

Precautionary principle

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The **precautionary principle** or precautionary approach 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 harmful, the burden of proof that it is *not* harmful falls on those taking the action.

This principle allows policy makers to make discretionary decisions in situations where there is the possibility of harm from taking a particular course or making a certain decision 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.^[1]

Precautionary Principle

The Precautionary Principle helps us choose whether an action should, or should not be done, without knowing the risks with certainty.	The Columns A+B Represent a Human CHOICE Which column should we choose?	
	A) Action Not Taken	B) Action Taken
These Two Rows are a <u>Prediction or Guess</u> . The certainty of risk is unknown and unknowable. We cannot choose the row.	Grave-Harm Caused=False	Benefits of Action not taken. Life continues
	Grave-Harm Caused=True	Benefits of Action not taken. Life Continues

The Precautionary Principle illustrated as a decision matrix

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Formulations of the precautionary principle

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*. All definitions have two key elements.

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 establishment of an obligation, if the level of harm may be high, for action to prevent or minimise such harm even when the absence of scientific certainty makes it difficult to predict the likelihood of harm occurring, or the level of harm should it occur. The need for control measures increases with both the level of possible harm and the degree of uncertainty.

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."^[2]

This definition is important for several reasons. First, it explains the idea that scientific uncertainty should not preclude preventative measures to protect the environment. Second, the use of "cost-effective" measures indicates that costs can be considered. This is different from a "no-regrets" approach, which ignores the costs of preventative action.

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." (The Wingspread Conference on the Precautionary Principle was convened by the Science and Environmental Health Network).

The February 2, 2000 European Commission Communication on the Precautionary Principle notes: "The precautionary principle applies where scientific evidence is insufficient, inconclusive or uncertain and preliminary 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 by the EU".

The January 29, 2000 Cartagena Protocol on Biosafety says: "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."

It is important to emphasize that, although this principle operates in the context of scientific uncertainty, it is considered by its proponents to be applicable only when, on the basis of the best scientific advice available, there is good reason to believe that harmful effects might occur.

The precautionary principle is most often applied in the context of the impact of human actions on the environment and human health, as both involve complex systems where the consequences of actions may be unpredictable.

As applied to environmental policy, the precautionary principle stipulates that for practices such as the release of radiation or toxins or massive deforestation the burden of proof lies with the advocates. [1] (http://www.biotech-info.net/rachels_586.html) Concerning potential risks to public health, examples of cases in which the precautionary principle has been advocated (but not always accepted) are: the commercialization of genetically modified foods, the use of growth hormones in cattle raising, measures to prevent the "mad cow" disease, health claims linked to phthalates in PVC toys, among many others.

An important element of the precautionary principle is that its most meaningful applications pertain to those that are potentially irreversible, for example where biodiversity may be reduced. With respect to bans on substances like mercury in thermometers, freon in refrigeration, or even carbon dioxide exhaust from automobile engines and power plants, it implies:

... a willingness to take action in advance of scientific proof [or] evidence of the need for the proposed action on the grounds that further delay will prove ultimately most costly to society and nature, and, in the longer term, selfish and unfair to future generations.

– [2] (<http://dieoff.org/page31.htm>)

The concept includes an implicit ethical responsibility towards maintaining the integrity of natural systems, and acknowledges the fallibility of human understanding.

Some environmental commentators take a more stringent interpretation of the precautionary principle, stating that proponents of a new potentially harmful technology must show the new technology is without major harm before the new technology is used.^{[3][4]}

Origins and theory

The formal concept evolved out of the German socio-legal tradition in the 1930s, centering on the concept of good household management.[3] (<http://www.agobservatory.org/library.cfm?refID=30236>) In German the concept is *Vorsorgeprinzip*, which translates into English as *precaution principle*.

Many of 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".[4] (http://www.biotech-info.net/rachels_586.html) 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.

The precautionary principle is in some ways an expansion of the English common law concept of ‘duty of care’ originating in the decisions of the judge Lord Esher in the late 1800s. According to Lord Esher: “Whenever one person is by circumstances placed in such a position with regard to another that everyone of ordinary sense who did think, would at once recognise that if he did not use ordinary care and skill in his own conduct with regard to those circumstances, he would cause danger or injury to the person, or property of the other, a duty arises to use ordinary care and skill to avoid such danger”. This statement clearly contains elements of foresight and responsibility, but does not refer to a lack of certainty, as the word “would” is used rather than “might”, or “could”. The other important difference is that the duty of care applies only to people and property, not to the environment.

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)^[5] and Arrow and Fischer (1974)^[6] 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)^[7] 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."

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.[5] (http://www.biotech-info.net/science_and_PP.html) R.B. Stewart (2002)^[8] 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.

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. 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.^[9] '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. 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.^[9]

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.^[10]

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 [6] (http://www.biotech-info.net/treaties_and_agreements.html) is reflected in the 1992 Rio Declaration on Environment and Development (signed at the United Nations Conference on Environment and Development).

"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 ‘precautionary 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,¹⁶ 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)^[11]

European Commission

On 2 February 2000, the European Commission issued a Communication on the precautionary principle,^[12] 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."^[13]

After the adoption of the European Commission's Communication on the precautionary principle, the principle has come to inform much EU policy, including that in areas beyond that of environmental policy. It is implemented, for example, in the EU food law and also affects, among others, policies relating to consumer protection, trade and research, and technological development. While a comprehensive definition of the precautionary principle was never formally adopted by the EU, a working definition and implementation strategy for the EU context has been proposed by Rene von Schomberg in Fisher et al. (2006):^[14]

"Where, following an assessment of available scientific information, there are reasonable grounds for concern for the possibility of adverse effects but scientific uncertainty persists, provisional risk management measures based on a broad cost/benefit analysis whereby priority will be given to human health and the environment, necessary to ensure the chosen high level of protection in the Community and proportionate to this level of protection, may be adopted, pending further scientific information for a more comprehensive risk assessment, without having to wait until the reality and seriousness of those adverse effects become fully apparent".

USA

On July 18, 2005, the City of San Francisco passed a Precautionary Principle Purchasing ordinance (<http://www.municode.com/Resources/gateway.asp?pid=14134&sid=5>) , 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 Principle including the Breast Cancer Fund, helped bring this to fruition.

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.

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".

Corporate

The Body Shop International, a UK-based cosmetics company, recently included the Precautionary Principle in their 2006 Chemicals Strategy. (http://www.thebodyshopinternational.com/NR/rdonlyres/D7F2A9D1-416A-47B8-8BC3-1E858A37F81C/0/BSI_Chemicals_Strategy.pdf.)

Environment/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)
- 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.^[15]

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 (<http://www.crnano.org/precautionary.htm>) 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."The academic 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.^[16]

Change of laws controlling societal norms

Associate Justice Martha Sosman's dissent^[17] in *Goodridge v. Department of Public Health*, the decision of the Supreme Judicial Court of Massachusetts that mandated legalization of same sex marriage, is an example of the precautionary principle as applied by analogy to changes in culturally significant social policy. She describes the myriad societal structures that rest on the institution of marriage, and points out the uncertainty of how they will be affected by this re-definition. The disagreement of the majority illustrates the difficulty of reaching agreement on the value of competing perspectives. Although the *Goodridge* case involved interpreting the state constitution, the substantive canon in Anglo-American jurisprudence that derogations of fundamental societal values should be narrowly construed^[18] is analogous to the precautionary principle favoring a statutory interpretation that comports with rather than damages the common law and established norms. See, for example, *Holy Trinity Church v. United States*, 143 U.S. 457 (1892).

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.

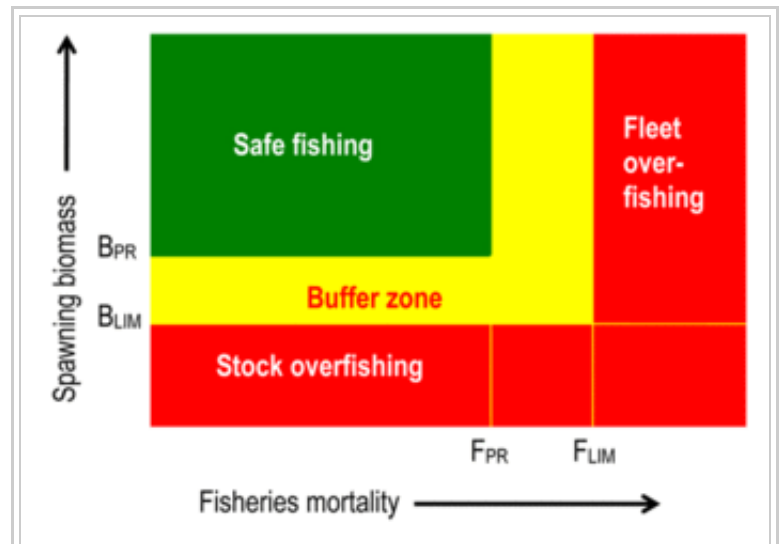
In classifying endangered species, the precautionary principle means that if there is doubt about an animal's or plant's exact conservation status, the one that would cause the strongest protective measures to be realized should be chosen. Thus, a species like the Silvery Pigeon that might exist in considerable 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.^[*citation needed*]

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, then 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.

Criticisms

Threshold of plausibility

The Wingspread Statement version of the PP takes the form "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". When applying this principle, it is recommended that society establish a minimal threshold of scientific certainty or plausibility before undertaking precautions. Normally, no minimal threshold of plausibility is specified 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. Often the only precaution taken is a ban on the product or activity.^[19]



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 *Sancho vs. DOE*, Helen Gillmor, Senior District Judge, wrote in a dismissal of Wagner's lawsuit which included a popular^[20] 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.^[21]

Negative consequences of application

The Precautionary Principle may cause resentment, since people are more aware of negative changes than they are positive changes (i.e. a ban is more noted than allowing a proposal to proceed). Because of this effect, a technology which brings advantages may be banned by PP because of its potential for negative impacts, leaving the positive benefits unrealized.^[22]

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.^[23]

A California researcher has pointed out the fallacy of extrapolating possible risk of a proposed product or action, without examining equally closely the possible risks of **not** adopting the proposal. When looking at the proposal, policymakers tend to apply PP to that proposal while assuming the alternative(s) to be risk-free, which places an unfair burden on the proponents of the new product or activity.^[24]

Internal Inconsistency

The Precautionary Principle, applied to itself as a policy decision, may rule out its own use depending on the precise definition used; for example, Prohibitory PP as a policy decision would need to demonstrate that no substantial damage would result from the prohibition of products and technologies. For a potential example of this, the uncertain safety and long-term environmental effects of nuclear power led to its disfavor by precautionary groups, which may have resulted in greater carbon emissions through the use of coal power.

Perspective

- Critics of the principle argue that it is impractical, since every implementation of a technology carries some risk of negative consequences.^[22] For example, when the arrival of amplified music came on the scene, the risk of electrocution and deafness arose. However, this did not prevent it from becoming an artistic and cultural norm.
- A summary of some representative objections to the precautionary principle are described in a Reason article by Ronald Bailey^[25] which, using the Wingspread consensus as a starting point, argues the possibilities for misapplication of the principle.

See also

- Benefit of the doubt (similar concept)
- Best Available Technology
- Biodiversity
- Biosafety
- Biosecurity
- Complex systems
- Diffusion of innovations
- Ecologically sustainable development
- Environmental law
- Health Impact Assessment
- Informed consent
- Maximin principle
- Opportunity cost
- Pascal's Wager
- Possible carcinogen
- Postcautionary principle
- Prevention of Disasters Principle
- Proactionary Principle
- Risk aversion
- Safe trade
- Substitution principle (sustainability)
- Sustainability
- Tombstone mentality

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