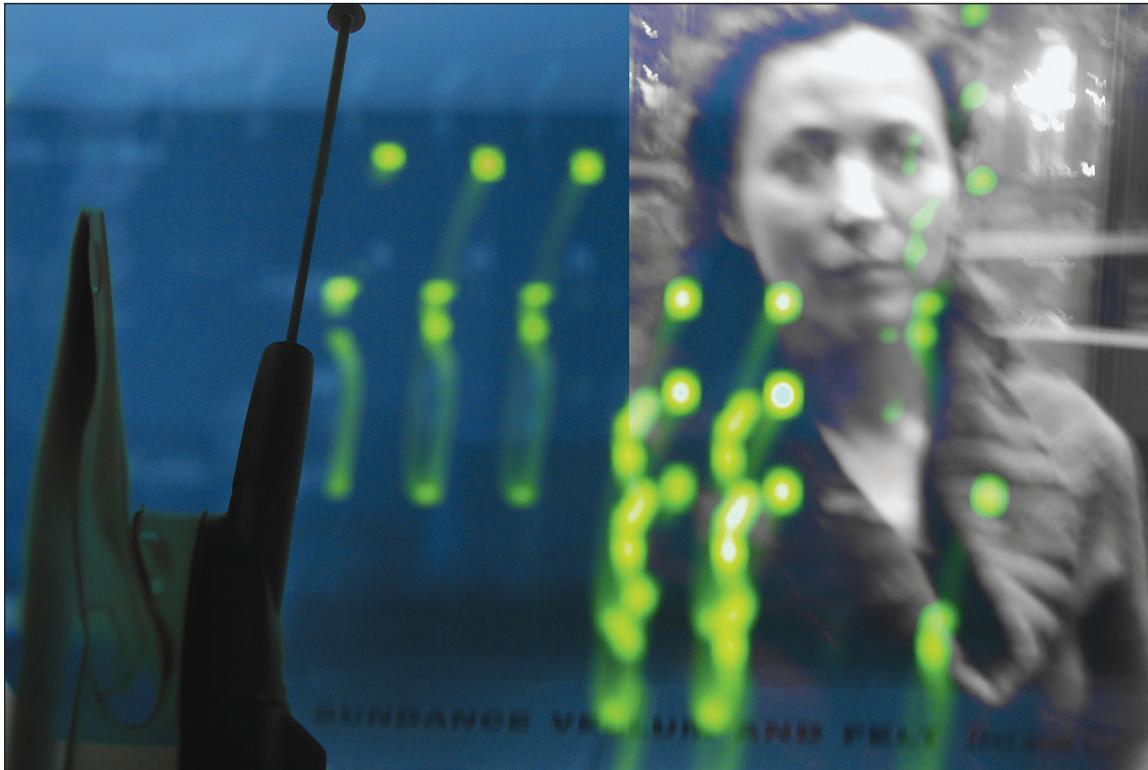


# The Precautionary Principle

## — COMMON SENSE OR ENVIRONMENTAL EXTREMISM?

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The fact that technologies have unintended consequences is self-evident. But risk management — managing the adverse effects of technology — is both uncertain and politically contentious, since it entails making decisions about socially important issues in the face of scientific uncertainty.

Originating in European environmental policy in the 1970s, the precautionary principle (PP) is embodied in adages such as “better safe than sorry” and “err on the side of caution.” In practice, this means taking steps to avoid possible environmental or health damage, in the face of insufficient scientific evidence.

The PP has achieved widespread political support, and — by the Treaty on European Union — it is the foundation of environmental policy in the European Union (EU). As a separate article in this issue by Petrini and Vecchia points out [p. 4], the PP is firmly established in international law, and a considerable body of case law is developing about its use in the EU.

However, it has also generated immense controversy. Its advocates (e.g., [1]) — who generally have a “green” political orientation — argue that it is the common sense approach to avoiding nasty surprises from new technologies. They point to the tragic history of health problems from asbestos, lead, and other such toxic substances, as examples of harm that might arise when early indications of hazard are not followed up with sufficient caution [2].

But critics describe the PP using terms such as “environmental extremism” [3]. Critics often complain that “precautionary” calculations usually consider risks

only, and disregard the possibility that new technologies can make life safer [4], [5]. Industry fears (correctly) that the PP will raise the bar to the introduction of new products and deployment of infrastructure, perhaps to arbitrarily high levels in the pursuit of absolute safety. One wag has proposed that the PP be applied to all uses of the PP, which would create stasis — a good or bad thing, depending on ones point of view.

Nevertheless, the PP is a fact of international law, and it is important to learn to use it wisely. I argue that the PP is flexible in meaning and interpretation, the range “precautionary” measures is very great, and no single approach can be said to be “required” by the PP. The problem of establishing exposure limits to electromagnetic fields (EMF) from power lines and mobile telephones makes a good case in point.

## DEFINING THE PRINCIPLE

“Precautionary” approaches to managing risk can be traced far back into history. One authority mentioned as the first application of the PP the famous incident when John Snow removed the handle of the Broad Street water pump in London in 1854, thereby stopping an epidemic of cholera [6].

However, as an identifiable doctrine, the PP is most directly traced to European environmental policies in the 1970s. By now more than a dozen “precautionary” statements can be found in international treaties and declarations [7], that can be taken as different statements of the PP.

While these “precautionary” statements consistently urge a risk-adverse approach to regulating risks in the face of scientific uncertainty, they vary greatly in implication.

For example, the 1984 Bremen Ministerial Declaration of the International Conference on the Protection of the North Sea declared that “States must not wait for proof of harmful effects before

taking action...”. While it might be difficult to measure precisely the damage created by dumping chemical wastes into ocean waters, no genius is required to imagine that such practices are environmentally damaging.

In the same vein, the 1992 Rio Declaration says “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.” In this case, “scientific certainty” can be interpreted as either certain knowledge of the risk, or certain knowledge that the proposed remedies will be effective. The Rio Declaration, unlike some other statements, raise the issue of cost effectiveness, and thus opens the door to cost-benefit analysis.

A much stronger statement of the PP is found in the World Charter for Nature, which says “where potential adverse effects are *not fully understood*, the activities should not proceed.” Since the future consequences of no action are fully understood, taken at face value this would seem to prohibit any new technology.

The Treaty on European Union — the founding document of the European Union with immense legal significance to its member states — simply states “community policy shall be based on the precautionary principle” — without any further definition of the principle.

## CONTROVERSIES

As with the application of any general precept to human affairs, the devil is in the details. Precautionary measures by European states have led to political and legal controversy, giving rise (for example) to complaints that the “precautionary” measures were really intended for trade protection.

France, for example, values its small farms — one commonly sees small herds of cattle grazing in tiny suburban pastures, on their way to

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sale as beef in the local *marché*. France has banned British beef (for fear of bovine spongiform encephalopathy) and cattle raised with synthetic hormones (most American and Canadian beef). British, Canadian and American beef producers might easily suspect that these “precautionary” measures were really taken for reasons of trade protectionism, and who is to prove them wrong? Likewise, are the French roadblocks to the licensing of genetically engineered crops really intended for environmental protection? Or to protect small French farmers from competition by large agribusiness that relies on such crops?

The litigation resulting from such measures has created a small but growing body of case law, for example decisions by the European Court of Justice. (The Court has sided with member states in banning British beef early in the bovine spongiform encephalopathy or “mad cow disease” (BSE) crisis, but recently (2002) ruled against a continued ban by France on British beef. It has also required France to establish a timely process for evaluating applications for the sale of genetically modified crops). Nevertheless, there still remains very limited case law in the EU related to the PP, and the issue is virtually unexplored elsewhere around the globe.

Disagreements about the meaning of the PP are legion. In a recent legal review of the PP, Van der Zwaag described “seven slippery aspects” of the PP: confusion in terminology, definitional variations, definitional generalities, the spectrum of precautionary measures available, ongoing philosophical tensions and competing socio-economic interests, debate over who should be responsible for making precautionary decisions, and limited interpretation by international tribunals [8]. In short, the Precautionary Principle remains elusive and flexible in meaning, and even in the

EU there is scant legal precedent to guide its application. An important Commentary by the European Commission, to be discussed near the end of this article, goes a long way to address this problem.

### **PRECAUTIONARY APPROACHES TO REGULATING EXPOSURE TO ELECTROMAGNETIC FIELDS**

The PP was originally devised for protection against foreseeable environmental risks for which little scientific data are available that are useful for setting policy, for example risks of ocean dumping of sewage. It has increasingly been used to manage technological and health risks for which extensive data are available, despite inevitable gaps and inconsistencies in the evidence. Electromagnetic fields make a good case in point.

The biological effects of nonionizing electromagnetic fields have been studied for many years, and an immense literature exists on the subject. Two major (and scientifically quite different) issues are possible risks from household or occupational exposure to power-frequency (50-60 Hz) electric and magnetic fields, and exposures from use of mobile telephones (which operate at the radiofrequency range, typically near 800 or 1900 MHz). Both issues have prompted high levels of public concern in recent times, yet extensive scientific research has failed to clearly identify any health problems from ordinary levels of exposure.

*Power-line fields and cancer.* The fear that living near a power line or other electrical utility increases the risk of childhood cancer was raised by an epidemiological study in 1979. Since then, more than 100 epidemiological studies, and countless animal and cellular studies, have been completed.<sup>1</sup> No scientific consensus has emerged

<sup>1</sup>An accessible, and relatively complete, review is available on the World Wide Web. See [9].

that power-line fields cause or promote cancer. However, a review in summer of 2001 by the International Agency for Research on Cancer (IARC) concluded that power-frequency magnetic fields are a “possible” human carcinogen – putting power-line fields in the same category as coffee and tea [10]. Thus, there is no scientific consensus that such fields actually cause cancer (or other diseases) but at least one expert group has stated that the evidence is sufficient to warrant some level of suspicion.

*Mobile phones and brain cancer.* Public concerns about possible health risks from wireless communications technologies were prompted by an announcement on American television in 1993 by a man whose wife had used a mobile phone and later died of brain cancer. The resulting lawsuit was subsequently dismissed for lack of evidence, but the public concerns that these allegations raised prompted a resurgence in research in biological effects of RF fields. A review of the issue (presented at a WHO sponsored conference in Erice, Sicily, in November 1999) identified more than 200 ongoing and recently completed studies related to possible health hazards of RF energy, including a dozen epidemiological studies, more than 60 cancer-related animal studies, and 75 cellular studies. These studies have not identified a link between the use of mobile phones and brain cancer – or any other health effect for that matter. Some of these studies have reported effects of using mobile phones in humans, but these effects are small and of no apparent health significance, and the validity of the results can often be questioned on technical grounds.

Faced with this evidence, government and other expert groups have provided mixed messages to the public. For example, in mid-2000 a blue ribbon committee in the U.K. (the Stewart committee) issued a report that concluded “the

balance of evidence to date suggests that exposures to RF radiation below [recommended limits] do not cause adverse health effects to the general population [11]. But “[i]t is not possible at present to say that exposure to RF radiation, even at levels below national guidelines, is totally without potential adverse health effects...”.

Thus, the issues of possible health effects of power-line fields, or of RF energy from wireless communications – while scientifically very different – are similar in many respects. Despite extensive research, no evidence has emerged to persuade health agencies or expert groups that a health problem exists at all, at ordinary levels of exposure. But at the same time health agencies are not willing to state that the fields are “safe.” Levels of public exposure (to both RF and power-line fields) are invariably far below levels that are recognized as hazardous, and far below exposure limits such as those of IEEE C95.1 [12] or of the International Commission on Nonionizing Radiation Protection (ICNIRP) [13].

But the public remains concerned, and there is frequent community opposition to new power lines and cellular base stations. Responding to these concerns, governments have considered or adopted a variety of precautionary measures, which may or may not explicitly mention the PP.

These “precautionary” approaches have varied greatly [14], [15]. Different approaches that have been taken by governments (for power frequency and/or RF fields) include:

1. *Gather information but take no regulatory action.* Major exposure limits (such as IEEE C95.1 or ICNIRP limits) have been revised repeatedly since the health issues have arisen. Despite frequent tweaking, no fundamental change has occurred in their rationale. Likewise, few governments have

implemented drastic reductions in exposure limits for power-line or RF fields. But most governments follow the issue carefully, and many have set up expert groups to review the scientific data.

2. *Prudent avoidance.* This approach was first put forward 1989 by Morgan *et al.* at Carnegie Mellon University [16] to address public concerns about possible risks of electric or magnetic fields associated with power lines. Morgan *et al.* recommended that measures be taken at moderate cost, to reduce exposure to the population.

Prudent avoidance has received limited acceptance, being adopted as policy by a few states (California, Colorado, Hawaii, New York, Ohio, Texas, and Wisconsin) and a few countries (Australia, Sweden). As considered by American states, prudent avoidance would allow modest changes in the design of a power transmission line; some state regulators (in California for example) interpret “modest cost” to mean less than a 5% increase in the total cost of a project. Thus, prudent avoidance would support routing power lines away from schools and phasing the conductors to minimize magnetic fields outside the rights of way of the lines, but not burying power lines, an effective but very expensive way to reduce public exposure to fields.

Prudent avoidance is, however, popular at the grass-roots level. The concept frequently surfaces in public debates about locating power lines, frequently in the sense of “prudently avoiding my back yard.”

3. *Other low-cost “precautionary” measures.* More recently, policies that resemble prudent avoidance (without explicitly citing the concept) now appear in policies related to locating cellular base stations, which for esthetic and health reasons often have been the focus of community opposition.

Thus, for example, in May 2002, the Australian Radiation Pro-

tection and Nuclear Safety Agency (ARPNSA) adopted a new set of exposure limits for RF energy. The standard generally follows international (ICNIRP) limits but contains the requirement for “minimizing, as appropriate, RF exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided this can be readily achieved at reasonable expense.... The incorporation of arbitrary additional safety factors beyond the exposure limits of this Standard is not supported.”

As another example, the Stewart committee [11] recommended that telephone companies not promote the use of mobile telephones by children – not because there is an identified problem, but as a precautionary measure against unknown hazards that might surface in the future.

Neither the ARPANSA limits nor the Stewart report explicitly mention “prudent avoidance” as proposed by Morgan. Indeed, in the words of Vitas Anderson (a member of the committee that drafted the limits) the committee considered and rejected prudent avoidance “due to a perception of waning general support for this concept” [17]. Instead, the committee forged an “uneasy compromise between the perceived political need to incorporate some form of precautionary measures (though the standard’s review of the bioeffects literature provides no support for this) and the desire to minimize the community harm that would be caused by unnecessarily denying or delaying public access to RF services that provide social, economic and public safety benefits.”

Nevertheless, the Stewart recommendations, and the ARPANSA policies, resemble “prudent avoidance” in their emphasis on low-cost measures. If the costs are low, the cost-benefit issue becomes moot (even if the health benefits are small or nonexistent).

4. *Mandatory exposure limits*

based on the PP. A few countries (Italy, Slovenia, Switzerland) have taken very different approaches, by passing strict limits on human exposure to RF energy based on precautionary considerations.

In Switzerland and Italy, the

increased costs of service and in terms of degraded network performance) is difficult to gauge.

In the United States, by and large, prudent avoidance policies do not seem to have created major political or legal problems. By the same token, they seem to have had little impact in the U.S.

#### **DIFFICULTIES WITH PRECAUTIONARY APPROACHES TO EMF REGULATION**

Prudent avoidance, as applied to electromagnetic fields, is deeply paradoxical. The only known hazards of electromagnet-

ic fields (either power-line or RF fields) require exposure levels that far exceed those found in ordinary environments. Even if one accepted the principle of prudent avoidance, nobody knows what kinds of fields are to be (prudently) avoided. Finally, prudent avoidance seems to be raised in connection with relatively low exposures from power distribution facilities – whereas much greater exposures are produced by domestic appliances in the home.

Prudent avoidance is more understandable if it is considered as a political response, rather than a health measure. The sight of mobile telephone base stations or power lines near schools, for example, clearly raises red flags in the minds of many people, whatever the actual exposures to the children may be. Moving these facilities away from schools may reduce public controversy about the siting of these facilities, whatever the actual health benefits might be.

If prudent avoidance and other precautionary measures have political benefits, they also have political risks: of sending the wrong message to the public, that a hazard

really exists. (Otherwise why would government recommend taking precautions in the first place?) That is surely the take-home lesson provided by the Stewart Commission's recommendations against selling mobile telephones to children. As Vecchia describes in a separate article in this special issue [pp. 23-27], the public clearly views exposure limits as thresholds for hazard (no matter how "safe" they may appear to their designers). Reducing exposure limits as "precautionary" measures inevitably means that real-world exposures are closer to the limits – and thus can be perceived as more dangerous by the public.

Finally, *ad hoc* "precautionary" measures, that respond to public concerns about particular technologies, are difficult to apply in a consistent way, given the many diverse applications of electromagnetic fields in modern society. All sorts of unanticipated consequences might happen.

For example, as a precautionary measure aimed at mobile telephone transmitters (which in early days of the technology were mostly mounted on vehicles), in 1995, Italy passed a law requiring a minimum distance of 20 cm from the antenna to the user's head. Still on the books, the law now can be read as forbidding a cell phone user from placing the handset against his or her ear. (This law is clearly broken many times a day by Italians). As a second example, Vecchia, in another article in this issue [p. 23], describes a serious political and legal dispute that has arisen recently in Italy related to a radio station owned by the Vatican, located outside of Rome.

As a result of such problems, the World Health Organization recently published a "background" white paper. The background urges governments to avoid undermining science-based exposure limits (e.g., those of ICNIRP). It recommends that pre-

Advocates of the Precautionary Principle argue that it is the common sense approach to avoiding nasty surprises from new technologies.

limits have recently been revised downwards from international (ICNIRP) limits by a factor of as much as 10 in field strength, or 100 in power density. In the Swiss case, the explicit intention was to reduce the exposure guidelines to the lowest levels that were felt to be technically and economically feasible. These revised limits are somewhat above exposure levels produced by cellular base stations. Thus, the limits would allow the installation of most base stations, but might well exclude antennas mounted on buildings, low structures, or very close to residences.

As might be expected, industry in those countries reacted with dismay at these changes. For example, in December 1999 (just before the new Swiss regulations came into effect), Swisscom issued a press release complaining that the new regulation "weakens the attractiveness of Switzerland as an economic location and makes additional transmitters necessary" and will increase the cost of service to its subscribers. Needless to say, the Swiss and Italians still have their mobile telephones, but the cost of the measures (both in terms of

cautionary policies should be adopted, if at all, as supplementary measures [15].

The WHO backgrounder noted with approval the New Zealand approach, which is similar to the Australian approach described above: rely on mandatory exposure limits that are based on scientific evidence, but at the same time encourage voluntary efforts to address public concerns. Such voluntary efforts might include improved risk communication, better communication between industry and local communities in the siting of facilities, and efforts to reduce RF exposure of the population to the lowest levels needed to satisfy service objectives.

## DEFINING THE PRINCIPLE

As the above discussion makes clear, the PP is not a monolithic entity that “demands” any particular action. It is a general counsel for a risk-averse approach to managing environmental and health risks, but there are many ways to accomplish that. Moreover, aversion of risk is only one value (although an important value) that is involved in regulation of technology.

Responding to the controversy created by precautionary measures taken in a number of its member states, in February 2000 the European Commission (the governing body of the European Union) issued an important Commentary on the PP [18], [19]. This Commentary has (considerable) legal influence in EU nations, but it deserves wider attention as an important attempt by an authoritative source to rationalize the application of the Principle.

The Commission acknowledged the central role that the PP plays in European environmental policy, and the need for precaution when managing risk under conditions of scientific uncertainty.

But the Commission also cautioned against arbitrary use of the

PP, and pointed to the need to use it in as politically transparent a way as possible. It stressed that “precautionary” measures should respond to an identified problem (not as an attempt to achieve zero risk). This latter provision would seem to exclude the application of the PP to environmental electromagnetic fields.

Perhaps as important, the Commission stressed that precautionary measures should be based on as careful a review of the relevant scientific evidence as possible, including an analysis of the costs and benefits of proposed measures. “Precautionary” measures should be temporary, and coupled with a commitment to obtain adequate information for a proper policy analysis.

Finally, the Commentary emphasized that risk management decisions are made in the political arena, and the PP has to satisfy political criteria for “transparency.”

“If it is to become a code or shorthand for blocking or banning everything which is objectionable, its credibility will quickly become lost,” remarked David Byrne, EC Commissioner for Health and Consumer Protection, at a recent conference [20]. “It is a principle which must be applied within an open and transparent framework which ensures that it is not used to promote any trade or political agenda.”

In its Commentary, the EC has defined a robust and careful formulation of the PP that clearly serves the public interest, and reduces the very real danger of using the PP as an *ad hoc* political response to public controversy. If the EC approach is generally followed, the PP will be less than many activists might wish, but also less than many of its critics might fear.

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