Energy generated with fossil fuels fell to 43.7 per cent of total energy production in the first half of 2023 (compared to 45.6 per cent in the first half of 2022)[96] – despite Germany's nuclear phase-out.[97] If this pace increases, Germany could phase out coal more rapidly than Poland, which remains locked into the construction phase of its nuclear power plants. A period during which Poland's existing power stations will keep burning coal and gas, its energy system unchanged.

(iii) Nuclear puts the brakes on the modernisation of our electricity grid.

To bring as much renewable energy online as possible, we need to update our power grid and move towards more flexible demand for electricity. The electricity grid of the future needs to be much more decentralised than in the past, because it will include many comparatively small power producers – as opposed to just a few large, centralised power stations like nuclear power plants. These vital changes require investments that cannot be tied up in nuclear reactors, which are technically bound to the old centralised system.

92 Tagesschau, Polen steigt in die Atomkraft ein, April 2023, https://www.tagesschau.de/ausland/europa/polen-atomenergie-103.html (in German)
93 Euractiv, Poland to slow coal phase-out process, maintain 2049 end-date, November 2022, https://www.euractiv.com/section/energy/news/poland-to-slow-coal-phase-out-process-maintain-2049-end-date/, and, Poland insists on nuclear's role in green transition, September 2023, https://www.euractiv.com/section/energy-environment/news/poland-insists-on-nuclears-role-in-green-transition/
94 Jens Weibezahn and Björn Steigerwald, Fission for Funds – The Financing of Nuclear Power Plants, May 2024, https://www.greenpeace.org/static/planet4-luxembourg-stateless/2024/06/65cd71d2-fission-for-funds-the-financing-of-nuclear-power-plants.pdf
95 Euractiv, Poland to slow coal phase-out process, maintain 2049 end-date, ibid.
96 German Federal Statistics Office, Stromerzeugung im 1. Halbjahr 2023: 11,4 % weniger Strom als im Vorjahreszeitraum, September 2023, https://www.destatis.de/DE/Presse/Pressemitteilungen/2023/09/PD23_351_43312.html#:~:text=April%202023%20nur%20noch%202,gesamte%20Halbjahr%20in%20Betrieb%20waren (in German)
97 Greenpeace Deutschland, Ein Jahr Atomausstieg in Deutschland – Ein energiewirtschaftlicher Schulterblick, April 2024, https://www.greenpeace.de/publikationen/20240409-greenpeace-studie-1-jahr-atomausstieg_0.pdf

Since renewable energy technologies supply different amounts of electricity to the grid depending on the wind and sun, it is also necessary to render the demand side more flexible. This means that households and industry must be able to manage their power consumption more proactively, in order to benefit from flexible electricity prices (which reflect when more renewable energy is being produced and is therefore cheaper). Fluctuations in renewable energy production can also be compensated for by storing excess solar or wind power at certain locations. Storage capacities for this therefore urgently need to be expanded (see 5.1). Investments in these flexibility and storage technologies are better for the energy systems of the future, and capital should not be diverted away from them towards more expensive nuclear power.

Nuclear power, meanwhile, is too inflexible and cannot be ramped up and down frequently or quickly enough for a modernised clean energy system (see 3.2). The popular image of nuclear power as a reliable, permanently available and practically endless source of energy stems from efforts to put a positive spin on this major disadvantage. In reality, nuclear power provides little incentive to use energy more efficiently, and the required changes to electricity demand are an obstacle for nuclear power plants. Consequently, clinging to nuclear power means that urgent modernisations necessary for a renewable electricity grid will not be undertaken, and capital will be tied up in large-scale projects that are not future-oriented.

Nuclear energy makes no contribution to the energy transition; on the contrary, it is a licence to do nothing.

Significance for the EU taxonomy

To be included in the EU taxonomy, an activity must contribute significantly to one of the six defined sustainability objectives (see Infographic 1). The European Commission claims that nuclear power contributes to the goal of combating climate change. As shown above, however, this claim is false. **On the contrary, sinking money into building new nuclear reactors or renovating old ones puts the brakes on the energy transition, keeps coal and gas-fired power stations running longer, and undermines efforts to combat the climate crisis.** This is exactly the opposite of what a transitional activity should achieve according to the Taxonomy Regulation.

4.2 Nuclear is not compatible with renewable energies

Nuclear power stations are the worst possible partner for renewable energies. Fluctuating electricity production from wind and sun needs to be supplemented by power sources that can be flexibly switched on and off. Nuclear reactors are not suited to this at all: it is only technically possible to a very limited extent, and far from economically viable.

Nuclear power plants are only economically viable if they operate for a very long time, as continuously as possible. If the number of full-load hours that a nuclear plant operates is reduced, the cost per kilowatt hour of the electricity it generates increases. This means that regular, prolonged shutdowns are not desirable for nuclear operators.[98] The consequence of this dynamic is that electricity from nuclear power is often given priority over renewable energy sources that are easier to switch on and off. In other words, because wind power is comparatively easier to shut down, nuclear power plants normally cover a fixed base load, running at close to 100 per cent capacity – meaning that cheaper and greener wind turbines are simply turned off when electricity demand is covered by the non-flexible nuclear base load. This in turn reduces the profitability of renewable energies and hinders their expansion.

Nuclear power is unsuitable to be the flexible reserve that the future power grid will need if it is to be based on renewable energy sources as much as possible (see 5.1).

This reality has been acknowledged, indirectly, by energy utilities E.ON and EDF, which have sought to limit the share of renewable energies in the energy mix, in order to protect their profitability from increased pressure for their nuclear plants to be more flexible.[99]

The output of nuclear power plants cannot, in any case, be managed in a sufficiently flexible way to compensate for fluctuations in renewable energy production.[100] It is only possible to quickly ramp down electricity production when a nuclear plant is operating in its upper power range, at approximately 80 to 100 per cent of output. Completely switching a nuclear reactor off and on again, however, takes several days – and puts strain on the reactor, shortening its life.[101] For this reason, a rapid shutdown from 100 to 0 per cent is only permitted 400 times during the entire lifetime of a nuclear reactor. Assuming a lifetime of 40 years, this would be equivalent to ten switch offs per year.[102] However, models have shown that in a power generation system with a 65 per cent share of renewables, nuclear reactors would have to be completely shut down roughly 100 times a year in order to avoid having to take renewables off the grid instead.[103] This is approximately ten times as many rapid shutdowns as is feasible.

Significance for the EU taxonomy

Nuclear power fails to meet the requirements for transition technologies. It slows down the deployment of low-carbon alternatives, and is incompatible with an increasing proportion of renewables in the grid.

98 Oda Becker, Review of the Taxonomy Regulation and Delegated Act Technical Aspects: Nuclear Energy, https://www.greenpeace.de/publikationen/EU_Taxonomie%20Expertise%20Nuclear.pdf
99 Frankfurter Rundschau, Stromriesen contra Windkraft, March 2009, https://www.fr.de/wirtschaft/stromriesen-contra-windkraft-11479534.html (in German). NB. E.ON no longer has any nuclear power plans and is not planning to build any more.
100 Grünwald, R., Caviezel, C., Lastfolgefähigkeit deutscher Kernkraftwerke. Monitoring, Karlsruhe Institute of Technology, March 2017, https://publikationen.bibliothek.kit.edu/1000102277 (in German)
101 Grünwald, R., Caviezel, C., ibid.
102 Grünwald, R., Caviezel, C., ibid.
103 EWI, GWS and Prognos, Energieszenarien fur ein Energiekonzept der Bundesregierung, Project Nr. 12/10, August 2010, https://www.ewi.uni-koeln.de/cms/wp-content/uploads/2015/12/EWI_2010-08-30_Energieszenarien-Studie.pd; DLR, Fraunhofer IWES, and IFnE, Langfristszenarien und Strategien für den Ausbau der erneuerbaren Energien in Deutschland bei Berücksichtigung der Entwicklung in Europa und global, "Leitstudie 2010", December 2010, https://www.dlr.de/dlr/presse/Portaldata/1/Resources/documents/leitstudie2010.pdf (both in German)

4.3 Nuclear is high-risk and unreliable

It is often claimed that nuclear power is a safe and reliable way of generating electricity – but this claim ignores the risk of catastrophe and natural disaster. The major nuclear disasters in Fukushima and Chernobyl are prime examples of this risk, events that paralysed entire countries, exposed the population to radionuclides, and contaminated the surrounding areas for generations to come. These accidents also had major implications for reactor design, which appears to have been a major factor in increasing nuclear costs. It would be extremely optimistic to assume that all unforeseen issues with nuclear plants that could have significant implications for their design have now been identified and taken into account. What's more, while some design lessons from Chernobyl and Fukushima have been implemented in new designs, their effectiveness is unknown and regulators are yet to determine which modifications might reduce certain risks. Meanwhile, the Russian war in Ukraine demonstrates another dimension of nuclear risk: the risk of nuclear disasters triggered by acts of war.

Infobox H

Lessons from Fukushima, Chernobyl and Zaporizhzhia

The numerous risks associated with nuclear power are starkly illustrated by three prominent examples:

Accident at Chernobyl nuclear power plant, 1986: The legacy of the nuclear reactor explosion and full-scale meltdown of the core during a system test at the Chernobyl power plant continues to be felt today, with many regions still uninhabitable or no longer able to be cultivated due to radioactive contamination. An area covering more than 200,000 km² of land in Europe was contaminated by the nuclear accident – nearly seven times the size of Belgium – primarily in Ukraine, Belarus and Russia, but also as far away as the UK and Ireland[104]. The impact on human health, meanwhile, has been severe, from deaths due to cancer and leukaemia, to health problems such as cardiovascular diseases, immune deficiencies and genetic mutations.[105]

104 IAEA, Environmental Consequences of the Chernobyl Accident and their Remediation: Twenty Years of Experience, Report of the Chernobyl Forum Expert Group 'Environment', 2006, https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1239_web.pdf

105 Greenpeace, The Chernobyl Catastrophe: Consequences on Human Health, 2006, https://archivo-es.greenpeace.org/espana/PageFiles/182800/chernobylhealthreport.pdf. See also, World Nuclear Association, Chernobyl Accident 1986, https://www.world-nuclear.org/ukraine-information/chernobyl-accident.aspx

Tsunami causes nuclear disaster at Fukushima, 2011: After the cooling system failed in the wake of a powerful tsunami, meltdowns occurred in three reactor buildings in Fukushima, leading to major hydrogen explosions that released large amounts of radiation. At least 160,000 residents had to evacuate their homes.[106] If the accident had taken a slightly different course, the entire greater Tokyo area – with its population of over 50 million people – would have required evacuation.[107]

In recent years, the nuclear power plant operator has deployed tens of thousands of workers, at major risk from radiation, to bring the situation at Fukushima under control and decontaminate the region – with limited success and at considerable cost.[108]

Rising clean-up costs have been estimated at between 700 million and several billion euros per year.[109] Contaminated water is a huge issue:[110] the total amount of radioactive waste water stored in tanks was over 1.3 million m3 by April 2023. Despite massive outcry, in 2023 Japan began discharging diluted radioactive water into the Pacific Ocean, a move that will have serious, long-term impacts for the environment.[111]

BU: ©DigitalGlobe/CC BY-NC-ND 2.0

106 Reuters, Ten years after Fukushima, Japan remembers 'man-made' nuclear disaster, March 2021, https://www.reuters.com/article/us-japan-fukushima-anniversary-legacy-idUSKBN2B103H
107 Kan, Naoto, and Jeffrey S. Irish, 'Prologue: My Nuclear Nightmare', in Jeffrey S. Irish (ed.), My Nuclear Nightmare: Leading Japan Through the Fukushima Disaster to a Nuclear-Free Future, 2017, https://academic.oup.com/cornell-scholarship-online/book/17273/chapter-abstract/174690919?redirectedFrom=fulltext
108 DW, UN: Fukushima cleanup workers risk 'exploitation', August 2018, https://www.dw.com/en/fukushima-un-says-cleanup-workers-in-danger-of-exploitation/a-45109476
109 Zeit Online, Fukushima kostet Japan jedes Jahr Milliarden, October 2016, https://www.zeit.de/politik/ausland/2016-10/nuklearkatastrophe-fukushima-japan-kosten-folgen (in German)
110 Greenpeace Germany, Stemming the tide 2020: The reality of the Fukushima radioactive water crisis, October 2010, https://www.greenpeace.de/publikationen/5768c541-the-reality-of-the-fukushima-radioactive-water-crisis_en_summary.pdf
111 Greenpeace International, Japan announces date for Fukushima radioactive water release, August 2023, https://www.greenpeace.org/international/press-release/61364/japan-announces-date-for-fukushima-radioactive-water-release/

The Zaporizhzhia nuclear plant: a security risk in a war zone, 2022–24: Fukushima and Chernobyl demonstrated that the impacts of a nuclear disaster can extend far beyond the site of the accident, both geographically and over time, but the recent annexation and shelling of the Zaporizhzhia nuclear power plant in Ukraine by the Russian military reveals a new risk: that of a nuclear reactor in an area of military conflict. This situation makes a nuclear accident in Europe much more likely.[112]

BU: © IMAGO/Erik Romanenko

Nuclear power has proven dangerous in the past – and the risks remain high to this day.

Radiation can have grave consequences for public health and the environment – whether under normal operating conditions or in the event of a nuclear accident. Radioactive particles spread through the air and impact natural metabolic cycles. Radiation affects humans – and animals – both when exposure is external, and when it is internal, for example by breathing, eating or drinking contaminated air, food or water (see Infobox I). High-energy radiation produced during radioactive decay damages cell structures – with the extent of the damage being affected by the method of exposure.[113] High doses of radiation lead to fatal radiation sickness, while at lower doses, the negative effects are often only apparent years later. This may result in chronic inflammation, cancer and genetic defects in subsequent generations.[114]

Research into the hazardous and insidious effects of radiation continues, as do efforts around the world to improve radiation protection based on the latest research findings, leading to increasingly stringent safety regulations.[115] Historically, the dangerous impacts of radiation have been underestimated and under-protected against.

112 Greenpeace Germany, A Nuclear Power Plant as Launch Pad, September 2023, https://www.greenpeace.de/publikationen/McKenzie_Report_Zaporizhzhia.pdf
113 For example, ingestion may cause more severe damage to cell structure than contact by the skin.
114 Greenpeace Germany, Risiko Atomkraft, 2007, https://www.greenpeace.de/publikationen/risiko_atomkraft_2007_1.pdf (in German)
115 German Federal Office for Radiation Protection (BfS), Atomausstieg erhöht die Sicherheit in Deutschland, aber es bleiben Risiken, April 2023, https://www.bfs.de/SharedDocs/Pressemitteilungen/BfS/DE/2023/003.html (in German)

Infobox I

Types of radiation: alpha, beta and gamma

Nuclear power plants use nuclear fission, which means a uranium atom is split into unstable particles, which in turn decay into other unstable particles and emit extremely high-energy radiation. This is mainly what is known as beta and gamma radiation. When this radiation strikes the body, electrically-charged particles called ions are created, hence the term 'ionising radiation'.[116]

With large-scale nuclear contamination, multiple types of radiation exposure occurs. External radiation exposure is primarily due to gamma and beta radiation, thanks to their longer range. Internal radiation exposure – when radioactive substances are inhaled or swallowed – mainly consists of alpha radiation, which only has a short range but can cause massive damage to cells due to its enormous energy output.[117] Some radioactive substances, such as radioactive iodine, accumulate in certain organs, such as the thyroid gland, where they cause damage.[118]

Nuclear reactors can never be 100 per cent safe. Exposure to dangerous levels of radiation primarily occurs when there are accidents in nuclear power plants, due to serious disruptions to operational procedures or sudden external influences. It is not – and has never been – possible to completely rule out such accidents. Old nuclear reactors are often maintained in operation longer than originally planned, and their materials and design become obsolete.[119] At the same time, there are new, additional threat scenarios for nuclear energy, a technology that was first developed back in the 1950s, long before the realities of the climate crisis, cyberattacks or the Russian war in Ukraine were at play. And although all available technological means, tools and advancements are used to minimise the risk of accidents, with such a complex technology, incalculable risks remain – as demonstrated by the tsunami-triggered nuclear disaster at Fukushima.

Nuclear accidents have far-reaching, even unforeseeable consequences, as the research project flexRISK has shown. FlexRISK investigated the geographical distribution of risk from severe accidents at nuclear facilities, particularly nuclear power stations in Europe.[120] It found that the area surrounding an accident could be affected for hundreds, if not thousands, of kilometres – often larger areas than existing emergency planning anticipates.[121] What's more, radiation can seriously harm humans and animals even at great distances, causing thyroid cancer and leukaemia, risk of chronic inflammation and genetic mutations in subsequent generations,[122] as well as the broader impacts from the loss of agricultural land due to contamination, and the social and economic impact on people who are forced to live in, or relocate from, contaminated areas.

116 Nuclear Safety, Types of ionising radiation, https://www.nuklearesicherheit.de/en/science/physics/ionising-radiation/types-of-ionising-radiation//
117 Agency for Toxic Substances and Disease Registry, Public Health Statement for Ionizing Radiation, https://wwwn.cdc.gov/TSP/PHS/PHS.aspx?phsid=482&toxid=86
118 American Thyroid Association, Nuclear Radiation and the Thyroid, https://www.thyroid.org/nuclear-radiation-thyroid/
119 Greenpeace Luxembourg, Risques liés aux réacteurs de 13000 MW en France, April 2024 https://www.greenpeace.org/static/planet4-luxembourg-stateless/2024/04/16a92c24-202404-nuke-1300mwe-rapportfr.pdf
120 Petra Seibert, Dèlia Arnold, Nikolaus Arnold et al., Flexrisk – Flexible tools for assessment of nuclear risk in Europe, Final Report, May 2013, BOKU-Met Report 23, https://meteo.boku.ac.at/report/BOKU-Met_Report_23_PRELIMv2_online.pdf
121 "An important finding was that regions where intervention measures [in the wake of nuclear accidents] could become necessary are larger than anticipated in current emergency planning of many European countries." Petra Seibert, Dèlia Arnold, Nikolaus Arnold et al., ibid., p. 10
122 Greenpeace Germany, Risiko Atomkraft, ibid.

Infobox J

Fukushima and the risks of the unforeseen

All serious nuclear accidents to date have been due to unforeseen events,[123] and Fukushima was no exception. Although protection against a possible tsunami was taken into consideration during the planning of the Fukushima Daiichi nuclear power plant, the March 2011 the tsunami was bigger than the contingency planning had anticipated. The recollections of Japan's Prime Minister at the time, furthermore, illustrate other weaknesses in emergency planning for nuclear accidents:

"[...] when I asked the head of the [Japanese] Nuclear Regulatory Commission about the situation immediately after the accident, I didn't grasp what he was saying. Then I asked: Are you a specialist in nuclear power? He answered: No, I studied economics. Even when the agency was staffed, it was assumed that a nuclear accident could be ruled out entirely. [...] Since my experience with Fukushima, my attitude has turned around 180 degrees: Now I'm campaigning for us to abandon nuclear power in Japan and, if possible, throughout the world."[124]

– Naoto Kan, Japanese Prime Minister at the time of the Fukushima accident

The catastrophic consequences of accidents at nuclear power plants do not exist with solar installations or wind farms, where accidents, if they occur, are localised and have no long-term ramifications.

Nuclear accidents burden future generations. The environmental degradation caused by nuclear disasters lasts for decades, if not centuries. Dealing with the fallout of an accident therefore ultimately falls to future generations. In Chernobyl, for instance, no one will be able to inhabit or use the affected areas for many years to come, and future generations will still have to pay for costs related to the contaminated reactor block and the disposal of the salvaged nuclear fuel.[125]

123 Greenpeace Germany, Risiko Atomkraft, ibid.
124 Der Spiegel, „Die Frage war, ob Japan untergeht", October 2015, https://www.spiegel.de/politik/ausland/ex-premier-ueber-fukushima-die-frage-war-ob-japan-untergeht-a-1056836.html (in German)
125 Oda Becker, ibid.

Infobox K

The nuclear debate in Germany

The disaster at the Fukushima nuclear power plant sparked a major debate in Germany. The heart of the debate was the question of what would constitute a safe and sustainable energy policy that does not burden future generations with unacceptable risks and costs. At the time of the disaster, the German government under Chancellor Angela Merkel convened an ethics commission to conduct a comprehensive review of the "ethically responsible basis" for decisions to secure a safe energy supply.[126] The commission concluded that:

„The phase-out [of nuclear] is necessary and recommended to rule out any future risks posed by nuclear power in Germany. This is possible because there are lower-risk alternatives. [...] For ethical reasons, nuclear power plants should only run until their output can be replaced by an energy supply that involves less risk."[127]

– Ethics Commission for a Safe Energy Supply

In light of the high risks involved, continuing to rely on nuclear power is unethical. By contrast, renewable energies provide a low-risk and sustainable energy supply.

Aside from the risk of accidents – and their catastrophic consequences – nuclear power has proven to be unreliable even under normal operating conditions.

Nuclear power stations are repeatedly taken offline due to technical malfunctions or because they require costly and lengthy maintenance.[128] In Germany, for example, the Brunsbüttel and Krümmel nuclear power plants had been out of service for 3–4 years due to prolonged technical problems and maintenance issues before they were permanently closed in 2011.[129] In France, an unprecedented number of outages in the reactors of nuclear power operator EDF caused record losses, leading the company to become so laden with debt that it had to be nationalised.[130] The financial burden of these reliability issues has thus been placed on society as a whole and will be paid for with taxpayers money.[131]

Service interruptions at nuclear power plants put considerable stress on energy security. In such situations, a large amount of electricity is suddenly unavailable, in far more dramatic proportions than the occasional fluctuations that occur when there is a drop in the amount of available sunlight or wind.[132] An energy system designed for renewables, moreover, is much more responsive to variability than the old centralised power system, which means that energy supply security from renewables will continue to increase in future.

126 Ethics Commission for a Safe Energy Supply, Germany's energy transition – A collective project for the future, May 2011, https://www.bundesregierung.de/resource/blob/2065474/457334/bae4db36ddee0379dac83f1a14cab337/2011-05-30-abschlussbericht-ethikkommission-en-data.pdf?download=1 (in German)

127 Ethics Commission for a Safe Energy Supply, ibid.

128 Energy Brainpool, Analyse Der Kraftwerksverfügbarkeit Von Kernkraftwerken Am Beispiel Frankreichs, June 2022, https://green-planet-energy.de/fileadmin/docs-pe/sonstiges/2022-06-13_FactSheet-Analyse_der_Kraftwerksverfuegbarkeit_Kernkraft_GPE_final.pdf (in German)

129 Taz, AKWs in Brunsbüttel und Krümmel: Erneute Pannen, December 2016, https://taz.de/AKWs-in-Brunsbuettel-und-Kruemmel/!5369425/ (in German)

130 Reuters, French court clears nationalisation of EDF, May 2023 https://www.reuters.com/business/energy/french-appeals-court-clears-govts-buyout-edf-ruling-2023-05-02/

131 Jens Weibezahn and Björn Steigerwald, Fission for Funds - The Financing of Nuclear Power Plants, ibid.

132 Reuters, France's EDF takes more nuclear reactors offline after faults found, December 2021, https://www.reuters.com/markets/europe/edf-extend-civaux-nuclear-outage-shut-down-reactors-chooz-safety-measures-2021-12-15/

The climate crisis increases the risk of nuclear power station outages – or even accidents. Extreme weather events, wildfires, rising sea levels and rising water temperatures in rivers and lakes will intensify as the climate crisis unfolds. Nuclear power plants are not equipped to handle this, and even the EU's own European Scientific Advisory Board on Climate Change has expressed concerns about nuclear power plant operability linked to increasing water scarcity and hotter water temperatures.[133] French nuclear plants, for example, have repeatedly been unable to operate in recent years during summer due to droughts and excessively warm river water temperatures.[134]

Nuclear power plants are not resistant to the effects of climate change – they are ill-equipped to cope with the changes and dangers that will only intensify in the years to come.

Significance for the EU taxonomy

One of the core elements of the EU taxonomy is the 'do no significant harm' (DNSH) principle, which stipulates that a taxonomy-compliant technology must not pose a significant risk to the environment.

Nuclear power plants pose grave dangers. The European Commission, however, simply ignores the possibility of nuclear accidents, the impact of the climate crisis[135] and the hazard posed by terrorism or war, and only includes the 'normal course of operations' in its sustainability assessment. Yet nuclear energy is not comparable to other economic activities: no other technology requires such elaborate safety mechanisms and emergency measures as nuclear power.

It therefore stands to reason that the consequences of major nuclear accidents, which can be triggered by natural events and human factors, as well as by war and terrorist attacks, should be fully included in the assessment.[136] The inclusion of nuclear power in the EU taxonomy of sustainable activities thus clearly contravenes the DNSH principle.

133 European Scientific Advisory Board on Climate Change, EU climate Advisory Board: focus on immediate implementation and continued action to achieve EU climate goals, ibid.
134 Bloomberg, French Winter Power Twice as Pricey as Germany's on Nuclear Woes, April 2023, https://www.bloomberg.com/news/articles/2023-04-19/french-winter-power-twice-as-pricey-as-germany-s-on-nuclear-woes, and France Cuts Nuclear Output as Heat Triggers Water Restrictions, July 2023, https://www.bloomberg.com/news/articles/2023-07-13/france-cuts-nuclear-output-as-heat-triggers-water-restrictions; The Guardian, EDF cuts output at nuclear power plants as French rivers get too warm, August 2022, https://www.theguardian.com/business/2022/aug/03/edf-to-reduce-nuclear-power-output-as-french-river-temperatures-rise
135 European Scientific Advisory Board on Climate Change, EU climate Advisory Board: focus on immediate implementation and continued action to achieve EU climate goals, ibid, Page 65
136 Oda Becker, ibid.

4.4 The nuclear waste problem remains unresolved

The dangers of radioactive waste are often downplayed, in terms of the risks and the duration of storage.

Nuclear waste is extremely toxic. Take plutonium, which is produced when the uranium used as fuel is bombarded with subatomic particles called neutrons. Plutonium cannot penetrate human skin, but when it enters the body through inhalation or ingestion, the body's cells are directly exposed to toxic radiation. One millionth of a gram of plutonium – a particle not even the size of a grain of dust – can cause fatal lung cancer.[137]

Nuclear power produces large quantities of radioactive waste, which needs to be stored for hundreds of thousands of years. A nuclear power station like Civaux 1 in France produces up to 30 tonnes of radioactive waste every year, including some 300 kg of plutonium isotopes and 1.5 tonnes of highly radioactive fission products (spent fuel).[138] It is only after up to a million years of safe storage – completely isolated from the biosphere – that radiation levels return to those of uranium ore.[139]

In searching for suitable repositories for nuclear waste, some countries, like Finland, consider shorter time periods for the storage of radioactive waste to be acceptable (meaning that radiation levels at the end of its storage will be proportionally higher) – but even then they anticipate that it will have to be safely stored for at least 100,000 years.[140]

Infobox L

European Commission's views on nuclear waste rely on flawed report

The European Commission's arguments make extensive reference to a report by its Joint Research Centre (JRC), which looked at nuclear energy in relation to the taxonomy's 'do no significant harm' (DNSH) principle.[141]
Incredibly, the JRC report concluded that the production of highly radioactive nuclear waste that lasts hundreds of thousands of years does not do significant harm. This JRC report is highly controversial, due to a number of problematic elements, including that:[142]

- It does not properly acknowledge that there is still no guaranteed safe deep geological repository for nuclear waste;
- It takes a highly simplified – and very optimistic – view of the process of establishing national deep geological repositories;
- It does not analyse the consequences of possible accidents, especially when waste is stored in a deep geological repository. This is a major shortcoming because such accidents could trigger significant quantities of radioactive contamination;
- It refers to existing EU nuclear waste legislation, but fails to mention the problems with its implementation. Virtually no EU member state has

137 BfS, Plutonium, https://www.bfs.de/DE/themen/ion/wirkung/radioaktive-stoffe/plutonium/plutonium_node.html (in German)
138 International Panel of Fissile Materials, Spent Fuel from Nuclear Reactors: An Overview, June 2011, https://fissilematerials.org/library/ipfm-spent-fuel-overview-june-2011.pdf
139 BASE, The nuclear phase-out in Germany, https://www.base.bund.de/EN/ns/nuclear-phase-out/nuclear-phase-out_node.html
140 BBC, Finland's plan to bury spent nuclear fuel for 100,000 years, June 2023, https://www.bbc.com/future/article/20230613-onkalo-has-finland-found-the-answer-to-spent-nuclear-fuel-waste-by-burying-it
141 JRC, Technical assessment of nuclear energy with respect to the 'do no significant harm' criterion of Regulation (EU) 2020/852 ('Taxonomy Regulation'), August 2021, https://publications.jrc.ec.europa.eu/repository/handle/JRC125953
142 Oda Becker, ibid.

complied with the Radioactive Waste and Spent Fuel Management Directive within the specified timeframe (between 2015 and 2021).[143]
This failure even led to the launch of a number of infringement procedures in 2018, since all but five member states were unable to properly implement all aspects of the nuclear waste directive.[144]

Incinerating nuclear waste doesn't solve the problem. It has been suggested that nuclear waste can be incinerated in special nuclear reactors, as part of an 'advanced nuclear fuel cycle'.[145] However, the promise of 'breeder' reactors, for example, that use existing nuclear waste as nuclear fuel,[146] has long been pursued but with little success.[147] This option was studied thoroughly as part of Germany's search for deep geological storage for nuclear waste: it was concluded that the technical challenges and financial costs of this process would be enormous, without providing any significant advantages for a final repository, as the end-product of the incinerated waste would still need to be safely stored for a million years.[148] This is because the end-product would be just as radioactive as the original nuclear waste – the same level of radioactivity would simply be concentrated in a smaller volume.[149]

Nuclear waste is a burden for future generations. The search for permanent deep geological storage, or repository – which is currently the favoured option to dispose of nuclear waste – will take decades and entail enormous costs. Even if an acceptable option for final disposal is eventually found, the process of putting the nuclear waste into its permanent storage is nevertheless expected to take around 100 years.[150] Future generations, furthermore, will have no choice but to deal with our radioactive legacy, both to pay the costs of monitoring and maintaining its storage, and to bear the risks from its presence. Yet with timelines from hundreds of thousands to millions of years – a timescale in which ice ages and major tectonic shifts can be expected – there is no guarantee that future generations will be equipped to do this, or even aware of the toxic legacy beneath their feet, or if the supposedly 'permanent' storage has been compromised. As things currently stand, no guaranteed safe permanent repository has been found, and the failure of the geological repository in the Asse II salt mine illustrates the magnitude of this challenge.[151]

143 Directive 2011/70/Euratom.
144 European Commission, Second report on progress of implementation of Council Directive 2011/70/EURATOM and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects, December 2019, https://eur-lex.europa.eu/legal-content/EN/TXT/%20PDF/?uri=CELEX:52019DC0632&from=EN p. 9; and, WAU, CNFE et al, Nuclear Waste Management in the EU: Implementation of Directive 2011/70/Euratom Assessment Report, https://ecology.at/files/pr913_1.pdf
145 The concept of advanced nuclear fuel cycles depends on a process called partitioning and transmutation (P&T) - for more information, see e.g. Friederike Frieß, Matthias Englert et al., Advanced Nuclear Fuel Cycles and Nuclear Waste Disposal, 2021, https://www.oeko.de/fileadmin/oekodoc/Advanced-nuclear-fuel-cylces-and-nuclear-waste-disposal.pdf.
146 See, e.g. RePlanet, What a waste!, https://www.replanet.ngo/whatawaste
147 T. Kooyman, Current state of partitioning and transmutation studies for advanced nuclear fuel cycles, in Annals of Nuclear Energy, Vol. 157, 2021, https://www.sciencedirect.com/science/article/abs/pii/S0306454921001158; and, Nuclear Engineering International, France cancels ASTRID fast reactor project, September 2019, https://www.neimagazine.com/news/newsfrance-cancels-astrid-fast-reactor-project-7394432
148 BASE, Sicherheitstechnische Analyse und Risikobewertung von Konzepten zu Partitionierungs- und Transmutationsanlagen für hochradioaktive Abfälle, March 2021, https://www.base.bund.de/SharedDocs/Downloads/BASE/DE/berichte/kt/gutachten-partitionierung-und-transmutation.pdf?__blob=publicationFile&v=7 Executive summary in English, pp. 25–39
149 World Nuclear Association, Treatment and Conditioning of Nuclear Waste, https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-wastes/treatment-and-conditioning-of-nuclear-wastes.aspx
150 German Commission on the Storage of High-Level Radioactive Waste, Final report, 2016, ttps://www.bundestag.de/resource/blob/434430/35fc29d72bc9a98ee71162337b94c909/drs_268-data.pdf, p. 200
151 Greenpeace Germany, Asse II – der Endlager-GAU, https://www.greenpeace.de/klimaschutz/energiewende/atomausstieg/asse-ii-endlager-gau (in German)

The derelict nuclear waste repository “Asse II” near Remlingen, Germany, in 2009. The first nuclear waste containers were sunk at Asse II in 1967. At the end of the 1980s, it was discovered that water was seeping in, and that the pit was partially unstable. “Asse II” is to be cleared, but a final repository is still not in sight.

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Infobox M

France’s intractable problems with nuclear waste disposal

Activists gather in front of the headquarters of the Orano nuclear company in Châtillon, France, to protest the transport of France’s spent uranium to Siberia. Source: Greenpeace media, Nuclear Waste Action at Orano‘s Headquarters in Châtillon, France, October 2021

© Victor Point / Greenpeace

France is a prime example of the difficulties involved in nuclear waste disposal. Only the USA and China generate more electricity from nuclear power than France. France also produces a variety of types of radioactive waste in enormous quantities, as several Greenpeace reports have documented.[152] However, official figures from the national nuclear waste management agency ANDRA, and from the nuclear industry itself, drastically understate the actual quantities. A substantial proportion of France’s radioactive

152 See, for example, Greenpeace France, Les déchets nucléaires en question, April 2019, https://www.greenpeace.fr/dechets-nucleaires-rejets-radioactifs/ (in French)

material is not classified as nuclear waste,[153] as a recent Greenpeace report on the actual quantities and costs of nuclear waste shows.[154]

It is also clear that the reprocessing sector in France is not working: instead of being recycled, nuclear waste and other materials have been exported to Russia, or are piling up at increasingly congested sites across the country. Examples include the highly radioactive waste stored in spent fuel pools at the nuclear reprocessing plant in La Hague, Normandy.[155] Meanwhile, low-level radioactive waste is piling up at the Soulaines site in the Aube region.[156] There is strong opposition to building new reprocessing or storage sites in France, because no one wants a nuclear waste dump in their backyard. The intensity of local resistance has been demonstrated in places like Belleville-sur-Loire[157] and the town of Bure.[158] The local population in La Hague has also opposed planned storage pools for spent fuel elements,[159] some of which is highly radioactive and thus exceedingly dangerous – and will remain so for thousands of years.

Significance for the EU taxonomy

Nuclear waste storage contravenes both the 'do no significant harm' (DNSH) principle and the precautionary principle, due to its hazards and environmental impact. Yet the European Commission – relying heavily on the controversial JRC report (see Infobox L) – once again downplays the situation by comparing nuclear waste with the waste produced by batteries and solar panels,[160] and points to the current rules and targets of the EU member states aimed at dealing with the problem by 2050. However, there is no such solution in sight for nuclear waste – yet another reason why nuclear power has no place in the EU taxonomy for sustainable activities.

Despite the fact that nuclear waste storage is one of the main criteria for taxonomy-aligned nuclear power, no country currently has an operational deep storage repository. The European Commission only requires that there be a plan to have such a disposal facility for high level radioactive waste in operation by 2050. However, doubts over how realistic this actually is raise the prospect of stranded assets in non-compliant facilities in many European countries.

153 French Nuclear Safety Authority (ASN), L'ASN rend son avis sur la gestion des matières radioactives et l'évaluation de leur caractère valorisable, October 2020, https://www.asn.fr/l-asn-informe/actualites/avis-sur-la-gestion-des-matieres-radioactives-et-l-evaluation-de-leur-caractere-valorisable (in French)
154 Greenpeace France, À quel prix? Les coûts cachés des déchets nucléaires, 2019, https://www.greenpeace.fr/a-quel-prix-les-couts-caches-des-dechets-nucleaires/ (in French)
155 Reporterre, Déchets nucléaires: les piscines de La Hague vont déborder, February 2018, https://reporterre.net/Dechets-nucleaires-les-piscines-de-La-Hague-vont-deborder (in French)
156 Le Monde, Dans l'Aube, le centre de stockage des déchets très faiblement radioactifs sera saturé en 2029, April 2021, https://www.lemonde.fr/planete/article/2021/04/01/dans-l-aube-le-centre-de-stockage-des-dechets-tres-faiblement-radioactifs-sera-sature-en-2029_6075252_3244.html (in French)
157 Le Monde, Les élus prennent conscience de l'ampleur du chantier à venir: le site de déchets nucléaires de Bure face à de nouvelles oppositions locales, April 2021, https://www.lemonde.fr/planete/article/2021/04/01/le-projet-d-enfouissement-des-dechets-nucleaires-cigeo-suscite-de-nouvelles-reserves-de-collectivites_6075190_3244.html (in French)
158 France Info, Cher: le projet de stockage des déchets nucléaires à Belleville-sur-Loire abandonné, June 2020, https://france3-regions.francetvinfo.fr/centre-val-de-loire/cher/cher-projet-stockage-dechets-nucleaires-belleville-loire-abandonne-1848436.html (in French)
159 Reporterre, Le projet de piscine radioactive à La Hague vivement contesté, January 2022, https://reporterre.net/Le-projet-de-piscine-radioactive-a-La-Hague-vivement-conteste (in French)
160 European Commission, Requests for internal review, https://environment.ec.europa.eu/law-and-governance/aarhus/requests-internal-review_en See No. 26, Annex to the Commission's reply to Greenpeace's request, p.88.

4.5 Nuclear damages the climate and the environment

Nuclear power is not carbon neutral. Nuclear power is increasingly presented as a climate-friendly source of electricity, its proponents calling for it to have a place in the energy system of the future. Yet this view only takes into consideration one aspect of nuclear power, in isolation, namely the electricity production phase of the nuclear power plants currently in operation.

> **To truly assess the climate friendliness of nuclear energy, however, the entire life cycle of the technology must be taken into account.** This includes the mining and milling of uranium to produce fuel rods, which emits huge amounts of CO_2, as well as the construction of the nuclear reactor, followed by its operation, maintenance and renovation, and finally its decommissioning and dismantling at the end of its operational lifespan. When the entire life cycle is considered, the carbon accounting looks very different: one study, for example, estimates nuclear power's life cycle emissions at between 9 and 70 grams of CO_2e per kilowatt hour.[161] By way of comparison, the same study puts the life cycle emissions of onshore wind at 7 to 10.8 g of CO_2e per kilowatt hour, and utility-scale solar plants at 10 to 29 g of CO_2e per kilowatt hour.

Taking the highest value for each type of power generation, this means that onshore wind is less than one-sixth as emissions-intensive as nuclear power over its life cycle, and utility-scale solar less than half. And nuclear power's emissions may well be even higher: a different method of calculating total CO_2e emissions over one hundred years, set out in the same study, suggests that nuclear power may produce up to 178g CO_2e per kilowatt hour – significantly more than the taxonomy target of 100g.[162]

Nuclear reactors pose a risk to water quality. Vast quantities of water are required to cool nuclear reactors, which is why nuclear power plants are often built on the coast or beside rivers. The discharge of warm water from nuclear plants, as part of their normal operation, can significantly increase the temperature of rivers, which poses a threat to fish and other organisms.[163] Heatwaves and water shortages caused by climate change are also having an effect on the operation of nuclear power plants, and exemptions to rules on the maximum temperature of water that can be released are increasingly being granted, so as to maintain nuclear operations, thereby actively circumventing environmental protection laws.[164] Fukushima has also shown that, in the event of a nuclear accident, the impact on the environment – including from contaminated, radioactive water – can be enormous and long-term (see 3.3).

The consequences of uranium mining are catastrophic. Uranium fuels nuclear reactors, making it a key raw material in the production of nuclear energy. Uranium is a finite resource, mainly extracted from ores that are mined in open-cast mines. A nuclear power plant with a capacity of 1,000 megawatts[165] requires 160 to 175 tonnes of uranium per year, and with a uranium grade of 0.2 per cent in the ore, this entails moving 80,000 tonnes of rock.[166] The process of getting the uranium out of the mined ore creates a toxic sludge known as the tailings, which contain around 85 per cent of the ore's radioactivity.[167] Uranium mining is not only very costly, it

161 Jacobson, M.Z., ibid.
162 Jacobson, M.Z., ibid.
163 World Nuclear News, Heatwave forces temporary change to water-discharge rules in France, July 2022, https://www.world-nuclear-news.org/Articles/Heatwave-forces-temporary-change-to-water-discharg
164 Ibid., and, Bloomberg, France Cuts Nuclear Output as Heat Triggers Water Restrictions, July 2023, https://www.bloomberg.com/news/articles/2023-07-13/france-cuts-nuclear-output-as-heat-triggers-water-restrictions#xj4y7vzkg
165 For comparison, each of the four reactors in the French NPP Cattenom has a capacity of about 1,300 megawatts, see https://www.edf.fr/centrale-nucleaire-cattenom
166 .ausgestrahlt, Uranbergbau und Uranerzaufbereitung, https://www.ausgestrahlt.de/themen/uran/uran-bergbau-aufbereitung-anreicherung/ Uranium content in ore varies heavily, and may be even lower (e.g. 0.1%), which would mean an even greater proportion of waste rock, etc. See e.g. Öko-Institut, Streitpunkt Kernenergie: Eine neue Debatte über alte Probleme, https://www.oeko.de/uploads/oeko/aktuelles/streitpunkt_kernenergie.pdf
167 .ausgestrahlt, ibid.

also has negative environmental impacts on water, air, and soil: recurring influxes of water lead to contamination, which in turn pollutes large tracts of land, while uranium and its decay products pollute both drinking water and the food chain.[168]

Uranium mining is controlled by a small number of companies, mainly from Canada, Australia, Kazakhstan, Russia, Niger, Namibia, Uzbekistan and the USA. The expensive and difficult clean-up of contaminated landscapes too often falls by the wayside, with clean-up measures postponed even as the toxic and radioactive contamination of the environment continues. Highly contaminated sites – such as tailings piles – are often easily accessible, and thus pose a danger to the public.[169]

A uranium mine in Niger, operated by Orano (formerly AREVA), a French state-owned company. Nearby mining towns are contaminated with radioactivity, as a Greenpeace investigation revealed in 2009.[170]

© Philip Reynaers / Greenpeace

Infobox N

The impacts of uranium mining on indigenous peoples and workers

Humans and wildlife are affected by uranium mining, including the contamination of groundwater. This particularly affects indigenous peoples, on whose land most uranium mines are located – generally against their will.[171] The workers in the mines also suffer, through exposure to noise, dust, heavy metals, radon gas and ionising radiation. Workers and their families can be affected by contaminated food, clothing and drinking water, as well as toxic and radioactive dust particles in the air. The consequences of this contamination include birth defects, leukaemia, cancer, kidney damage and respiratory diseases.[172]

168 Nuclear Free Future Foundation et al, Uranium Atlas 2022, ttps://beyondnuclearinternational.files.wordpress.com/2020/09/uraniumatlas_2020.pdf
169 Oda Becker, ibid.
170 Greenpeace International, Radioactive Pollution Inspection in Niger, 2009, https://media.greenpeace.org/asset-management/27MZIF2SHC_E , and, Left in the Dust, 2010, https://media.greenpeace.org/archive/Report--Left-in-the-Dust-27MZIFIXELWO.html
171 Society for Threatened Peoples, Indigene sind Hauptopfer des Urankreislaufs: Klima-Taxonomie darf keine Hintertür für Atomkraft werden, September 2021, https://www.presseportal.de/pm/29402/5034298 (in German)
172 Der Spiegel, „Die Gesundheit von 80.000 Menschen ist bedroht“, April 2010, https://www.spiegel.de/wissenschaft/natur/uranabbau-in-niger-die-gesundheit-von-80-000-menschen-ist-bedroht-a-686633.html (in German)

Significance for the EU taxonomy

Nuclear power violates the taxonomy's criteria, over its entire life cycle, and in particular stages of its value chain. The taxonomy's requirements for life cycle emissions state that one kilowatt hour of electricity should produce no more than 100g of CO_2 – which is itself out of step with the EU's own goal of reaching climate neutrality by 2050. Even if the average life cycle emissions of nuclear power plants are currently below 100g, some calculations indicate that their life cycle emissions may be up to 178g. It is also evident that nuclear energy's emissions will rise if less productive uranium deposits are mined to meet demand, since a significant proportion of CO_2 emissions are generated during uranium extraction. Additionally, as a transitional activity nuclear power is supposed to have emission levels corresponding to the best performance in the energy sector, which it clearly does not have.

The long-term contamination of water, soil and air by uranium mining violates the 'do no significant harm' (DNSH) principle. On this issue, the European Commission merely refers to existing environmental protection regulations for uranium mining – but these are not intended to guarantee sustainable uranium mining, or sustainable production of electricity from nuclear energy, and are thus inadequate. The Commission should have laid down more stringent rules in this area, particularly because uranium mining concerns environmental impacts that occur outside of Europe, where regulations may be less strict. It should also be noted that the Commission argues that the upstream processes of uranium mining and milling are not relevant to the taxonomy, which is in direct contradiction of its own principles that explicitly call for a life cycle approach.

The situation of indigenous peoples on whose land uranium mining takes place, and who may have to live with the radioactive legacies of old mines (see Infobox N), is not mentioned anywhere in the JRC report, which the Commission refers to in its arguments.[173]

173 Oda Becker, ibid.

5 Renewable energy: a clean and sustainable solution

5.1 One hundred per cent renewables is achievable

A significant number of studies show that a global energy mix consisting of 100 per cent renewable energy is feasible by the year 2050,[174] and as early as 2040 in the EU.[175] The transition to renewables entails benefits at many levels, as set out in a recent report by the International Energy Agency (IEA),[176] including:

- **a reduction in energy bills, effective immediately;**
- **improved energy security;**
- **reduced CO_2 emissions in Europe; and,**
- **continually falling costs of renewable energy technologies.**

What is currently lacking in Europe is the political will to expand the necessary infrastructure and adapt the grid for renewables. This is due, in part, to the huge pressure exerted by the fossil and nuclear energy lobbies – and their political allies – to maintain the old, centralised system, which relies on these dirty and dangerous sources of energy, for as long as possible.[177]

The costs of expanding renewable sources of energy have, in general, declined dramatically in recent years.[178] A more comprehensive calculation, however, should also take into account that transforming the energy system and expanding the grid will involve additional costs. A recent French study shows that a similar amount of investment would be required for an electricity system with 100 per cent renewable sources of energy, including the costs of upgrading the grid infrastructure, as for the provisional expansion of nuclear power.[179] The considerable uncertainties in the cost estimates for nuclear power, however, mean that the actual costs for the latter may well turn out to be significantly higher.

Investment in fossil gas, meanwhile, while also higher than the cost of renewables, comes with additional economic dependencies, price volatility and unpredictability – costs that must be borne by consumers and households. A decentralised renewable energy system, on the other hand, offers additional societal benefits by reducing energy dependency.

174 Abstracts of 89 Peer-Reviewed Published Journal Articles From 37 Independent Research Groups With Over 210 Different Authors Supporting the Result That Energy for Electricity, Transportation, Building Heating/Cooling, and/or Industry can be Supplied Reliably with 100% or Near-100% Renewable Energy at Different Locations Worldwide, July 2023, https://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/100PercentPaperAbstracts.pdf; T.W. Brown, T. Bischof-Niemz, et al, Response to 'Burden of proof: A comprehensive review of the feasibility of 100% renewable-electricity systems', in Renewable and Sustainable Energy Reviews, Vol. 92, 2018, https://www.sciencedirect.com/science/article/pii/S1364032118303307, and additional sources in the following chapter

175 The PAC project, ibid.

176 IEA, Renewable Energy Market Update, June 2023, https://www.iea.org/reports/renewable-energy-market-update-june-2023

177 See, for example, Corporate Europe Observatory, RePowerEU plans misleading and heavily influenced by fossil fuel industry, May 2022, https://corporateeurope.org/en/2022/05/repowereu-plans-misleading-and-heavily-influenced-fossil-fuel-industry, and Euronews, Sustainability has lost its meaning as the nuclear lobby triumphs, August 2023, https://www.euronews.com/2023/08/25/sustainability-has-lost-its-meaning-as-the-nuclear-lobby-triumphs

178 Lazard, ibid. p.9.

179 Behrang Shirizadeh, Philippe Quirion, Low-carbon options for the French power sector: What role for renewables, nuclear energy and carbon capture and storage?, in Energy Economics, Vol. 95, 2021, https://www.sciencedirect.com/science/article/abs/pii/S0140988320303443?via%3Dihub

Fluctuations in renewable energy output can be compensated for. The renewables sector has enormous potential for development, and current challenges like the fluctuating output of solar and wind energy can be compensated for by using what are known as flexibility measures. Extensively researched in recent years, with their viability scientifically established,[180] flexibility measures include:

- **A more interconnected European grid.** Surpluses and shortages in electricity production that arise in different regions with different weather conditions need to be balanced out at a national and European level. An interconnected grid system already exists in Europe, but needs to be enhanced further.
- **Expansion of storage capacities.** Surplus solar or wind power needs to be temporarily stored and then fed into the grid at times when less power is being produced. This can be accomplished in the short-term using batteries, and in the long term by, for example, producing green hydrogen.
- **Smart demand management.** Industrial and residential demand can be managed – through flexible electricity pricing and smart systems and meters – so that it increases when lots of electricity is available, and declines when there is less. For example, electric vehicles can be charged, and washing machines run, at midday, when there is plenty of solar power available.
- **Combinations of genuinely complementary sources of energy,** such as geothermal energy and green hydrogen, also have a role to play. During extended phases of low electricity generation from renewables, such as long periods without wind and sun, reserve power stations that do not normally operate would fill the gap.

The energy storage technology sector – including batteries – is flourishing, with new and better solutions constantly emerging on the market. This could be partially supported – in line with the US model – by state guarantees for particularly risky yet innovative green investments, accompanied by taxonomy-aligned private investments.

The future is electric. The phasing-out of fossil fuels will entail the electrification of areas like transport and heating, giving electricity a greater share of the energy mix. This will have an impact on consumer behaviour.

> **Total energy consumption must decrease.** Every type of energy production has an impact on the environment, and we live on a planet with a limited supply of resources. This is where energy savings come into play: efficiency and sufficiency. Efficiency means that energy is used more effectively, while sufficiency means an overall reduced demand for energy. These two levers are identified in the most recent IPCC report as necessary components for mitigating global warming.[181]

Greenpeace sees the reduction of energy demand as crucial. Getting a grip on energy demand requires individuals to take a more proactive approach, from the use of public transport and energy-saving measures for home heating to climate-friendly dietary habits.[182] Even more importantly, however, it will require government programmes on energy conservation and energy efficiency, such as a comprehensive plan to renovate and insulate buildings.

180 See, for example, Mark Z. Jacobson, Mark A. Delucchi, et al., 100% Clean and Renewable Wind, Water, and Sunlight All-Sector Energy Roadmaps for 139 Countries of the World, in Joule, Vol.1, September 2017, https://www.cell.com/joule/fulltext/S2542-4351(17)30012-0?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS2542435117300120%3Fshowall%3Dtrue, European Renewable Energy Council, RE-thinking 2050, April 2010, https://warwick.ac.uk/fac/soc/pais/research/csgr/green/foresight/energyenvironment/2010_erec_rethinkhing_2050.pdf; Alice Hooker-Stroud, Philip James, et al., Toward understanding the challenges and opportunities in managing hourly variability in a 100% renewable energy system for the UK, in Carbon Management, Vol.5, 2014, https://www.tandfonline.com/doi/full/10.1080/17583004.2015.1024955;
The négaWatt Association, https://negawatt.org/en; and, Inforse-Europe, Energy Vision for Hungary, http://www.inforse.org/europe/VisionHU.htm

181 IPCC, Climate Change 2023 Synthesis Report, https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf

182 A range of guides are available on this subject, many of which are available from consumer and environmental organisations. See, for example, The Greenpeace Guide to Life, https://www.greenpeace.org.uk/wp-content/uploads/2021/11/Greenpeace-Guide-To-Life-2.pdf

5.2 Trends in energy production confirm viability of renewables

The Eggesin solar park in Germany, with 10 megawatt peak (MWp) capacity and 36,000 solar modules. The electricity generated can meet the needs of approximately 3,000 households and reduce annual CO_2 emissions by around 7,000 tonnes. Suffolk sheep graze on the site to keep the grass short under the modules.

In contrast to nuclear power, the market for renewable energy is booming: renewables are economically competitive and attracting an ever-increasing number of investors.

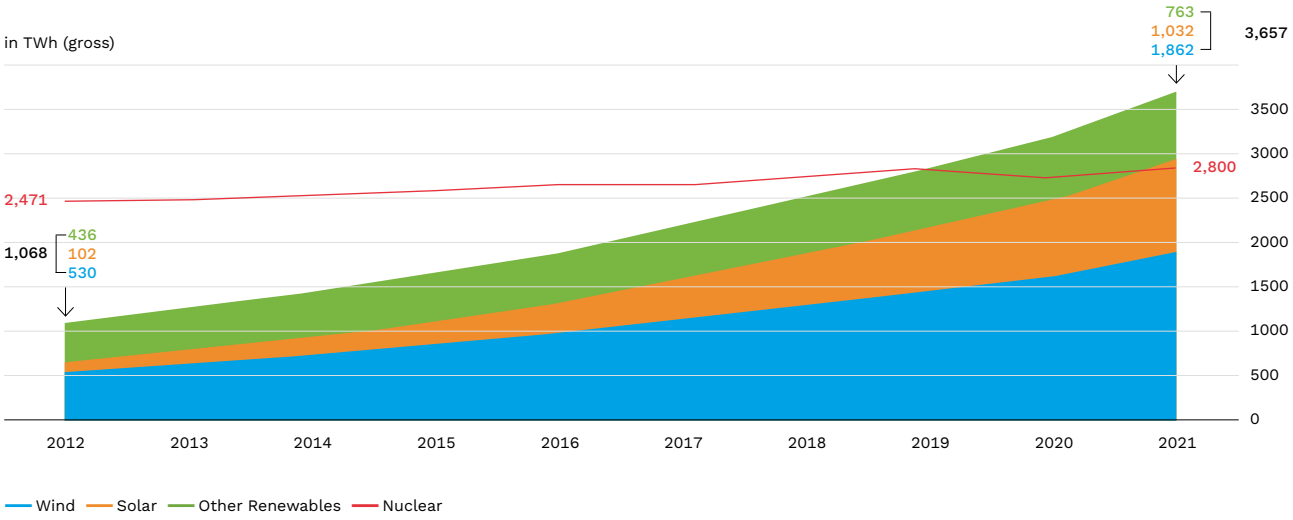
Nuclear energy is simply irrelevant in the global context, regardless of the nuclear lobby's stubborn refusal to admit it. Not even two per cent of the world's energy needs are currently met by nuclear power – and this figure continues to decline.[183] In the EU, nuclear electricity generation has been decreasing since 2006, and it accounted for 22 per cent of electricity generation in 2022, in large part due to France's role as a major nuclear power producer.[184] This means that nuclear power covers four to five per cent of Europe's overall energy demand (i.e. including heating and transport as well as electricity).

183 Austrian Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology, Atomkraft? Nicht einmal 2 Prozent der weltweiten Endenergie — irrelevant!, https://www.bmk.gv.at/dam/jcr:7e36e3f8-30d0-42ba-ae6c-2e94cbe1150a/Atomkraft_2_Prozent_Endenergie_ua.pdf&sa=D&source=docs&ust=1698058284871656&usg=AOvVaw1l-XjRmuiK5V_wR4z4SlVY

184 European Council, Infographic – How is EU electricity produced and sold?, https://www.consilium.europa.eu/en/infographics/how-is-eu-electricity-produced-and-sold/

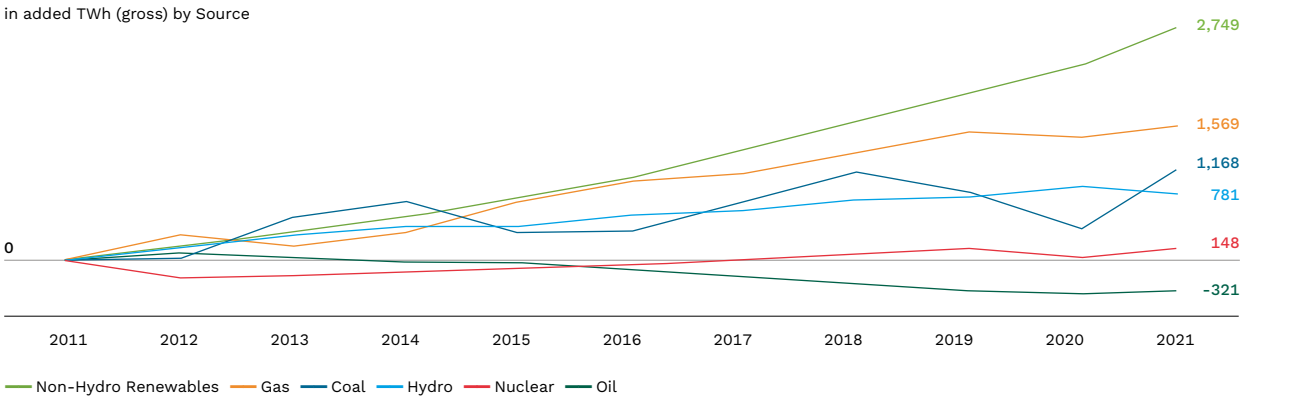
Global growth in renewable energy was unprecedented in 2022, when installed capacity rose by nearly ten per cent.[185] Nearly 300 gigawatts of renewable energy capacity was installed,[186] compared to less than eight gigawatts of nuclear power.[187] This pattern has been reflected in global trends for quite some time, as the following diagrams clearly show.

Infographic 7: Nuclear vs. Renewables (excluding hydropower), Annual electricity production in Terawatt hours (TWh), Global figures, 2012–2021.



Source: Based on the BP Statistical Review 2022[188] in the World Nuclear Report 2022[189]

Infographic 8: World electricity generation – Additional net electricity generation, annual production compared to 2011, Power Generation in the World – Annual Production Compared to 2011



Source: Based on the BP Statistical Review 2022[190] in the World Nuclear Report 2022[191]

185 IRENA, Renewable capacity statistics 2023, https://www.irena.org/Publications/2023/Mar/Renewable-capacity-statistics-2023
186 IRENA, Record Growth in Renewables Achieved Despite Energy Crisis, March 2023, https://www.irena.org/News/pressreleases/2023/Mar/Record-9-point-6-Percentage-Growth-in-Renewables-Achieved-Despite-Energy-Crisis
187 IAEA, The Database on Nuclear Power Reactors, https://pris.iaea.org/PRIS/home.aspx
188 BP, bp Statistical Review of World Energy 2022, https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf
189 World Nuclear Industry Status Report 2022, Graphs, https://www.worldnuclearreport.org/All-the-graphs-from-the-2022-report.html, Fig. 55
190 BP, ibid.
191 World Nuclear Industry Status Report 2022, Graphs, ibid. Fig. 54

A clear trend in favour of renewables is shown by the level of investment in the sector. In 2023, global investments in renewables were 10 times higher than investments in new nuclear power plants: 659 billion dollars were invested in solar and wind energy projects, compared to 63 billion dollars in nuclear power projects and 106 billion dollars in fossil projects (including fossil gas).[192] One obvious reason for this is that nuclear power is becoming increasingly expensive, as current trends and studies show. This stems in part from the growing costs of adapting to climate risks and from the more stringent safety precautions that have been implemented since the Chernobyl and Fukushima nuclear accidents.

The grossly overestimated importance of nuclear energy is nothing new. From the very early days of the nuclear power industry, predictions of its future role in the energy mix have had to be revised downwards. And nuclear energy is expected to become even less relevant in the future. At the same time, early projections massively underestimated renewable energy technologies, which have proven, time and again, to be far more successful than anticipated.[193] We cannot afford to divert money away from renewable technologies now by placing them at disadvantage vis-a-vis other polluting energy sources.

! **The time has come for us all to invest in the true technologies of the future. Renewable energies are demonstrating unprecedented growth, driving down costs even further – and a 100 per cent renewables-based energy system is achievable by 2040 in the EU.**[194]

192 IEA, World Energy Investment 2023, https://www.iea.org/reports/world-energy-investment-2023/overview-and-key-findings
193 Carbon Brief, Analysis: How have the IEA's renewable forecasts changed?, October 2016, https://www.carbonbrief.org/analysis-how-have-iea-renewable-forecasts-changed/
194 The PAC project, ibid.

6 Conclusion

In light of the incontrovertible trends showing the rise of renewables and decline of fossil fuels and nuclear power, it is clear that Europe should follow the scientific recommendations and pursue a successful energy transition that relies on 100 per cent renewable energy. The nuclear lobby may not have tired of spreading disinformation about the purported benefits of nuclear power, but promoting investments in nuclear – as envisaged by the EU taxonomy – ultimately does nothing to combat the climate crisis. Instead, investments in nuclear power – and fossil gas – delay urgently needed climate protection measures.

Both fossil gas and nuclear power have proven to be completely unsuitable as transitional activities, failing to meet the criteria set by the European Commission itself (see Infographic 1). By classifying them as transitional activities in the EU taxonomy, the Commission is guilty of misrepresentation, particularly in the case of nuclear power. A transitional activity is intended only to bridge the gap until 2050 – yet the Commission has recently stated that nuclear power will continue to be needed beyond this date.

The European Commission's decision to include both gas and nuclear technologies in the EU taxonomy shows that it has caved in to sustained lobbying by their proponents. This decision, furthermore, rests on a highly questionable factual basis, a particularly striking example of which is the controversial JRC report that the Commission relies upon to argue that nuclear power is not harmful (see Infobox L).

An EU sustainable finance taxonomy that promotes fossil gas and nuclear power as ostensibly green transitional activities undermines the EU's own climate goals, misleads investors, wastes money, and ultimately commits a breach of law. This is what prompted Greenpeace Germany, as an independent environmental protection organisation, to file a lawsuit before the General Court of the Court of Justice of the EU in 2023, along with seven other Greenpeace organisations.

The delegated act on the inclusion of gas and nuclear in the EU taxonomy must be considered invalid and cannot be allowed to continue to compromise Europe's energy transition.