

Precautionary principle

The **precautionary principle** or precautionary approach to **risk management** states that if an action or policy has a suspected risk of causing harm to the **public** or to the **environment**, in the absence of **scientific consensus** that the action or policy is not harmful, the **burden of proof** that it is *not* harmful falls on those taking an action.

The principle is used by policy makers to justify discretionary decisions in situations where there is the possibility of harm from making a certain decision (e.g. taking a particular course of action) when extensive scientific knowledge on the matter is lacking. The principle implies that there is a **social responsibility** to protect the public from exposure to harm, when scientific investigation has found a plausible risk. These protections can be relaxed only if further scientific findings emerge that provide sound evidence that no harm will result.

In some legal systems, as in the law of the European Union, the application of the precautionary principle has been made a statutory requirement in some areas of law.

Regarding international conduct, the first endorsement of the principle was in 1982 when the **World Charter for Nature** was adopted by the **United Nations General Assembly**, while its first international implementation was in 1987 through the **Montreal Protocol**. Soon after, the principle integrated with many other legally binding international treaties such as the **Rio Declaration** and **Kyoto Protocol**.

1 Origins and theory

The term “precautionary principle” is generally considered to have arisen in English from a translation of the German term *Vorsorgeprinzip* in the 1980s.^{[1]:31}

The concepts underpinning the precautionary principle pre-date the term’s inception. For example, the essence of the principle is captured in a number of cautionary aphorisms such as “an ounce of prevention is worth a pound of cure”, “better safe than sorry”, and “look before you leap”. The precautionary principle may also be interpreted as the evolution of the ancient medical principle of “**first, do no harm**” to apply to institutions and institutional decision-making processes rather than individuals.

In economics, the precautionary principle has been analysed in terms of the effect on rational decision-making of the interaction of **irreversibility** and **uncertainty**. Authors such as Epstein (1980)^[2] and Arrow and Fischer

(1974)^[3] show that irreversibility of possible future consequences creates a **quasi-option** effect which should induce a “**risk-neutral**” society to favor current decisions that allow for more flexibility in the future. Gollier et al. (2000)^[4] conclude that “more scientific uncertainty as to the distribution of a future risk – that is, a larger variability of beliefs – should induce Society to take stronger prevention measures today.”

2 Formulations

Many definitions of the precautionary principle exist. Precaution may be defined as “*caution in advance*,” “*caution practised in the context of uncertainty*,” or *informed prudence*. Two ideas lie at the core of the principle:^{[5]:34}

1. an expression of a need by decision-makers to anticipate harm before it occurs. Within this element lies an implicit reversal of the onus of proof: under the precautionary principle it is the responsibility of an activity proponent to establish that the proposed activity will not (or is very unlikely to) result in significant harm.
2. the concept of proportionality of the risk and the cost and feasibility of a proposed action

One of the primary foundations of the precautionary principle, and globally accepted definitions, results from the work of the **Rio Conference**, or “**Earth Summit**” in 1992. Principle #15 of the **Rio Declaration** notes: “In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”^[6]

The 1998 **Wingspread Statement on the Precautionary Principle** summarizes the principle this way: “When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.”^[7] The Wingspread Conference on the Precautionary Principle was convened by the Science and Environmental Health Network.^[7]

The February 2, 2000 Commission of the European Communities, Communication from the Commission on

the Precautionary Principle, noted that, “The precautionary principle is not defined in the Treaty, which prescribes it only once - to protect the environment. But in practice, its scope is much wider, and specifically where preliminary objective scientific evaluation indicates that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen for the Community.” [8]:10

The January 29, 2000 Cartagena Protocol on Biosafety says, in regard to controversies over GMOs: “Lack of scientific certainty due to insufficient relevant scientific information . . . shall not prevent the Party of import, in order to avoid or minimize such potential adverse effects, from taking a decision, as appropriate, with regard to the import of the living modified organism in question.” [9]:6

3 Application

The application of the precautionary principle is hampered by both lack of political will, as well as the wide range of interpretations placed on it. One study identified 14 different formulations of the principle in treaties and nontreaty declarations.^[10] R.B. Stewart (2002)^[11] reduced the precautionary principle to four basic versions:

1. Scientific uncertainty should not automatically preclude regulation of activities that pose a potential risk of significant harm (Non-Preclusion PP).
2. Regulatory controls should incorporate a margin of safety; activities should be limited below the level at which no adverse effect has been observed or predicted (Margin of Safety PP).
3. Activities that present an uncertain potential for significant harm should be subject to best technology available requirements to minimize the risk of harm unless the proponent of the activity shows that they present no appreciable risk of harm (BAT PP).
4. Activities that present an uncertain potential for significant harm should be prohibited unless the proponent of the activity shows that it presents no appreciable risk of harm (Prohibitory PP).

In deciding how to apply the principle, analysis may use a cost-benefit analysis that factors in both the opportunity cost of not acting, and the option value of waiting for further information before acting. One of the difficulties of the application of the principle in modern policy-making is that there is often an irreducible conflict between different interests, so that the debate necessarily involves politics.

3.1 Strong vs. weak

Strong precaution holds that regulation is required whenever there is a possible risk to health, safety, or the environment, even if the supporting evidence is speculative and even if the economic costs of regulation are high.^{[12]:1295-96} In 1982, the United Nations World Charter for Nature gave the first international recognition to the strong version of the principle, suggesting that when “potential adverse effects are not fully understood, the activities should not proceed.” The widely publicized Wingspread Declaration, from a meeting of environmentalists in 1998, is another example of the strong version.^[13] ‘Strong precaution’ can also be termed as a “no-regrets” principle, where costs are not considered in preventative action.

Weak precaution holds that lack of scientific evidence does not preclude action if damage would otherwise be serious and irreversible.^{[14]:1039} Humans practice weak precaution every day, and often incur costs, to avoid hazards that are far from certain: we do not walk in moderately dangerous areas at night, we exercise, we buy smoke detectors, we buckle our seatbelts.^[13]

According to a publication by the New Zealand Treasury Department,

The weak version [of the Precautionary Principle] is the least restrictive and allows preventive measures to be taken in the face of uncertainty, but does not require them (eg, Rio Declaration 1992; United Nations Framework Convention of Climate Change 1992). To satisfy the threshold of harm, there must be some evidence relating to both the likelihood of occurrence and the severity of consequences. Some, but not all, require consideration of the costs of precautionary measures. Weak formulations do not preclude weighing benefits against the costs. Factors other than scientific uncertainty, including economic considerations, may provide legitimate grounds for postponing action. Under weak formulations, the requirement to justify the need for action (the burden of proof) generally falls on those advocating precautionary action. No mention is made of assignment of liability for environmental harm.

Strong versions justify or require precautionary measures and some also establish liability for environmental harm, which is effectively a strong form of “polluter pays”. For example, the Earth Charter states: “When knowledge is limited apply a precautionary approach ... Place the burden of proof on those who argue that a proposed activity will not cause significant harm, and make the responsible parties liable for environmental harm.” Reversal

of proof requires those proposing an activity to prove that the product, process or technology is sufficiently “safe” before approval is granted. Requiring proof of “no environmental harm” before any action proceeds implies the public is not prepared to accept any environmental risk, no matter what economic or social benefits may arise (Peterson, 2006). At the extreme, such a requirement could involve bans and prohibitions on entire classes of potentially threatening activities or substances (Cooney, 2005). Over time, there has been a gradual transformation of the precautionary principle from what appears in the Rio Declaration to a stronger form that arguably acts as restraint on development in the absence of firm evidence that it will do no harm.^[15]

3.2 International agreements and declarations

The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. The principle was implemented in an international treaty as early as the 1987 Montreal Protocol, and among other international treaties and declarations^[16] is reflected in the 1992 Rio Declaration on Environment and Development (signed at the United Nations Conference on Environment and Development).

3.2.1 “Principle” vs. “approach”

No introduction to the precautionary principle would be complete without brief reference to the difference between the precautionary **principle** and the precautionary **approach**. Principle 15 of the Rio Declaration 1992 states that: “in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation.” As Garcia (1995) pointed out, “the wording, largely similar to that of the principle, is subtly different in that: (1) it recognizes that there may be differences in local capabilities to apply the approach, and (2) it calls for cost-effectiveness in applying the approach, e.g., taking economic and social costs into account.” The ‘approach’ is generally considered a softening of the ‘principle’.

“As Recuerda has noted, the distinction between the ‘precautionary principle’ and a ‘pre-

cautionary approach’ is diffuse and, in some contexts, controversial. In the negotiations of international declarations, the United States has opposed the use of the term ‘principle’ because this term has special connotations in legal language, due to the fact that a ‘principle of law’ is a source of law. This means that it is compulsory, so a court can quash or confirm a decision through the application of the precautionary principle. In this sense, the precautionary principle is not a simple idea or a desideratum but a source of law. This is the legal status of the precautionary principle in the European Union. On the other hand, an ‘approach’ usually does not have the same meaning, although in some particular cases an approach could be binding. A precautionary approach is a particular ‘lens’ used to identify risk that every prudent person possesses (Recuerda, 2008)^[17]

3.2.2 European Commission

On 2 February 2000, the European Commission issued a Communication on the precautionary principle,^[8] in which it adopted a procedure for the application of this concept, but without giving a detailed definition of it. Paragraph 2 of article 191 of the Lisbon Treaty states that

“Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay.”^[18]

After the adoption of the European Commission’s Communication on the precautionary principle, the principle has come to inform much EU policy, including areas beyond environmental policy. As of 2006 it had been integrated into EU laws “in matters such as general product safety, the use of additives for use in animal nutrition, the incineration of waste, and the regulation of genetically modified organisms.”^{[19]:282–83} Through its application in case law, it has become a “general principle of EU law.”^{[19]:283}

3.2.3 USA

On July 18, 2005, the City of San Francisco passed a Precautionary Principle Purchasing ordinance, which requires the city to weigh the environmental and health costs of its \$600 million in annual purchases – for everything from cleaning supplies to computers. Members of the Bay Area Working Group on the Precautionary Prin-

principle including the **Breast Cancer Fund**, helped bring this to fruition.

3.2.4 Japan

In 1997, Japan tried to use the consideration of the precautionary principle in a WTO SPS Agreement on the Application of Sanitary and Phytosanitary Measures case, as Japan's requirement to test each variety of agricultural products (apples, cherries, peaches, walnuts, apricots, pears, plums and quinces) for the efficacy of treatment against codling moths was challenged.

This moth is a pest that does not occur in Japan, and whose introduction has the potential to cause serious damage. The United States claimed that it was not necessary to test each variety of a fruit for the efficacy of the treatment, and that this varietal testing requirement was unnecessarily burdensome.

3.2.5 Australia

The most important Australian court case so far, due to its exceptionally detailed consideration of the precautionary principle, is *Telstra Corporation Limited v Hornsby Shire Council*. The case was heard in the New South Wales Land and Environment Court under Justice CJ Preston (24 April 2006). The Principle was summarised by reference to the NSW *Protection of the Environment Administration Act 1991*, which itself provides a good definition of the principle:

"If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reasoning for postponing measures to prevent environmental degradation. In the application of the principle... decisions should be guided by: (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and (ii) an assessment of risk-weighted consequence of various options".

The most significant points of Justice Preston's decision are the following findings:

1. The principle and accompanying need to take precautionary measures is "triggered" when two prior conditions exist: a threat of serious or irreversible damage, and scientific uncertainty as to the extent of possible damage.
2. Once both are satisfied, "a proportionate precautionary measure may be taken to avert the anticipated threat of environmental damage, but it should be proportionate."
3. The threat of serious or irreversible damage should invoke consideration of five factors: the scale of threat (local, regional etc.); the perceived value of the threatened environment; whether the possible

impacts are manageable; the level of public concern, and whether there is a rational or scientific basis for the concern.

4. The consideration of the level of scientific uncertainty should involve factors which may include: what would constitute sufficient evidence; the level and kind of uncertainty; and the potential to reduce uncertainty.
5. The principle shifts the burden of proof. If the principle applies, the burden shifts: "a decision maker must assume the threat of serious or irreversible environmental damage is... a reality [and] the burden of showing this threat... is negligible reverts to the proponent..."
6. The precautionary principle invokes preventative action: "the principle permits the taking of preventative measures without having to wait until the reality and seriousness of the threat become fully known".
7. "The principle should not be used to try to avoid all risks."
8. The precautionary measures appropriate will depend on the combined effect of "the degree of seriousness and irreversibility of the threat and the degree of uncertainty... the more significant and uncertain the threat, the greater...the precaution required". "...measures should be adopted... proportionate to the potential threats".

3.2.6 Corporate

The **Body Shop International**, a UK-based cosmetics company, recently included the Precautionary Principle in their 2006 **Chemicals Strategy**.

3.3 Environment and health

Fields typically concerned by the precautionary principle are the possibility of:

- Global warming or abrupt climate change in general
- Extinction of species
- Introduction of new and potentially harmful products into the environment, threatening biodiversity (e.g., genetically modified organisms)
- Threats to public health, due to new diseases and techniques (e.g., AIDS transmitted through blood transfusion)
- Long-term effects of new technologies (e.g. health concerns regarding radiation from cell phones and other electronics communications devices)

- Persistent or acute pollution (asbestos, endocrine disruptors...)
- Food safety (e.g., Creutzfeldt-Jakob disease)
- Other new biosafety issues (e.g., artificial life, new molecules)

The precautionary principle is often applied to biological fields because changes cannot be easily contained and have the potential of being global. The principle has less relevance to contained fields such as aeronautics, where the few people undergoing risk have given informed consent (e.g., a test pilot). In the case of technological innovation, containment of impact tends to be more difficult if that technology can self-replicate. Bill Joy emphasized the dangers of replicating genetic technology, nanotechnology, and robotic technology in his article in *Wired Magazine*, "Why the future doesn't need us", though he does not specifically cite the precautionary principle. The application of the principle can be seen in the public policy of requiring pharmaceutical companies to carry out clinical trials to show that new medications are safe.

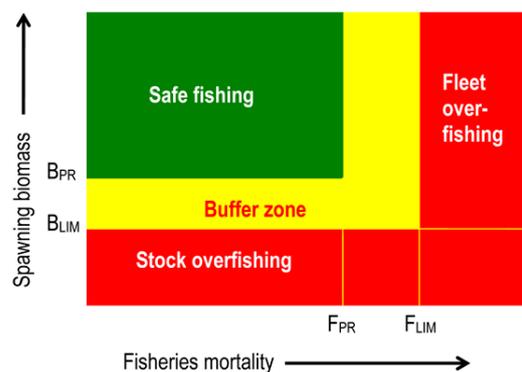
Oxford based philosopher Nick Bostrom discusses the idea of a future powerful superintelligence, and the risks that we/it face should it attempt to gain atomic level control of matter.^[20]

Application of the principle modifies the status of innovation and risk assessment: it is not the risk that must be avoided or amended, but a potential risk that must be prevented. Thus, in the case of regulation of scientific research, there is a third party beyond the scientist and the regulator: the consumer.

In an analysis concerning application of the precautionary principle to nanotechnology, Chris Phoenix and Mike Treder posit that there are *two forms* of the principle, which they call the "strict form" and the "active form". The former "requires inaction when action might pose a risk", while the latter means "choosing less risky alternatives when they are available, and [...] taking responsibility for potential risks." Thomas Alured Faunce has argued for stronger application of the precautionary principle by chemical and health technology regulators particularly in relation to TiO₂ and ZnO nanoparticles in sunscreens, biocidal nanosilver in waterways and products whose manufacture, handling or recycling exposes humans to the risk of inhaling multi-walled carbon nanotubes.^[21]

3.4 Resource management

Several natural resources like fish stocks are now managed by precautionary approach, through Harvest Control Rules (HCR) based upon the precautionary principle. The figure indicates how the principle is implemented in the cod fisheries management proposed by the International Council for the Exploration of the Sea.



The Traffic Light colour convention, showing the concept of Harvest Control Rule (HCR), specifying when a rebuilding plan is mandatory in terms of precautionary and limit reference points for spawning biomass and fishing mortality rate.

In classifying endangered species, the precautionary principle means that if there is doubt about an animal's or plant's exact conservation status, the one that would cause the strongest protective measures to be realized should be chosen. Thus, a species like the silvery pigeon that might exist in considerable numbers and simply be under-recorded or might just as probably be long extinct is not classified as "data deficient" or "extinct" (which both do not require any protective action to be taken), but as "critically endangered" (the conservation status that confers the need for the strongest protection), whereas the increasingly rare, but probably not yet endangered emerald starling is classified as "data deficient", because there is urgent need for research to clarify its status rather than for conservation action to save it from extinction.

If, for example, a large ground-water body that many people use for drinking water is contaminated by bacteria (e-coli 0157 H7, campylobacter or leptospirosis) and the source of contamination is strongly suspected to be dairy cows but the exact science is not yet able to provide absolute proof, the cows should be removed from the environment until they are proved, by the dairy industry, not to be the source or until that industry ensures that such contamination will not recur.

4 Criticisms

Critics of the principle use arguments similar to those against other formulations of technological conservatism.

4.1 Internal inconsistency - applying strong PP risks causing harm

Strong formulations of the precautionary principle, without regard to its most basic provisions that it is to be applied only where risks are potentially high AND not

easily calculable, applied to the principle itself as a policy decision, may rule out its own use.^{[14]:26ff} The reason suggested is that preventing innovation from coming to market means that only current technology may be used, and current technology itself may cause harm or leave needs unmet; there is a risk of causing harm by blocking innovation.^{[22][23]} As Michael Crichton wrote in his novel, *State of Fear*: “The ‘precautionary principle’, properly applied, forbids the precautionary principle.”^[24] For example, forbidding nuclear power plants based on concerns about risk means continuing to rely on power plants that burn fossil fuels, which continue to release greenhouse gases.^{[14]:27} In another example, the Hazardous Air Pollutant provisions in the 1990 amendments to the U.S. Clean Air Act are an example of the Precautionary Principle where the onus is now on showing a listed compound is harmless. Under this rule no distinction is made between those air Pollutants that provide a higher or lower risk, so operators tend to choose less-examined agents that are not on the existing list.^[25]

4.2 Blocking innovation and progress generally

Because applications of strong formulations of the PP can be used to block innovation, a technology which brings advantages may be banned by PP because of its potential for negative impacts, leaving the positive benefits unrealized.^{[26][27]:201}

The precautionary principle has been ethically questioned on the basis that its application could block progress in developing countries.^[28]

4.3 Vagueness and plausibility

The PP calls for inaction in the face of scientific uncertainty, but some formulations do not specify the minimal threshold of plausibility of risk that acts as a “triggering” condition, so that any indication that a proposed product or activity might harm health or the environment is sufficient to invoke the principle.^{[29][30]} In *Sancho vs. DOE*, Helen Gillmor, Senior District Judge, wrote in a dismissal of Wagner’s lawsuit which included a popular^[31] worry that the LHC could cause “destruction of the earth” by a black hole:

Injury in fact requires some “credible threat of harm.” *Cent. Delta Water Agency v. United States*, 306 F.3d 938, 950 (9th Cir. 2002). At most, Wagner has alleged that experiments at the Large Hadron Collider (the “Collider”) have “potential adverse consequences.” Speculative fear of future harm does not constitute an injury in fact sufficient to confer standing. *Mayfield*, 599 F.3d at 970.^[32]

5 See also

6 References

- [1] Sonja Boehmer Christiansen. The Precautionary Principle in Germany: Enabling Government. Chapter 2 in *Interpreting the Precautionary Principle*, eds Tim O’Riordan and James Cameron Earthscan Publications Ltd, 1994
- [2] Epstein, L.S. (1980). “Decision-making and the temporal resolution of uncertainty”. *International Economic Review* **21** (2): 269–283. doi:10.2307/2526180. JSTOR 2526180.
- [3] Arrow, K.J. and Fischer, A.C. (1974). “Environmental preservation, uncertainty and irreversibility”. *Quarterly Journal of Economics* **88** (2): 312–9. doi:10.2307/1883074. JSTOR 1883074.
- [4] Gollier, Christian, Bruno Jullien & Nicolas Treich (2000). “Scientific Progress and Irreversibility: An Economic Interpretation of the ‘Precautionary Principle’”. *Journal of Public Economics* **75** (2): 229–253. doi:10.1016/S0047-2727(99)00052-3.
- [5] Andrew Jordan & Timothy O’Riordan. Chapter 3, The precautionary principle: a legal and policy history, in *The precautionary principle: protecting public health, the environment and the future of our children*. Edited by: Marco Martuzzi and Joel A. Tickner. World Health Organization 2004
- [6] UNEP. “Rio Declaration on Environment and Development”. Retrieved 29 October 2014.
- [7] Staff, Science and Environmental Health Network. January 26, 1998 Wingspread Conference on the Precautionary Principle
- [8] Commission of the European Communities. February 2, 2000 Communication From The Commission on the Precautionary Principle
- [9] Official text of the Cartagena Protocol
- [10] Foster, Kenneth R.; Vecchia, Paolo; Repacholi, Michael H. (2000). “Science and the Precautionary Principle”. *Science* **288** (5468): 979–981. doi:10.1126/science.288.5468.979. ISSN 0036-8075. PMID 10841718
- [11] Stewart, R.B. (2002). “Environmental Regulatory Decision Making Under Uncertainty”. *Research in Law and Economics* **20**: 76.
- [12] Sachs, Noah M. (2011). “Rescuing the Strong Precautionary Principle from its Critics”. *University of Illinois Law Review* **2011** (4): 1285–1338.
- [13] “The paralyzing principle: Does the precautionary principle point us in any helpful direction?” Goliath Business Knowledge on Demand. December 2002. http://goliath.ecnext.com/coms2/gi_0199-2593495/The-paralyzing-principle-does-the.html

- [14] Mandel, Gregory N.; Gathii, James Thuo (2006). "Cost Benefit Analysis Versus the Precautionary Principle: Beyond Cass Sunstein's Laws of Fear". *University of Illinois Law Review* **2006** (5): 1037–1079
- [15] "Precautionary Principle: Origins, definitions, and interpretations." Treasury Publication, Government of New Zealand. 2006. <http://www.treasury.govt.nz/publications/research-policy/ppp/2006/06-06/05.htm>
- [16]
- [17] Recuerda, M. A. (2008). "Dangerous interpretations of the precautionary principle and the foundational values of the European Union Food Law: Risk versus Risk". *Journal of Food Law & Policy* **4** (1).
- [18] Consolidated Version of the Treaty on the Functioning of the European Union article 191, paragraph 2
- [19] Recuerda, Miguel A. (2006). "Risk and Reason in the European Union Law". *European Food and Feed Law Review* **5**.
- [20] Nick Bostrom 2003 Ethical Issues in Advanced Artificial Intelligence – section 2
- [21] Faunce TA, *et al.* (2008). "Sunscreen Safety: The Precautionary Principle, The Australian Therapeutic Goods Administration and Nanoparticles in Sunscreens" (PDF). *Nanoethics* **2** (3): 231–240. doi:10.1007/s11569-008-0041-z. Archived from the original on 2011-02-28.
- [22] Brown, Tracey (9 July 2013)The precautionary principle is a blunt instrument *The Guardian*, Retrieved 9 August 2013
- [23] Sherry Seethaler. *Lies, Damned Lies, and Science: How to Sort through the Noise around Global Warming, the Latest Health Claims, and Other Scientific Controversies* FT Press, 2009
- [24] Merchant, G *et al.* Impact of the Precautionary Principle on Feeding Current and Future Generations CAST Issue Paper 52, June 2013
- [25] Goldstein BD, Carruth RS (2004). "Implications of the Precautionary Principle: is it a threat to science?". *Int J Occup Med Environ Health* **17** (1): 153–61. PMID 15212219.
- [26] Sunstein, Cass R. *The Paralyzing Principle: Does the Precautionary Principle Point us in any Helpful Direction? Regulation*, Winter 2002–2003, The Cato Institute.
- [27] David Deutsch, *The Beginning of Infinity* Penguin Books (UK), Viking Press (US), 2011. ISBN 978-0-7139-9274-8
- [28] Jimenez-Arias, Luis G. (2008). *Bioethics and the Environment*. Libros en Red. p. 73.
- [29] van den Belt H (July 2003). "Debating the Precautionary Principle: "Guilty until Proven Innocent" or "Innocent until Proven Guilty"?. *Plant Physiol.* **132** (3): 1122–6. doi:10.1104/pp.103.023531. PMC 526264. PMID 12857792.
- [30] Bailey, Ronald. *Precautionary Tale*. Reason. April 1999
- [31] Roger Highfield, Science Editor (5 September 2008). "Scientists get death threats over Large Hadron Collider". *Telegraph.co.uk*. Retrieved 29 October 2014.
- [32] "LHC lawsuit dismissed by US court". *symmetry magazine*. Retrieved 29 October 2014.

7 Other publications

- Kai Purnhagen, "The Behavioural Law and Economics of the Precautionary Principle in the EU and its Impact on Internal Market Regulation", Wageningen Working Papers in Law and Governance 2013/04,
- Arrow, K.J., *et al.* (1996). "Is There a Role for Cost-Benefit Analysis in Environmental, Health, and Safety Regulation?". *Science* **272** (5259): 221–2. doi:10.1126/science.272.5259.221. PMID 8602504.
- Andorno, Roberto (2004). "The Precautionary Principle: A New Legal Standard for a Technological Age" (PDF). *Journal of International Biotechnology Law* **1**: 11–19. doi:10.1515/jibl.2004.1.1.11.
- Communication from the European Commission on the precautionary principle Brussels (2000)
- European Union (2002), European Union consolidated versions of the treaty on European Union and of the treaty establishing the European community, Official Journal of the European Union, C325, 24 December 2002, Title XIX, article 174, paragraph 2 and 3.
- Greenpeace, "Safe trade in the 21st Century, Greenpeace comprehensive proposals and recommendations for the 4th Ministerial Conference of the World Trade Organisation" pp. 8–9
- Harremoës, Poul, David Gee, Malcolm MacGarvin, Andy Stirling, Jane Keys, Brian Wynne, Sofia Guedes Vaz (October 2002). "The Precautionary Principle in the 20th Century: Late Lessons from Early Warnings — Earthscan, 2002. Review". *Nature* **419** (6906): 433. doi:10.1038/419433a.
- O’Riordan, T. and Cameron, J. (1995), *Interpreting the Precautionary Principle*, London: Earthscan Publications
- Raffensperger, C., and Tickner, J. (eds.) (1999) *Protecting Public Health and the Environment: Implementing the Precautionary Principle*. Island Press, Washington, DC.
- Recuerda Girela, M.A., (2006), *Seguridad Alimentaria y Nuevos Alimentos, Régimen jurídico-administrativo*. Thomson-Aranzadi, Cizur Menor.

- Recuerda Girela, M.A., (2006), “Risk and Reason in the European Union Law”, *European Food and Feed Law Review*, 5.
- Ricci PF, Rice D, Ziagos J, Cox LA (April 2003). “Precaution, uncertainty and causation in environmental decisions”. *Environ Int* **29** (1): 1–19. doi:10.1016/S0160-4120(02)00191-5. PMID 12605931.
- Sandin, P. “Better Safe than Sorry: Applying Philosophical Methods to the Debate on Risk and the Precautionary Principle,” (2004).
- Stewart, R.B. “Environmental Regulatory Decision making under Uncertainty”. In *An Introduction to the Law and Economics of Environmental Policy: Issues in Institutional Design*, Volume 20: 71–126 (2002).
- Sunstein, Cass R. (2005), *Laws of Fear: Beyond the Precautionary Principle*. New York: Cambridge University Press
- 1998 *Wingspread Statement on the Precautionary Principle*
- Science and Environmental Health Network, *The Precautionary Principle in Action – a Handbook*
- Gary E. Marchant, Kenneth L. Mossman: *Arbitrary and Capricious: The Precautionary Principle in the European Union Courts*. American Enterprise Institute Press 2004, ISBN 0-8447-4189-2; free online PDF
- Umberto Izzo, *La precauzione nella responsabilità civile. Analisi di un concetto sul tema del danno da contagio per via trasfusionale (e-book reprint) [The Idea of Precaution in Tort Law. Analysis of a Concept against the Backdrop of the Tainted- Blood Litigation]*, UNITN e-prints, 2007, first edition Padua, Cedam 2004.free online PDF
- The Precautionary Principle Project: Sustainable Development, Natural Resource Management and Biodiversity Conservation

8 External links

- A Small Dose of Toxicology
- Bay Area Working Group on the Precautionary Principle
- Roberto Andorno, “The Precautionary Principle: A New Legal Standard for a Technological Age”, *Journal of International Biotechnology Law*, 2004, 1, p. 11–19
- Report by the UK Interdepartmental Liaison Group on Risk Assessment, 2002. “The Precautionary Principle: Policy and Application”
- David Appell, *Scientific American*, January 2001: “The New Uncertainty Principle”
- *The Times*, July 27, 2007, Only a reckless mind could believe in safety first
- *The Times*, January 15, 2005, “What is . . . the Precautionary Principle?”
- Bill Durodié, *Spiked*, March 16, 2004: The precautionary principle assumes that prevention is better than cure
- European Environment Agency (2001), *Late lessons from early warnings: the precautionary principle 1896–2000*
- Applying the Precautionary Principle to Nanotechnology, *Center for Responsible Nanotechnology* 2004
- Better Safe than Sorry: Applying Philosophical Methods to the Debate on Risk and the Precautionary Principle
- Communication from the European Commission on the precautionary principle
- UK Interdepartmental Liaison Group on Risk Assessment (ILGRA): *The Precautionary Principle: Policy and Application*
- Report of UNESCO’s group of experts on the Precautionary Principle (2005)
- Max More (2010), *The Perils Of Precaution*

9 Text and image sources, contributors, and licenses

9.1 Text

- **Precautionary principle** *Source:* <http://en.wikipedia.org/wiki/Precautionary%20principle?oldid=649290653> *Contributors:* Lee Daniel Crocker, Eloquence, Bryan Derksen, Robert Merkel, The Anome, Ed Poor, Rmhermen, Anthere, Heron, B4hand, Bobdobbs1723, Boud, Michael Hardy, Alfio, Snoyes, Bogdangiusca, Nikai, Corixidae, Kaihsu, Palfrey, Astudent, ۰۱۰, Wik, Bhuston, Populus, Modulatum, Wolf-keeper, Crasch, No Guru, Arnejohs, Guanaco, Kravietz, JRR Trollkien, Sam Hocevar, Pgreenfinch, Neutrality, Punchi, Flex, Freakofnurture, Spiffy sperry, Rich Farmbrough, Vsmith, ArnoldReinhold, Westendgirl, Ttguy, PhilHibbs, Dtremenak, Vortexrealm, AppleJuggler, Pearle, Paul Bonneau, Arthena, Rd232, Ricky81682, Apoc2400, Mailer diablo, Ynhockey, Batmanand, Sponge, Snowolf, Brownpau, Alai, Drbreznjev, Bookandcoffee, Kazvorpai, Woohookitty, Carcharoth, Behun, Graham87, Parmaestro, David Levy, Rjwilmsi, Pdelong, XP1, NeonMerlin, Mahlum, Krueschan, Jrtayloriv, Srleffler, Common Man, WhyBeNormal, GangofOne, Sasoriza, Dj Capricorn, FrankTobia, YurikBot, Wavelength, RussBot, PWhittle, Tralala, Tresckow, Chaser, Dysmorodrepanis, Mosquitopsu, Daniel Mietchen, Epipelagic, Mike Treder, Wknight94, Closedmouth, Arthur Rubin, Rob G Weemhoff, Allens, Emcee, Sardanaphalus, SmackBot, Tobias Schmidbauer, Reedy, Unyoyega, Mgreenbe, Miguelaznar, Ohnoitsjamie, Hmains, Angelbo, Chris the speller, RDBrown, Colonies Chris, Jon Nevill, Argyriou, “alyosha”, Someoneisatthedoor, Richard001, Metamagician3000, DDima, StN, Arnoutf, Mringgaard, Bcasterline, Arodb, Staalmannen, Anlace, Wickethewok, AT2663, Ckatz, Bbold, Hu12, Apathos, Beherbert, Dartelaar, Eastlaw, Dmatisoff, CmdrObot, Argon233, Knappster, Woffie, Tawkerbot4, Chris Henniker, Japan-man, Getf*cked, Electron9, Ajkr925, Ben Harris-Roxas, Lfstevens, Samuel Erau, Aavrakot, Epeefleche, Albany NY, Prospect77, PhilKnight, Rosie.cooney, Ralgara, Father Goose, WhatamIdoing, Jimjamjak, Hbent, DGG, Jim.henderson, Nijhofrene, Wild Pansy, R'n'B, Reblf, Maurice Carbonaro, Skumarlabot, DanaJayne, Skier Dude, Tarotcards, Jorfer, Dunsandel, VolkovBot, Johnfos, Gonzeaux, Rmauger, Thadius856AWB, Raymondwinn, Pnprice, Pvednes, Infineede, SylviaStanley, Hrafn, Phe-bot, WRK, Nopetro, PhilMacD, Danelosis, Ricklaman, Der Golem, Eiland, DerekMorr, ComputerGeezer, Utaranchal, Frozen4322, SchreiberBike, Polly, The Baroness of Morden, Jytdog, Dark Mage, SilvononBot, Winged Cat, Addbot, Pensatrice, Jncraton, Pince Nez, Yobot, A.k.a., AnomieBOT, Bsimmoms666, Materialscientist, Juanita09, Citation bot, Xqbot, Account3915, DSisyphBot, GrouchoBot, Dzsi, MerlLinkBot, Vladimir.frolov, FrescoBot, Citation bot 1, Micromesistius, Fauncet, Digenti, Sgsg, Informed counsel, RjwilmsiBot, Pmiddlemas, Solomonfromfinland, Tolly4bolly, Scientific29, Rangoon11, ChuispastonBot, Teapeat, Teakt17, ClueBot NG, Vergilden, Chester Markel, CitationCleanerBot, Awsmkid101, MrBill3, RealZero, IjonTichyIjonTichy, Mogism, ClutchTheMagnum, Lhays, Lalo3767, BrillifAN, Intpol123, Caligo57, 4Truth2020, Eddu1973, Monkbot, Jennchiu, ميسيس يار, Aniroodh Sarkar and Anonymous: 172

9.2 Images

- **File:Commons-logo.svg** *Source:* <http://upload.wikimedia.org/wikipedia/en/4/4a/Commons-logo.svg> *License:* ? *Contributors:* ? *Original artist:* ?
- **File:Folder_Hexagonal_Icon.svg** *Source:* http://upload.wikimedia.org/wikipedia/en/4/48/Folder_Hexagonal_Icon.svg *License:* Cc-by-sa-3.0 *Contributors:* ? *Original artist:* ?
- **File:HCR.gif** *Source:* <http://upload.wikimedia.org/wikipedia/en/0/06/HCR.gif> *License:* PD *Contributors:* ? *Original artist:* ?
- **File:Portal-puzzle.svg** *Source:* <http://upload.wikimedia.org/wikipedia/en/f/fd/Portal-puzzle.svg> *License:* Public domain *Contributors:* ? *Original artist:* ?
- **File:Symbol_book_class2.svg** *Source:* http://upload.wikimedia.org/wikipedia/commons/8/89/Symbol_book_class2.svg *License:* CC BY-SA 2.5 *Contributors:* Mad by Lokal_Profil by combining: *Original artist:* Lokal_Profil
- **File:Wikiquote-logo.svg** *Source:* <http://upload.wikimedia.org/wikipedia/commons/f/fa/Wikiquote-logo.svg> *License:* Public domain *Contributors:* ? *Original artist:* ?

9.3 Content license

- Creative Commons Attribution-Share Alike 3.0