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NEWS & ANALYSIS

Unifying the Precautionary Principle

by Joshua MacLeod

Christopher Stone is absolutely right in pointing out that formulations of the precautionary principle are widely varying, often incredibly vague, and all too frequently not “particularly helpful.”¹ Despite this (or perhaps, in fact, because of the perceived palatability of vague formulations), the principle has become widespread in domestic and international law and policy. Organizations from the United Nations (U.N.) to the Occupational Safety and Health Administration and the World Trade Organization, as well as nations such as Canada, Germany, the United Kingdom (U.K.), the United States, and many others are known to have endorsed one form or the other of the principle.² Certainly it would seem, then, that one worry that cannot be plaguing proponents of the precautionary principle is that it is not getting enough recognition.

Proponents of the precautionary principle should, however, be quite worried about the flaws in the literature that Stone has pointed out. First, there ought to be concern about the sheer multitude and disarray of distinct theoretical formulations of the precautionary principle. Proponents of the principle ought to be concerned that the principle’s uptake into law and policy is not going to result in effective action to prevent possible harm. An overabundance of variety in theoretical formulations of the principle will (and has) without a doubt translate(d) into an overabundance of formulations of the principle in law and policies. This disarray will most certainly translate into disarray in, for instance, what is thought to be the proper application of the precautionary principle. Such a disunified precautionary front is certainly less likely to be successful in supporting rigorous and appropriate precautionary action. Second, there ought to be concern about the vagueness of the formulations of the precautionary principle that lawmakers and policymakers are adopting. Such vague formulations have been adopted, I imagine, primarily for two reasons: (1) the vast disarray of theoretical versions of the precautionary principle; and (2) the fact that the formulations are often sufficiently vague so as to allow interpretations of them that do not demand much at all.

One potentially effective way of evading these most unfortunate possibilities is to uncover what exactly it is that all

the formulations of the precautionary principle share. More exactly, we are interested in teasing out what the sufficient constitutive element of a precautionary principle is—that without which a given principle is not a *precautionary* principle. This will allow us to figure out exactly what it means to care about precaution. Once we are clear about what it means to care about precaution, it ought to be a considerably easier task to discover the most effective means of instituting precaution where appropriate. Once this is achieved, establishing a unified precautionary front will be a much easier task, since being clear about what it means to care about precaution will most certainly help remove both confusion and disagreement about the precautionary principle. A great deal indeed rests on uncovering this sufficient constitutive element of the precautionary principle.

I. Varieties of Precautionary Principles

A. Uncertainty

It seems that every formulation of the precautionary principle has at least this in common: each calls for steps toward prevention of possible harms *in the face of uncertainty*.³ Take, for example, the nine following formulations of the principle:

- (1) “[W]here potential adverse effects are not fully understood, the activities shall not proceed.”⁴
- (2) “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.”⁵
- (3) “Put best, the precautionary principle stipulates that where the environmental risks being run by regulatory inaction are in some way uncertain but non-negligible, regulatory inaction is unjustified.”⁶

3. I, at least, have not yet found a formulation of the precautionary principle that does not at least entertain the idea that dealing with uncertainty is a constitutive element of the principle. Though, given the state of the literature, one probably exists. However, that is not to say that certain precautionary principle theorists do not think that the only defensible formulation of the principle simply collapses into what Harald Hohmann has called the “protective principle.” This principle, he writes, “imposes an obligation on [s]tates to prevent known or foreseeable harm.” HOHMANN, *supra* note 2, at 334. This considerably weaker principle is plainly not precautionary, and thus we will simply leave it to one side.

4. G.A. Res. 37/7, U.N. GAOR, 37th Sess., Supp. No. 51, at 17, U.N. Doc. A/37/51 (1982).

5. Rio Declaration on Environment and Development, June 14, 1992, princ. 15, U.N. Doc. A/CONF.151/5 (1992).

6. James Cameron, *The Precautionary Principle*, in TRADE, ENVIRONMENT, AND THE MILLENNIUM 242 (Gary P. Sampson & W. Bradnee Chambers eds., 1999).

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1. Christopher D. Stone, *Is There a Precautionary Principle?*, 31 ELR 10790 (July 2001).

2. See, e.g., HARALD HOHMANN, PRECAUTIONARY LEGAL DUTIES AND PRINCIPLES OF MODERN INTERNATIONAL ENVIRONMENTAL LAW: THE PRECAUTIONARY PRINCIPLE: INTERNATIONAL ENVIRONMENTAL LAW BETWEEN EXPLOITATION AND PROTECTION 14-81, 250-74, 318-25 (1994); PETER H. SAND, THE PRECAUTIONARY PRINCIPLE: A EUROPEAN PERSPECTIVE 44-46 (2000); EUROPEAN ENVIRONMENT AGENCY, LATE LESSONS FROM EARLY WARNINGS: THE PRECAUTIONARY PRINCIPLE 1896-2000, at 14 (2001).

(4) “[T]he precautionary principle . . . advises that lack of scientific evidence for a claim should not be taken as a reason for exercising a lack of cautions when the risk is high.”⁷

(5) “[The precautionary principle is in part constituted by] a willingness to take action in advance of formal justification of proof.”⁸

(6) “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.”⁹

(7) “[The precautionary principle] shifts the burden of proof from the opponents of an activity to the advocates. It asks them to prove that the risks aren’t unreasonable.”¹⁰

(8) “[The precautionary principle] reverses the traditional burden of proof in environmental pollution cases, so that the burden is placed upon the body proposing a possibly harmful activity to show that no harm will be caused.”¹¹

(9) “[T]he precautionary principle requires a different kind of science . . . the precautionary principle invites us to put the ethics back into science.”¹²

Our purposes here are not to evaluate any of these formulations of the precautionary principle, but merely to see what is sufficiently constitutive of a precautionary principle. We can see right away that each of these formulations involves some concern for action (loosely construed) to prevent harm in the face of uncertainty. As stated above this is true of all formulations of the principle. Thus, from here on we will treat “precaution” as a technical term involving, at the minimum, action in the face of uncertainty with respect to the potential harm of an activity or substance.

B. Types of Action

Now that we see that precautionary principles all share a concern for action (loosely construed) in the face of uncer-

tainty, it is important to note one way which these (and all) principles can differ: with respect to what *sort of action* each formulation demands in the face of uncertainty. The first six formulations call for what I will call direct regulatory or precautionary action. Such action might take the form of passing legislation or instating precautionary policy; for instance: banning or restricting genetically modified organisms; banning or restricting pesticides, pollutants, and toxins; forcing the renovation of environmentally hazardous or outmoded factories, power plants, etc.; restricting or eliminating greenhouse gases; and so on. In short, wherever there is a potential hazard whose possible harms are masked by uncertainty, the action taken to prevent or regulate this hazard will constitute direct regulatory or precautionary action. The *amount* of possible hazards that are required to be restricted or regulated depends upon how strong the formulation of the precautionary principle is under which we are working. For instance, the first formulation from above calls for a complete abatement of all activities whose potential hazards are not fully understood. This is a very strong formulation. A less strong formulation is the second, which only calls for direct regulatory or precautionary action in the face of possible “serious or irreversible” harm.¹³ We see then quite readily that a spectrum can be created with the weakest formulations of the precautionary principle (those that call for direct action against only very serious harms) on the near side, and the extremely strong formulations (those that call for action against any potential harm) on the far side. Let us call this the direct regulatory spectrum (DRS).¹⁴ We are not here, however, interested in entering the ugly debate over the correct stringency of the precautionary principle; simply seeing the existence of this spectrum is sufficient.

The seventh and eighth formulations call for shifting the burden of proof of harm (to be borne by the opponents of an activity or substance) to the burden of proof of safety (to be borne by the advocates of an activity or substance). In other words, these formulations posit the obligation of advocates of an activity or substance to prove their product or action safe¹⁵ in place of the more standard obligation borne by the opponents of a product or action to prove that action or product to be harmful. This might also appear to be quite a strong (that is, stringent) formulation of the precautionary principle. This appearance has led some to mistakenly believe that this formulation is actually on the extreme end of the DRS. For instance, we have Harald Hohmann who writes that

[t]he precautionary principle covers a wide range of possible obligations. . . . In its weakest formulations, it comes close to the protective principle [see above] (sometimes called the preventative principle). The other extreme would be reversal of the normal burden of proof, so that a potential actor must prove that his activity will not cause harm before it can be sanctioned.¹⁶

7. STEPHEN F. HALLER, APOCALYPSE SOON?: WAGERING ON WARNINGS OF GLOBAL CATASTROPHE 7 (2002).
8. Andrew Jordan & Timothy O’Riordan, *The Precautionary Principle in Environmental Policy and Politics*, in PROTECTING PUBLIC HEALTH AND THE ENVIRONMENT: IMPLEMENTING THE PRECAUTIONARY PRINCIPLE 24 (Carolyn Raffensperger & Joel Tickner eds., 1999).
9. Joel Tickner et al., *The Precautionary Principle in Action: A Handbook* 1, at <http://www.biotech-info.net/handbook.pdf> (last visited Aug. 13, 2004).
10. ANNE PLATT MCGINN, WHY POISON OURSELVES? A PRECAUTIONARY APPROACH TO SYNTHETIC CHEMICALS 18 (2000) (emphasis in original).
11. David Freestone & Ellen Hey, *Implementing the Precautionary Principle: Challenges and Opportunities*, in THE PRECAUTIONARY PRINCIPLE AND INTERNATIONAL LAW: THE CHALLENGE OF IMPLEMENTATION 265 (David Freestone & Ellen Hey eds., 1996).
12. This quote of Carolyn Raffensperger comes from David Appell, *The New Uncertainty Principle*, SCI. AM., Jan. 2001, at 18. This quote, however, is misleadingly vague. Raffensperger actually has something quite specific in mind here. For preliminary purposes we can say this: Raffensperger means that the precautionary principle calls for a departure from orthodox, “mechanistic,” science. This “mechanistic science” is to be replaced with “precautionary science,” which allegedly deals more effectively with scientific uncertainty of potential harms by minimizing instead of maximizing Type-II errors (for definition of Type-II errors, see below).

13. The various strengths of formulation have been much of the cause of controversy over the precautionary principle. The unattainable goal seems to be to define a principle that is neither too strong, such as the first, nor too weak, such as perhaps the fifth formulation is.
14. The extent to which the potential harms are to be dealt with is a different spectrum, the response spectrum (RS), discussed hereinbelow.
15. There is a question here about how one can prove something safe. Isn’t this like proving a negative? Can it even be done? This question may need to be dealt with, but not here.
16. HOHMANN, *supra* note 2, at 334.

In other words, Hohmann is committed to claiming that formulations of the precautionary principle that call for the “reversal of the normal burden of proof” are on the far end of the DRS. However, reversal of the normal burden of proof is simply not *direct* regulatory action. *Direct* regulatory action consists in the restriction or abatement of a potentially dangerous activity or substance. Burden of proof-shifting is a more *general* stance regarding introduction or continuation of the production of a potentially harmful substance or the introduction or continuation of a potentially harmful activity. Burden of proof-shifting is therefore *indirect* precautionary action. It may indeed *lead to direct precautionary action*, but it is plainly distinct from direct action. This therefore disqualifies it from appearing on the DRS.

Instead it has its own spectrum. Call this spectrum the burden of proof spectrum (BPS). On the near side we have formulations that call for proof of less safety, and proof in fewer cases, i.e., fewer substances and activities will fall under the purview of the formulations on this side of the spectrum, such as the seventh formulation from above. On the far side we have formulations that call for proof of utter safety, and proof in all cases, i.e., for all potentially dangerous substances and activities.^{17, 18} The eighth formulation from above is an example of a formulation from the far side of the BPS. Again, we do not here want to debate where on this spectrum the precautionary principle ought to lie. Instead, it is again sufficient at this point to bring the existence of this spectrum to our attention.

The ninth formulation, though we cannot see this in the quote above, calls for another sort of reversal. It demands the reversal of the orthodox, so-called mechanistic, scientific methodology that calls for the minimization of Type-I errors and the resulting maximization of Type-II errors. Reversing this gives the following formulation: minimize Type-II errors and thereby maximize Type-I errors.¹⁹ Type-I errors are “false positives,” that is, positing the claim that, for instance, something is harmful when, in fact, it is not. Type-II errors are just the opposite, i.e., “false negatives”—claiming, for instance, something is benign when it is in fact harmful.²⁰ What this is supposed to amount to is a paradigm shift in standard scientific methodology. These formulations of the precautionary principle insist that science should view it as better to deem something harmful when it is in fact benign than it is to deem something benign

when it is in fact harmful.²¹ This should result in fewer potentially harmful activities and substances being practiced or introduced since science will, when faced with uncertainty about the possible deleterious effects, favor deeming the action or substance harmful.²²

These formulations thus also have a spectrum. Call it the precautionary science spectrum (PSS). The PSS is meant only to concern itself with the potential harms of a substance or activity. Thus, minimizing Type-II errors means, when there is uncertainty about a substance or activity’s potentiality for harm,²³ science should tend to label that activity or substance as harmful.²⁴ We therefore countenance the PSS thusly: on the near side we require more potentiality for harm before we label the substance or activity as harmful, and on the far side we require less potentiality for harm before we label the substance or activity as harmful.²⁵ More specifically, extremely near-side formulations from the PSS probably would not label greenhouse gases as harmful, since, though there is not much exculpatory evidence on the side of greenhouse gases, there is a very small (rather unconvincing) bit.²⁶ More far-end formulations from the PSS certainly label greenhouse gases as harmful, since, if we assume that greenhouse gases are harmful, and then raise the bar as to what will count as exculpatory evidence against this charge, we are unlikely to find any compelling evidence that would suggest exculpation.²⁷

Taken together (and with one addition to come), these spectrums contain the bulk of the possible formulations of the precautionary principle.²⁸

17. These formulations of the precautionary principle do not yet exist (save for far end, of course), as far as I know. I am introducing them preemptively. One can see that they mirror the above formulations of direct regulatory precautionary principles, and it is therefore likely that, given time, these spectrums would show up in the literature. The controversy would again be arising from disagreement as to where in the spectrum the precautionary principle should lie.

18. How much proof of safety the precautionary principle should demand and how often the principle should demand it (that is, the principle’s position in the BPS) will largely turn on concerns like the following. Perhaps the expense and general onus of proving everything absolutely safe before we do it or introduce it (or continue to do it) will simply be too great to accept, etc. Or, perhaps the expense and general onus of *not proving* everything utterly safe will prove too great to accept. This is merely meant to demonstrate where the ample room for controversy here could come from.

19. Katherine Barret & Carolyn Raffensperger, *Precautionary Science*, in *PROTECTING PUBLIC HEALTH AND THE ENVIRONMENT*, *supra* note 8, at 109.

20. This has nothing to do with falsification, as it might sound. Instead, it has everything to do with lack of information.

21. This leaves open questions about the definition of “harmful.” Such questions, however, we cannot answer here.

22. This will reduce the number of harmful activities and substances assuming, of course, that the public sphere heeds science.

23. By “potentiality for harm,” I mean the combination of two things: (1) the perceived likelihood of causing harm; and (2) the amount of harm the activity or substance might cause.

24. The question might arise here: how much uncertainty about an activity or substance’s potentiality for harm is needed before it falls under the purview of the PSS? Let us just say this: whatever amount of uncertainty qualifies an activity or substance to fall under the general purview of the precautionary principle will be enough to qualify it for the PSS as well. Another theorist can help us decide the further question of how much uncertainty is needed apropos some substance or activity to place it under the purview of the precautionary principle generally.

25. *See supra* note 17. The same holds here, *mutatis mutandis*.

26. Apparently, there may be “carbon-sinks” that are trapping released greenhouse gases and keeping them from contributing to rising temperatures.

27. These same considerations hold true for the BPS, e.g., greenhouse gases might pass off as safe on extremely near-end formulations from the BPS, but certainly not on any of the other formulations.

28. There is at least one type of precautionary principle that I have left out: alternatives assessment. I have chosen not to deal with this not because it cannot be treated along the same lines as the other sorts of formulation, but rather because just the opposite is true. That is, precautionary principles that call for alternatives assessment demand action in the face of uncertainty, that action is assessing alternatives; such formulations of the principle can be put on a spectrum with the near end constituted by formulations which call for less alternatives being assessed in fewer circumstances, and the far end constituted by formulations which call for more alternatives being assessed in more circumstances. Furthermore, the upcoming talk of risk tolerance applies to alternatives assessment as well. These formulations of the principle can be ignored because they behave just as the others. I imagine this is true for any other sorts of formulations of the precautionary principle of which I am not aware or have, for concerns of space, omitted here.

C. *Realms of Precaution*

We now have three spectrums of precautionary principles, which have been demarcated first by restricting the domain of principles to those that demand action in the face of uncertainty. Next we divided the three broad formulations of the precautionary principle with respect to the three sorts of action each called for. The first called for direct regulatory or precautionary action. The second called for the indirect precautionary action of shifting the burden of proof (of safety or harm) from opponents to proponents of a substance or activity. The third also called for indirect precautionary action, but in this case the indirect action called for is the minimization of Type-II errors in the science of harms. Now we must briefly explore what realm or realms, e.g., the environment, crime, public policy, etc., these formulations are to range over. This is important because we are working toward a sufficient constitutive element of the precautionary principle. In order to uncover this element, we must of course specify the domain that the principle should concern itself with.

Most authors who have discussed the precautionary principle work under the assumption that the domain of the principle consists of the potential threats to the environment and/or the resulting threats to people. Furthermore, it is arguable that nearly all of the uptake of the precautionary principle into domestic and international law and policy is apropos the environment. There does not, however, seem to be anything about the precautionary principle generally that demands that it be concerned with the environment. It just so happens that with rising global temperatures, ever-increasing destruction of wildlife, habitat, marine life, etc. academics and responsible policymakers are on the prowl for a theoretical way of justifying the reduction of possible future harms to the environment. So the possibility remains for formulations of the precautionary principle to exist that are not limited solely to ranging over environmental concerns. Such formulations, however, would be blisteringly controversial (considerably more controversial than formulations of the principle dealing with the environment). For instance, a precautionary principle that called for protection against future violence by mentally ill persons by, say, incarcerating them would seem to be an egregious violation of civil rights, though it would indeed prevent future criminality. In fact, applying a precautionary principle to the public realm just generally seems to be a bad idea. Such a principle might call for juvenile offenders to be incarcerated for extreme periods of time or tried as adults at increasingly early ages, since they have ostensibly showed signs of criminality.²⁹ Another example would be the increasing U.K. use of video monitoring in public spaces, another potential civil rights violation. A formulation of the principle that dealt with foreign policy or international relations might result in increased U.S.-like unilateral invasions—after all, the oft-cited reason was one of precautionary self-defense. This list, of course, goes on.³⁰

Simply to avoid this controversy, we will ignore any formulations of the precautionary principle that do not specifi-

cally and solely pertain to potential harms to the environment and/or the resulting harm to people; after all, there is plenty of controversy to deal with, even with this restriction.³¹ This brings us a bit closer to uncovering the sufficient constitutive element of the precautionary principle. We now know that this element must demand action in the face of uncertainty. We know that this action must be regarding potential harm to the environment and/or the resulting harm to people. And we know that this element must be common to every possible formulation of the precautionary principle on each of the three spectrums. We now turn to unmasking this element.

II. Diminished Risk Tolerance: The Sufficient Constitutive Element

A. *The Entailment of the Spectrums, From the PSS to the BPS*

Though there are convenient demarcations between the three spectrums of formulations of the precautionary principle, they are nondistinct in an important way. Imagine that we decide to embrace the formulation of the precautionary principle that is on the farthest left of the PSS. This means that we obligate science to deem harmful substances and activities that have even a small potentiality for harm. Now we ask, if this substance (say) were to be one day deemed benign or even salutary, who would have to have shouldered the burden of proof for this? Of course, it would have to be the *proponents* of the substance. It works this way: generally, the party who is in the minority of belief shoulders the burden of proving the majority wrong. So, if science has deemed something harmful, and I refuse to believe it, I shoulder the burden of proof here.³² We can generalize this sentiment thusly: if science has deemed P to be the case, then if I claim not-P, I shoulder the burden of proof of not-P.³³

We have shown that if our formulation from the PSS deems something as harmful, that same something will be assumed harmful until proven otherwise. Now, are the activities and substances that the far end of the PSS would deem harmful the same as the activities and substances that the far end of the BPS would demand proof of safety for? Of course, since the far end of the PSS deems everything that has the potential for harm (however great or small that potential) harmful, and analogously the far end of the BPS demands that everything that has the potential for harm be proved utterly harmless (until it is proved harmless, it is considered harmful). The same is going to hold true for the middle and near formulations of the precautionary principle as well. In other words, choose any position on the PSS. The formulation of the precautionary principle that occupies this position will deem certain substances and activities as harmful. Now, find that same relative position on the BPS. The formulation of the principle that occupies this position will deem harmful the exact same activities and substances that the analogous formulation from the PSS deemed as harmful.

29. This all depends, of course, upon the strength of the formulation of the precautionary principle.

30. Jonathan Wiener, *Whose Precaution After All? A Comment on the Comparison and Evolution of Risk Regulatory Systems*, 13 DUKE J. COMP. & INT'L L. 207 (2003).

31. I am ignoring these formulations of the precautionary principle because I just find it extremely dubious that any formulations of the principle made with respect to crime or foreign policy, or the like, could ever be made palatable.

32. This, again, assumes that people at large heed science.

33. HALLER, *supra* note 7, at 142.

This holds true, *mutatis mutandis*, for those activities that the PSS formulation deems as benign. We see that it could only be the case that what the various formulations on these two spectrums deem as harmful or benign be co-extensional, since both of them have the following underwriting notion: substances and activities are guilty until proven innocent. The BPS (generally speaking) demands that potentially harmful substances be demonstrated harmless before they are considered as such. The PSS does the same by minimizing false negatives (remember, this means that it is better to claim that something is harmful, when it is not, than it is to claim something is benign when it is in fact harmful). So, it follows that were we to adopt any formulation of the precautionary principle on the PSS, we would have also, thereby, adopted the formulation of the principle on the BPS that occupies the same relative position.

To see this more vividly, take greenhouse gases as an example. For illustrative purposes let us again imagine our having adopted the farthest formulation of the precautionary principle on the PSS. Since greenhouse gases certainly have the potential for harm, our principle will oblige science to deem greenhouse gases as harmful. Have we here also reversed the standard burden of proof that is, have we here demanded that proponents of the continued release of greenhouse gases prove that such continued release would be benign? Of course we have. Since in our hypothetical scenario science has deemed it as harmful, any disbelievers are going to shoulder the burden to prove that the continued release of greenhouse gases would not be harmful. Thus we can see quite vividly that adopting a formulation of the precautionary principle from the PSS includes adopting the analogous formulation of the principle on the BPS.

B. The Entailment of the Spectrums, From the PSS to the DRS

We have shown that adopting a formulation of the precautionary principle from the PSS entails adopting the analogous formulation of the precautionary principle on the BPS. From here it can be shown that adopting a formulation from either the BPS or the PSS entails adopting the analogous formulation from the DRS. Formulations from the DRS demand direct regulatory or otherwise precautionary action to prevent possible harm. As stated above, such action consists in, at the minimum, legislation or in the mandating of policy designed to abate or reduce the continuation or introduction of potentially harmful activities or substances. Imagine again that we have adopted the farthest out precautionary principle on the PSS. This means that we have mandated that our science deem harmful all potentially harmful activities and substances.³⁴ It also means that we have, by our considerations above, obliged the proponents of potentially dangerous activities or substances to prove that their activity or substance is utterly safe. Have we thereby committed ourselves to direct regulatory or otherwise precautionary action designed to abate or diminish the continuation or introduction of all potentially harmful activities or substances? Yes, we have.³⁵

To illustrate how this works, let us again take for example greenhouse gases. Again, since greenhouse gases certainly have the potential for harm, our precautionary principle (formulated from the PSS) will oblige science to deem greenhouse gases as harmful. From here direct regulatory or otherwise precautionary action is guaranteed. Our hypothetical policymakers have, by supposition, accepted the farthest out precautionary principle on the PSS; thus, they are obliged to admit that greenhouse gases are harmful. This will lead to law and policy that reflects the notion that greenhouse gases are harmful. Such law and policy must include provisions for the abatement or restriction of greenhouse gas emissions, else it would not be the case that the policymakers were taking seriously the fact that greenhouse gases were determined to be harmful. Since, by supposition, they are taking this seriously, we can conclude that direct regulatory or otherwise precautionary action will ensue to prevent the potential harms that greenhouse gases might produce.³⁶ Thus, we see that committing oneself to a formulation of the precautionary principle from the PSS also commits oneself to the analogous formulation on the DRS. If we choose a nearer formulation from the PSS, this will mean that we are obliged to take direct regulatory or precautionary action in fewer instances, since fewer actions and substances will have been deemed harmful. If we choose a farther out formulation from the PSS, we will be obliged to take regulatory or precautionary action in more instances, since more actions and substances will have been deemed harmful.

However, the stringency of the direct regulatory or precautionary action that will be required once we have adopted a position on the PSS (and thereby on both the BPS and the DRS) will depend on many factors, including: cost, urgency, perceived threat, etc. This creates what we will call the response spectrum (RS). On the near side we are obliged to instate less stringent regulatory or precautionary action, and on the far side we obliged to instate more stringent regulatory or precautionary action. Where one falls in this spectrum is *not* entailed by where one falls in the PSS or the DRS. However, *that* one falls on this spectrum *is* entailed by endorsing some formulation of the PSS.³⁷ The RS is a quite important part of the precautionary principle, and one that has caused its share of controversy, but let us leave this to one side for the moment.

C. The Sufficient Constitutive Element

We now are well-nigh to unmasking the sufficient constitutive element. We know that adopting a formulation of the precautionary principle from the PSS entails adopting a formulation from the BPS and the DRS. This means that whatever formulation from the PSS is found to be most compelling will determine where on both the BPS and the DRS we will end up. We now must determine what considerations will inform which formulation from the PSS will be found most compelling. Put broadly, the considerations for choosing a formulation from the PSS must be concerning how much risk to ourselves and the environment we are willing

34. With respect to the environment.

35. This assumes, of course, that the policymakers heed the science. They should, indeed, since our supposition was that we have adopted the farthest out precautionary principle on the PSS. By "we," for these purposes, we can have it simply mean a governing body or agency.

36. The rigor of their response is an upcoming question. *See* RS discussion hereinbelow.

37. This does not hold true if there is some formulation of the PSS that does not require anything to be deemed harmful. But since such a formulation would be both unlikely and unique, we can ignore it.

to accept (in the face of uncertainty). We see that this is the case since once we answer how much risk we are willing to accept, our position on the PSS will have been established.³⁸ More risk tolerance will equate to a nearer position on the PSS, less risk tolerance will equate to a further position on the PSS.³⁹ This formulation also holds true for the RS. How much risk we are willing to tolerate is sufficient to constitute our position on this spectrum. If we are willing to tolerate more risk, we will occupy a position in the spectrum that demands less stringent responses to possible environmental threats. If we are willing to tolerate less risk, we will occupy a position in the spectrum that demands more stringent responses to possible threats. Thus we come to the following two representations.

I. Starting From the PSS:

	Chosen Position	
Precautionary Science Spectrum:	Near _____ x _____	Far
Burden of Proof Spectrum:	Near _____ x _____	Far
Direct Regulatory Spectrum:	Near _____ x _____	Far
Response Spectrum:	Near _____ x _____	Far

II. Starting From the Risk-Tolerance Spectrum (RTS)⁴⁰:

	Chosen Position	
Risk-Tolerance Spectrum:	Near _____ x _____	Far
Precautionary Science Spectrum:	Near _____ x _____	Far
Burden of Proof Spectrum:	Near _____ x _____	Far
Direct Regulatory Spectrum:	Near _____ x _____	Far
Response Spectrum:	Near _____ x _____	Far

The most important thing to notice here is that determining one's position on the the PSS determines one's position on the BPS and the DRS, but not on the RS. Determining one's position on the RTS, on the other hand, determines one's position on all of the other spectrums. In other words,

38. Perhaps a more formal argument is owed here; however, the point strikes me as obvious enough.

39. There is a possibility that deserves to be countenanced: one might have a low tolerance for risk, but think that picking a position on the PSS is superfluous, perhaps because he has in mind something that he takes as a better way to reduce risk to the environment. For instance, one might forego the PSS altogether and just pick a formulation from the DRS. I certainly must admit that adopting a position on the PSS is nonmandatory, even for those who have a low risk tolerance. I also must admit that the various precautionary principle spectrums are not interentailing. The direction of entailment is only from PSS to BPS to DRS. Nonetheless, I think it can be safely claimed that when one has low tolerance for risk in the face of uncertainty, adopting *some* position on one or more of the precautionary principle spectrums is mandatory. The precautionary principle, broadly construed, simply is the principle that reduces risk in the face of uncertainty. If you want the latter, and you will your ends, you must adopt some form of the former. What is really important here is this: the position on whatever spectrum you come to occupy (not just the PSS) will be determined by the amount of risk to the environment you are willing to tolerate. That is, there is a direct link between how much risk one is willing to accept and how near or far a formulation of the precautionary principle one ought to thereby embrace. So, to rephrase what we have above, once we answer how much risk we are willing to accept, our position on *one or more* of the spectrums has been established.

40. This spectrum is not a spectrum of precautionary principles, but rather is constituted by positions of risk tolerance—on the near end, more tolerance for risk, on the far end, less tolerance for risk.

the questions we must answer in order to know where along the spectrums we ought to position our precautionary principle are not questions about the principle per se. Rather, they are questions about how much risk we are willing to tolerate—we must simply position ourselves on the RTS, and the rest will fall into place.

III. Conclusion

At this point, we can see exactly the source of all the controversy surrounding the precautionary principle. Most of this controversy has manifested itself in disunity about which formulations along which spectrums we ought to adopt. This has led, primarily, to an overabundance of proposed formulations (as we saw above), but it has also led certain theorists to discount the principle as indefensible (except perhaps as another version of the protective principle). This controversy is both unfortunate, and, by and large (to recall Stone's phrase) extremely unhelpful. Given the above considerations, I believe that the source of the controversy actually lies with disagreements about risk tolerance. Theorists and lawmakers are disinclined to come to agreement on *how much risk should be tolerated*. There are, of course, many entirely legitimate competing concerns here. We must countenance the economic, technological, industrial, and agricultural setbacks that increased risk tolerance is certain to cause. We must, however, also countenance the loss of habitat, life, stable climate, and health that *diminished* risk tolerance is, in turn, sure to cause. I, unfortunately, do not have the wherewithal to weigh in on these issues here. But I hope we can now see that the sufficient constitutive element of the precautionary principle fits the following description: it demands action to prevent possible harm to the environment and/or the resulting harm to people, and it demands this action in the face of uncertainty; it is the lowest common denominator amongst the PSS, the BPS, the DRS, and the RS; the lower one's tolerance is, the further out on the spectrums one's adopted formulations of the precautionary principle will be. The uptake of these considerations should be this: we should not quibble about which formulation from which spectrum of the precautionary principle we should choose. *This choice will be made by deciding how much risk to the environment in the face of uncertainty we are willing to accept.*⁴¹ Precautionary principle theorists need not get mired in the details and controversies of the various formulations of the principle until they have decided the levels of risk to the environment and/or the resulting risk to its inhabitants that it is reasonable to tolerate. This miring has resulted in disunity in both the theorizing and uptake of the precautionary principle. Once the decision of risk tolerance is made, the mire will, hopefully, ebb.

41. The choice might also be, to a degree, informed by what we think the best means is to reducing potential risks to the environment to what we decide are acceptable levels. But questions about the best (that is, most effective) means of precaution, I would imagine, will be decided by science. Choosing one's position on the RTS will still decide whether one will use any means at all, and how stringent of means to use. The science steps in here and supplies a list of potentially effective means, listed from least to most stringent, allowing us to choose amongst these means based on our risk tolerance. *See supra* note 28.