A Warning Signal That Justifies Precautionary Chemical Regulation: Exploitation of the Availability Heuristic by Economically Motivated Actors

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I. INTRODUCTION

It is not surprising that a religious view of punishment in the afterlife involves fire and brimstone – the mental image of being burned or dying in a fire is a terrifying thought that seems a suitable basis for imagining and constructing the worst of all possible worlds. Among the spectrum of fires in this world, ranging perhaps from forest fires and volcanic eruptions to self-immolation and car fires, a mattress fire is especially troubling: it represents an element of the primordial intrusively triumphing over the sacredness of the home, not to mention the bedroom. There are reasons that our society glorifies firefighters as heroes and little boys play with fire trucks. There are also reasons that flame retardant chemicals in mattresses were not only regulatorily sanctioned, but mandated. By introducing them into the mattress, modern man can have a plush comfortable mattress and avoid the specter of a mattress fire. All is well, or is it? This Article is not a simple story of the regulation of mattress fires leading to the introduction of a substitute risk in the form of exposure to flame retardant chemicals that threaten our health. Instead, the history and experience of mattress regulation will be used to support a more general claim: economically motivated actors that exploit the availability heuristic\(^1\) tend to generate chemical products that require heightened regulatory scrutiny. And this heightened regulatory scrutiny should take the form of 1) shifting the burden of proving safety from the government to industry and 2) collaboratively working with consumers and industry to develop safe substitute products, methods, and approaches that will address the underlying problem. In other words, this Article suggests one

\(^1\) The availability heuristic is the cognitive tendency for people to overestimate the occurrence of an event if the event is easily brought to mind, or is “available” in our consciousness. Events that are especially graphic and traumatic, such as airplane crashes and house fires, tend to be subject to the availability heuristic, meaning that people are inclined to believe that they occur more often than they do.
type of situation that should trigger application of one form of the precautionary principle.\(^2\)

### A. The Dana-Sunstein Debate

David Dana and Cass Sunstein are among the commentators who have identified that cognitive heuristics can lead to problems in risk perception that present challenges for environmental and health regulation.\(^3\) Yet when these errors in risk perception occur, Dana recommends application of the precautionary principle, while Sunstein suggests usage of cost-benefit analysis.\(^4\) Dana writes, "[T]he precautionary principle can be understood as a corrective to cognitive biases favoring the avoidance of sure, immediate losses over the avoidance of unsure, non-immediate losses."\(^5\) Sunstein on the other hand has argued that cognitive heuristics, including the availability heuristic, lead to bias subject to exploitation by special interests, suggesting that this should imply a full embrace of cost-benefit analysis in order to expunge the irrational fears that grip society and tend to influence

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\(^4\) See Dana, supra note 4, at 1320; see also Kuran & Sunstein, supra note 3, at 753.

\(^5\) Dana, supra note 3, at 1316-17.
regulators.⁶ While Sunstein emphasizes that the existence of this mistake in the appraisal of risk leads groups to take advantage of the mistake for their own gain, he is most focused on the tendency for certain advocacy and environmental groups to drum up deranged, hysterical fears in order to generate support for policy and legal changes.⁷ Among the examples that Sunstein cites are what now read as a standard list of environmental scares: the use of the pesticide alar on apples, asbestos in schools, and Love Canal.⁸ What are arguably overreactions to problems such as these, leads to what has been termed the “pollutant of the month syndrome.”⁹ Viewing this as a troubling development discordant with objective realism, Sunstein asserts that cost-benefit analysis can function as a methodological tool to introduce logical and evidentiary weight into decision-making that will eliminate inaccurate risk perception.¹⁰

Dana has counterargued that cognitive biases, especially those that overvalue the avoidance of definite immediate losses relative to the avoidance of uncertain losses in the future, are so powerful, pervasive, and infiltrative that they inevitably bias public, political, and regulatory decision-making, even by experts, in ways that provide inadequate protection against long-term environmental harm.¹¹ Dana uses the example of global climate change to illustrate the bias: people view immediate cost increases, such as gasoline taxes, to reduce global climate change as unpalatable when the full repercussions of global climate change are unclear and distant, perhaps both temporally and geographically.¹² The framing of the choice between “money and hence economic welfare on the one hand and health and environmental welfare on the other raises issues of commensuration” and Dana goes on to suggest that the act of

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⁷ Id.
⁸ Id. at 83-84; Kuran & Sunstein, supra note 3, at 691-703.
¹⁰ Sunstein, supra note 6, at 129.
¹¹ See Dana, supra note 3.
¹² Id.
attempting to reduce uncertain future health and environmental losses to the same metric as immediate economic costs is difficult.\textsuperscript{13} If the choice is one between apples (i.e. economic welfare) and oranges (environmental/health welfare), then methodologies, often in the form of cost-benefit analysis, may seek to convert everything into dollars, which tend to be synonymous with economic welfare. In other words, the oranges must be translated into apples. But this transmutative exercise is only partially successful: if, to continue the analogy, health and environmental losses are the orange, then the orange contains a certain substance, and perhaps a lot of it, that cannot be converted into the apple of economic costs. In Dana’s example, the bias against a full accounting of health and environmental losses reflects the finding of loss aversion theory that people are risk averse when it comes to a definite and immediate loss and risk-prefering when it comes to the possibility of a future loss. In other words, the human animal is a gambler. If there is the possibility of something dangerous coming down the road, we tend to think we can avoid it. It is better to take our chances that we may be able to work out the problem rather than to accept an immediate loss in the here and now. Citing the work of Kahneman and Tversky that found people preferred avoiding a certain loss of $3000 in favor of rolling the dice with an 80\% chance of losing $4000 (which translates into a greater expected loss of $3200), Dana describes the widespread myopia that afflicts us and affects our environmental policies.\textsuperscript{14} Unable to escape this bias, our regulatory system, forever trying to convert everything into apples, should instead counter the inevitability of bias by embracing a precautionary principle that will procedurally seek to elicit more information by requiring that “the burden of putting forth evidence regarding the prudence of not regulating an identified environmental risk will be borne by the opponents of regulation.”\textsuperscript{15}

This Article is a continuation of Dana’s project, with a specific focus on chemical regulation, that is at a once a refinement, expansion, and modification of his work. To begin

\textsuperscript{13} Id. at 1320-21.
\textsuperscript{14} Id. at 1321-22.
\textsuperscript{15} Id. at 1328.
with, Dana places a high degree of hope, and perhaps confidence, that the precautionary principle will lead to the development of better information and better analysis of information.\textsuperscript{16} This does not depart so radically from the ends of Sunstein: both Sunstein and Dana evince a belief that more and better information can be attained – they part ways however on the means used to attain the information, with Sunstein demanding cost-benefit analysis and Dana arguing for the precautionary principle as a stop-and-think measure that will require the production of evidence. The difficulty with Sunstein’s approach, however, as the mattress case study and other examples will illustrate, is that cost-benefit analysis, among its myriad troubles, often validates and legitimates rules, such as flame retardant standards, that end up having immensely damaging effects on our health, safety, and well-being. Cost-benefit analysis therefore, far from serving a cathartic function revelatory of the truth, tends to catalytically and conspiratorially create an illusion of safety and welfare improvement. Sunstein would likely argue that rather than demonstrating the failure of cost-benefit analysis, the mattress case study illustrates the need for more of it, along with better information relating to precise quantification of the risks from flame retardants. The information, however, if it ever comes in, will come in too late. Societies and regulators must make ex ante decisions about risks with incomplete information. And that is one area in which this Article departs from Dana’s approach. Where Dana views the precautionary principle as ameliorative of informational scarcity, this Article maintains skepticism that procedural burden-shifting will produce meaningful evidence of harm. To be sure, there may well be instances in which industry can establish the safety of products, but more often than not, proving safety will be comparable to the difficulties faced by the government in proving that a chemical is unsafe. Therefore this Article recommends not only that the precautionary principle shift the burden of proof, but also that failing to establish safety serve the de facto function of generating safe substitute responses to the underlying problem (e.g. mattress fires). While industry of course should not be mandated to develop a particular product,
government can collaboratively work with industry and create incentives in the form or subsidies or research rewards for the development of safe substitute products. Social entities should work together to solve problems, but should not be permitted to fall back on chemical products that vitiate the fear associated with the attachment of the availability heuristic to a particular situation. As will be discussed, the precise contours of the new, substitute response need not be precisely stipulated, but the law must be clear that the old response will face a high burden of proof of safety, as will any subsequent response. The most important step, then, is the first one: regulatory, governmental, and societal suspicion should attach to the exploitation of the availability heuristic by companies that profit from the propagation of fear. Societal constituencies should not succumb to corporate pressure to both augment fear and then quell fear without regard for either the legitimacy of the fear or the consequences of reducing the fear – more colloquially, we should not kill an ant with a nuclear weapon. Instead, our collective response should reflect the care, caution, and understanding that tends to result from heightened scrutiny of corporate behavior in prescribed circumstances.

B. The Availability Heuristic

Because the availability heuristic is a foundational element of the approach put forth in the Article, a brief description of the heuristic is necessary. The availability heuristic is cognitive tendency of people to focus on certain readily identifiable and accessible issues, concepts and explanations and, as a result, to overestimate their occurrence. Vivid thoughts, whether borne of repetition or a naturally graphic quality, are easier for us to latch onto and emphasize in the course of decision-making. If an event such as a plane crash or a mattress fire is easily brought to mind, we tend to believe that the event occurs more often than it does. In reality, the ease with which we can think of a particular event has little bearing on its recurrence. There are of course important

18 Kuran & Sunstein, supra note 3, at 707.
limitations to this logic, at least from an evolutionary perspective: it is adaptive to learn to avoid repeating especially bad or traumatic experiences. From the perspective of assessing risk in the world, the availability heuristic, like other heuristics, represents a necessary mental parsimoniousness and threat prioritization that enables humans to function in the world.\textsuperscript{19} Our minds must draw limits on information flows; at some point, decisions must be made.\textsuperscript{20} Nevertheless, countless studies have demonstrated that people poorly judge risk in part because of the availability heuristic: less salient risks such as heart disease and strokes are underestimated, while more visible risks such as terrorist attacks and house fires are overestimated.

\textbf{C. Corporate Exploitation of the Availability Heuristic}

This Article observes that corporations tend to exploit a flaw in human risk perception: risks that are subject to the availability heuristic are overestimated and risks that are distant, temporally and otherwise, are underestimated. Corporations capitalize on overestimated risks by selling products that reduce those risks but that create new and underestimated risks. This is problematic from a legal and policy perspective because the gains from the swap tend to be unduly privatized, while the costs of new and excessive risk exposure are borne by the public. As the purported vanguards of the public interest, the government has an obligation to reduce public risks, especially if citizens, acting in private capacities as consumers, have difficulty observing the risks. To be sure, the problems such as mattress fires afflicted by the availability heuristic are still genuine problems, even if they are prone to exaggeration, and the government working in tandem with societal constituencies should work to mitigate the danger. But the government should not acquiesce to private interests that work to substitute one form of public risk (e.g. mattress fires) with another.

\textsuperscript{19} See Russell Korobkin, \textit{The Problems with Heuristics for Law}, in \textit{Heuristics and the Law} 47 (Gerd Gigerenzer and Christoph Engel eds., 2006).

\textsuperscript{20} Id. Russell Korobkin notes, “If all judgments and decisions were made only after considering all relevant data, attaching subjective preference weights to all possible outcomes, and creating probability predictions of each outcome, none of us could complete the myriad cognitive tasks we face each day.”
(flame retardant exposure). Companies that are in the business of exchanging one public risk for another should face a legal obligation to demonstrate that the new public risk is sufficiently minimal as to fall within our existing understanding of safety. If this proves impossible, then the problem should be addressed so that any solution is subject to safety assurances. It would then, of course, be the prerogative of companies to develop new, safe products. Government could work to address the initial public risk through sensible regulations, by funding research and development, and providing subsidies to generate safe products that will reduce public risk.

While the basis of the Article’s proposal is the mattress fire case study, several examples from the recent and not so recent past help to formulate, support, and solidify the proposal, even beyond the realm of chemical regulation. Companies routinely create intense fears that comport with the availability heuristic and then sell products to alleviate the fears. Among these examples of availability heuristics and their associated products that take away the fear are: 1) the terrorist attacks of September 11, 2001 leading to the growth in intelligence and defense private contracting; 2) horrible diseases leading to the sale of snake oil in the 1930s; 3) the Gulf Oil Spill leading to the application of dispersants; and 4) the recent bed bug outbreak leading to the use of practically any means necessary to kill bed bugs.

D. September 11, 2001 and the Military Industrial Complex

In recent memory, perhaps the ultimate example of an event that became the basis for the construction of an availability heuristic was the terrorist attack on September 11, 2001. According to one survey in 2004, Americans estimated their chance of serious harm from terrorism as 8.27%.21 Yet Sunstein

suggests that if there were one terrorist attack every year in the United States that killed as many people as the September 11 attacks, the risk of death from terrorism is 0.001%. September 11 both affected the public in mundane ways, such as reducing air travel in 2002, and monumentally important ways, such as governmental decisions to wage a “War on Terror” that has resulted in American troop deployment throughout the world, including Afghanistan and Iraq. For example, among the statements of President George W. Bush in the lead up to the Iraq War was: “Imagine those 19 hijackers [involved in the September 11 attacks] with other weapons and other plans – this time armed by Saddam Hussein. It would take one vial, one canister, once crate slipped into this country to bring a day of horror like none we have ever known.”

Governmental statements, synchronized and tandemized with private interests, laid the groundwork for a variety of entities to exploit the September 11 availability heuristic to justify a massive growth in the intelligence community and the military industrial complex. A Washington Post investigation uncovered 1,271 government organizations and 1,931 private companies that work on counterterrorism, homeland security, and intelligence in about 10,000 locations in the United States. Since September 11, 2001, 33 buildings have been constructed or are currently being built to house top-secret intelligence activities. Army Lieutenant General John R. Vines said with regard to the defense intelligence system, “[b]ecause it lacks a synchronizing process, it inevitably results in message dissonance, reduced effectiveness and waste. We consequently can’t effectively assess whether it is making us more safe.” In a similar vein, the Washington Post quoted retired Admiral Dennis C. Blair: “After 9/11, when we decided to attack violent extremism, we did as we often do in this country. The attitude was, if it’s worth doing, it’s probably worth overdoing.”

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22 Id.
25 Id.
26 Id.
27 Id.
Private contractors benefitted considerably, with the Washington Post estimating 265,000 out of the 854,000 people with top-secret clearances are private contractors. Dana Priest and William Arkin write:

Contractors kill enemy fighters. They spy on foreign governments and eavesdrop on terrorist networks. They help craft war plans. They gather information on local factions in war zones. They are the historians, the architects, the recruiters in the nation’s most secretive agencies. They staff watch centers across the Washington area. They are among the most trusted advisers to the four-star generals leading the nation’s wars.

And of course, in addition to the intelligence community, defense contractors and private security personnel and other private contractors in Afghanistan and Iraq have benefitted massively from two wars that were probably propelled, at least in part, by the September 11 availability heuristic. While comprehensive data documenting the amount paid to private intelligence and defense contractors after September 11, 2001 is difficult to pinpoint, even conservative estimates suggest that tens of billions of dollars have flowed to private contractors. Former Halliburton subsidiary KBR alone was paid more than $30 billion since 2001. And while spending money on national defense and counterterrorism as a reflection of a political perspective is one thing, the federal Commission on Wartime Contracting in Iraq and Afghanistan found, “[w]hile contractors provide vital services, the Commission believes their use has also entailed billions of dollars lost to waste, fraud, and abuse due to inadequate planning, poor contract drafting, limited competition, understaffed oversight

29 Id.
30 See generally Comm’n on Wartime Contracting in Iraq and Afghanistan, At What Cost? Contingency Contracting in Iraq and Afghanistan, Interim Report to Congress (June 2009).
31 Id. at 45.
functions, and other problems.\textsuperscript{32} In short, exploitation of the September 11 availability heuristic has, by almost any measure, been a boondoggle for private contractors.

E. Disease and Snake Oil

Terrible disease and illness functions not only as a subject of the availability heuristic (i.e. it is easy to imagine various diseases and hence overestimate their incidence) but as a reality: people become sick and find themselves in vulnerable situations desperately craving cures and treatments that may be for them the difference between life and death, impaired living and normal living, pain and a return to stasis. The historical record demonstrates that companies and individuals would sell snake oil, literally, to desperate captive audiences. In 1937, elixir sulfanilamide poisonings killed over 100 people seeking antibiotic treatment.\textsuperscript{33} Of course, these mass poisonings created an availability heuristic of their own, which engendered intensive regulation. It could be argued that the crucial aspect of the situation was the fact that the poisonings forced a stagnant legislature to act. But arguably, the precedential event was the fear of death and sickness in the first place, which led companies to generate drugs that either cause harm or were of dubious effectiveness. This wave of “snake oil poisonings” illustrates the damage wrought by economically motivated actors exploiting the availability heuristic, until of course their products cause mass killings and create an availability heuristic of their own. To a significant extent, the capacity of a drug to have harmful side effects, which, after all, is intended to have positive primary effects, comports with our intuitive sense of danger. It is perhaps


\textsuperscript{33} Carol Bellentine, Sulfanilamide Disaster: Taste of Raspberries, Taste of Death, The 1937 Sulfanilamide Incident, FDA CONSUMER MAGAZINE, June 1981, available at http://www.fda.gov/AboutFDA/WhatWeDo/History/Product Regulation/SulfanilamideDisaster/default.htm
easier to see the potential for risk in ingesting a purported drug, even if we have little idea what the risks actually are. In any event, Congress acted in the aftermath of the snake oil poisonings to pass the Federal Food, Drug and Cosmetic Act. FDA regulation thus gained a strong foothold reflective of public and political will decades ago, while chemical regulation in the United States remains comparatively anemic.

F. The Gulf Oil Spill and Dispersants

The Gulf Oil Spill led to the construction of a significant availability heuristic, as has also been pointed out with regard to the Exxon Valdez oil spill. The visual image of “oil on the beach” is worse in terms of human perception than oil under the sea. The economically motivated actors are of course BP (seeking to avoid the cost of additional liability that would accrue from horrifying beach imagery) and the dispersant manufacturers (seeking to profit from the sale of dispersant). In terms of systemic demand, the EPA and other government actors had seemingly done practically nothing over decade to test the potential harm of dispersants. Then, in the midst of crisis, the government was either too weak to stand up to BP to stop dispersant usage, was victimized by internecine splintering in which the Coast Guard won out over the EPA, or benefitted itself from the use of dispersants that hid the severity of the crisis. To the credit of the federal government, questions (at least from Congress) have arisen about dispersants, but it is clear that in the heat of the moment the government did not behave in precautionary way. As of the writing of this Article, the implications of dispersant usage remain unknown, but there is a widespread consensus that it would have been beneficial to subject dispersants to rigorous scientific testing years ago, rather than apply them in the midst of an oil spill and then hope for the best.

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34 Id.
G. Bed Bugs and Pesticides

Local news reports of the “Attack of the Bed Bugs” while perhaps comical, are surely no laughing matter for those with infestations. Pesticide companies, perhaps facing less vigorous revenues from growth in organic farming and from green consumer aversions to pesticides, may have identified a new revenue stream. While of course no one is claiming that bed bugs have been set loose by the pesticide companies, there is strong evidence of the availability heuristic at work: New York has formed a bed bug “battle plan” and media reports portray the insects as “blood-sucking vampires.” The hyperbolic portrayals of the bed bug play into our notion of physical harm – after all, bed bugs are essentially harmless (bites cause itching but do not transmit disease). So the availability heuristic works to concoct imaginary harm and also plays into other emotions: privacy (invasion of the bedroom) and disgust (bed bugs are associated with uncleanliness).

As fear and paranoia grow, pesticide companies are all too ready to quell the fear. People probably are not applying pesticides in order to prevent bed bugs (although they do apply pesticides to prevent cockroach and termite infestations), but if a bed bug infestation develops, fear is likely to lead to an overreaction and an overapplication of pesticides. Rather than engage in integrated pest management or use methods such as freezing or heating to eliminate bed bugs, people become more likely to call the exterminator to perform a fumigation.

The government, not acting in accordance with this Article’s prescription of precaution in the face of uncertainty, fans the flames and increases systemic demand. During the height of the recent bed bug crisis in August 2010, members of the Obama Administration had a meeting in Ohio to form an action plan – among those in attendance was a representative from the

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Pentagon. The meeting was partly a response to the State of Ohio petitioning the EPA for permission to use Propoxur, an insecticide that had been removed from home use in the 1990s due to its impact on the nervous system of children. The larger concern becomes the implication in media reports that the only solution is extermination with pesticides. This reinforces the sentiment that the pesticides are the solution to pest problems as a general matter. As will be described in the mattress fire case study, usage of flame retardants in some contexts tends to lead to their usage in other contexts; likewise, a pesticidal response to bed bugs suggests the appropriateness of using pesticides for other threats. Systemic demand to eliminate bed bugs also promotes the traditional stigma associated with having bed bugs: our society, viewing bed bugs as completely unacceptable, will use aggressive means to kill them. Rather than sending a representative from the Pentagon to work on an action plan, the federal government should give heightened scrutiny to the chemicals used to kill bed bugs and other pests. Substitute methods such as integrated pest management, freezing, and heating should be recommended. And the government should avoid fanning the flames of hysteria.

H. A Roadmap

With these four examples in mind as a backdrop, this Article will use the mattress fire case study as a basis to construct a new legal approach to address exploitation of the availability heuristic by economically motivated actors. The Article proceeds in four parts. Part I describes the project of reducing and defining the precautionary principle to apply to certain contexts in order to lead to improved practical outcomes. Part II explores current recommendations and theories of chemical regulation with particularized emphasis on the conventional approach of risk quantification. Part III presents the mattress case study as the basis

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37 Nina Burleigh, Ohio Turns to Feds for Help in Battle Against Bedbugs, TIME, Aug. 18, 2010.
for a proposed rule that exploitation of the availability heuristic to construct systemic demand should trigger of application of the precautionary principle. Finally, Part IV describes the legal nature of the precautionary response: shifting the burden of proof and the developing substitute approaches and products.

II. CONTEXT SPECIFICATION FOR APPLICATION OF THE PRECAUTIONARY PRINCIPLE

A. The Land of the Free and the Home of the Brave

David Dana, Cass Sunstein, and Stephen Gardiner, among others, have worked to distill and crystallize triggers of the precautionary principle and this Article continues the specification of contexts that should alert regulators to apply the precautionary principle. Limiting the application of the precautionary principle to certain situations represents a necessarily incremental approach. Widespread regulatory application of the precautionary principle in the United States is a fantastical dream, or nightmare, depending on political perspective, but regardless is highly unlikely. While some have attacked the precautionary principle as a theoretical impossibility since any precautionary step necessarily creates new risks of its own, most opponents of the idea have simply been able to assert that this is America after all, the land of the free (don’t tread on me) and the home of the brave (risk-takers), and Americans feel at home with rigorous methodological economic approaches such as cost-benefit analysis, even if it turns out that they only create the illusion of truth and improvement in human welfare. Of course, some have pointed out that the United States is not as hostile, nor Europe as friendly, to the precautionary principle as is commonly supposed. And on both sides of the


pond, political theorists, philosophers, and economists have struggled with what is perceived to be the limited theoretical rigor of the precautionary principle. More important are the practical problems: the overriding and inexorable fact remains in 2011 that American legislators and regulators seeking to require anything approaching a precautionary principle will face an America that will not go along, seemingly politically incapable of significant change. It is an America that tends to believe that a strong precautionary principle is at best a simple saying of "better safe than sorry" that should be in the back-of-the-head of regulators and at worst an overly broad device concocted by environmental health advocates and legal theorists with the ulterior motive of paralyzing economic activity. Yet, to the extent there is widespread consensus that current environmental health and safety regulations, and especially chemical regulations, are probably insufficiently protective of our health, we must ask ourselves what we should do?

**B. Toward a "Core Precautionary Principle"**

If the precautionary principle as typically articulated and understood is too broad, then one response would be to limit the principle’s application to specific circumstances that leave us with a "core precautionary principle." Stephen Gardiner embarked on the project of bringing clarity and meaning to the precautionary principle by proposing that the Rawlsian criteria for the application of the maximin principle synchronize with criteria that would be

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42 Gardiner, *supra* note 39 at 34.
43 Drawing from the work of John Rawls, the maximin principle can be understood to mean that policies should be selected based on whether they provide the best worst-case outcome. As Cass Sunstein writes in his book *Laws of Fear: Beyond the Precautionary Principle*, this could mean "asking officials to identify the worst case among the various options, and to select that option whose worst case is least bad." 60 (2005). John Rawls’ maximin principle articulated in his *Theory of Justice* states: "The basic structure is just throughout when the advantages of the more fortunate promote the well-being of the least fortunate, that is, when a decrease in their advantages would make the least fortunate even worse off than they are. The basic structure is perfectly just when
sufficient, though not necessary, for application of the precautionary principle. Gardiner describes these three criteria as: (1) significant uncertainty about the possible outcomes of decision-making; (2) the gains above the minimum level guaranteed by the maximin are not especially meaningful; and (3) the presence of grave risks. At first blush, these criteria do not seem to elevate the approach much beyond cost-benefit analysis accompanied by significant uncertainty: the first criterion represents ineliminable uncertainty, the second criterion represents benefits, and the third criterion represents costs. Faced with uncertainty, the specter of grave risks overwhelms the analysis. Gardiner suggests that this highlights the threat of disaster as one circumstance in which the precautionary principle is appropriate.

C. Sunstein’s Catastrophic Harm Principle and Irreversible Harm Precautionary Principle

Building on the Gardiner/Rawls approach, Cass Sunstein suggests that the maximin option may be appropriate as long as it does not result in significant measurable costs and can avoid an especially horrible worst-case scenario. If a catastrophic disaster could be avoided relatively cheaply, then we should take these inexpensive steps to prevent a horrific outcome. Sunstein also states that genuine uncertainty in the environmental domain, while rare, does exist, even among expertized regulators, although he is quick to point out that regulators should be able to make a rough assessment of the worst-case scenario together with the cost of the prospects of the least fortunate are as great as they can be.” Collected Papers 38 (1999).

44 Gardiner, supra note 39, at 47-8. This means that other possible routes exist to justify the application of the precautionary principle.

45 Gardiner, supra note 39, at 47.

46 Any course of action will change the circumstances facing a decision-maker such that a new worst-case scenario will be generated once a prior worst-case scenario is foreclosed due to a particular course of action. This hinges on the decisionmaker being able to exercise some degree of control over a situation, even if the control is imperfect and the system remains in flux due to external, uncontrollable stimuli.

avoiding the worst-case scenario, even if they lack information that would allow them to assign probabilities to different outcomes. This leads Sunstein to formulate what he terms the Catastrophic Harm Precautionary Principle: if there are “uncertain dangers of catastrophe when the cost of reducing those dangers are not huge and when incurring those costs does not divert substantial resources from extremely pressing problems,” then regulators should choose a course of action that prevents catastrophe.\textsuperscript{48} Sunstein supplements the Catastrophic Harm Precautionary Principle with the concept of irreversibility: if a particular course of action will yield irreversible consequences of an extreme nature, then regulators should err on the side of an alternative course of action that could preserve reversibility. He is correct to point out specific circumstances that should lead us to err on the side of caution, but to limit these circumstances to the catastrophic and irreversible amounts to an undermining of the precautionary principle through its limitation to events that appear extreme from an ex ante perspective. While there is certainly virtue in the project of describing circumstances that necessitate precautionary approaches, Sunstein’s method works a danger: describing precaution as applying to perhaps only obvious and catastrophic risks implies that other risks are palatable, when in fact they may only appear palatable because they are poorly understood. Rather than Irreversible Harm Precautionary Principle or Catastrophic Harm Precautionary Principle (which could in fact justify the usage of flame retardants to avoid mattress fires – after all, mattress fires that result in death surely are irreversible and catastrophic for the decedent), what is needed is an elucidation of more circumstances, and circumstances perhaps more specific than those posited by Sunstein, that justify its application.

D. Precautionary Contextualization

Gardiner adopts a broader view of the conceivable sufficient circumstances that would justify the application of the precautionary principle, emphasizing that the goal must be to describe “the relevant circumstances under which the

\textsuperscript{48} \textit{Id.} at 892-94.
A WARNING SIGNAL

precautionary principle is operative, by making clear what kinds of threats and uncertainty trigger the precautionary principle and what kinds of precaution are thereby triggered.”

Similarly, Douglas Kysar writes that the precautionary principle “focuses on particular categories of harm and separates them out for special treatment during early stages in the development of human knowledge and experience.”

And David Dana has embarked on this specification of contexts that call out for application of the precautionary principle, describing two such contexts: 1) heuristical bias towards irrational overweight of the avoidance of immediate determinate loss and irrational underweight of the avoidance of future indeterminate loss and 2) profit motives lead market actors to thoroughly explore a product’s possible benefits but neglect inquiry into its adverse effects.

With regard to the first context, Dana describes the historical regulatory inaction in the face of climate change, explaining that the certain cost to the economy of reducing carbon dioxide emissions weighs more heavily in the minds of all of us than the uncertain losses that could occur from climate change.

With regard to the second context, Dana uses the example of nanotechnology to demonstrate that the progenitors of new technologies effervescently investigate and laud the benefits of their product, but avoid investing in “adequate pre-market and post-market testing and surveillance.”

He specifies several conditions that militate against companies searching for and disseminating evidence that their products harm: “when particular products pose theoretical risks but not empirically-established ones; when any adverse effects will likely occur only in the relatively distant future; and when the link between the product and any distant adverse effects could well escape notice, or at least be difficult to establish as a matter of ‘but for’ causation.”

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49 Gardiner, supra note 39, at 38.
51 See Dana supra note 39.
52 Id. at 8.
53 Id. at 19.
54 Id.
E. Toward a New Rule

In relation to Dana’s work, this Article draws elements from the two categories he describes as justificatory of the precautionary principle, and then adds to them in order to create a new third stand-alone category. This new category results from the application of the rule: if the availability heuristic is exploited by economically motivated actors to construct systemic demand for chemical products, then those chemical products should be subject to the precautionary principle.

This proposed rule represents a combination of Dana’s separate categories to set the stage for systemic demand construction, thereby creating a more pernicious and exploitative outcome than Dana envisions. Where Dana identifies the capacity for the profit motive to lead companies to explore product benefits and ignore product risks, he does not specifically identify the tendency for companies to exploit the availability heuristic. Instead, his first category incorporates the concept of cognitive bias leading to overvaluation of avoidance of certain losses, but views it agnostically, as a feature of human existence, rather than as a human tendency that corporations are practically required to exploit in order to adhere to corporate laws mandating maximization of short-term shareholder profit. He writes of the availability heuristic: “The myopic focus on immediate losses also may reflect the availability bias, as such losses typically are easier to imagine than losses that would occur, if at all only years hence, and the optimism bias, whereby people may be believe, even in the absence of factual basis, that with time they will find a costless means to avoid future risks.” Dana views the development of what he terms the “myopia bias” as well as the preference for avoidance of sure losses over the avoidance of unsure losses as perhaps inevitable, noting that “some have speculated it has deep roots in evolutionary biology” but he does not construe its propagation as beneficial to vested interests. This leads him to optimistically prescribe regulators to search for better information,

55 Dana supra note 3, at 1325.
56 Id.
without necessarily calling for formal burden shifting.\textsuperscript{57} And he views the burden to be shifted as the more lenient burden of production rather than the burden of proof.\textsuperscript{58}

In contrast to Dana’s categories, the category presented in this Article involves an economically motivated actor mounting a campaign to take advantage of an availability heuristic, thereby creating systemic demand for chemical products.\textsuperscript{59} This activist tactic by profit-motivated corporations calls out for heightened regulatory scrutiny – the difference in the description of this category with Dana’s categories leads to a more ambitious prescription: the burden of proving safety must shift to industry and failing that, substitutes must be developed. This is not necessarily a disagreement with Dana’s propositions. It is simply a description of additional circumstances that necessitate giving even greater scrutiny to a situation. The problem described in this Article applies most appropriately to chemical regulation, in part because of the largely ineradicable uncertainty associated with the health and environmental effects of chemicals and in part because of the perhaps corresponding historical failures of chemical regulation in the United States. The Article next examines the reasons for the failures of chemical regulation.

\section*{III. CURRENT APPROACHES TO CHEMICAL REGULATION}

\subsection*{A. The Foundations of Chemical Regulation}

The starting point of almost all regulation is proof that it is necessary. Regulation tends to have to justify itself, partly out of the need to build political will to support the regulation and partly out of an historical tendency in the United States to view regulation with suspicion. This need not be the case, although most would see it as extremely constrictive, if not totalitarian, for the reverse to exist – for individual and group activity to have to justify itself to the state. The presumption is that actors can do whatever they please unless and until they inflict harm on others,

\textsuperscript{57} Id. at 1328.
\textsuperscript{58} Id.
\textsuperscript{59} See Kuran & Sunstein, \textit{supra} note 3.
with the default condition being that liberal market democracies permit unimpeded private action. While this presumption is usually interpreted broadly to enable most activities, productive activities almost always inflict at least some harm on the environment. Hence, environmental regulation is broadly justifiable and is widely feared by the corporations and industry as potentially intrusive and confiscatory of the freedom to produce. History however suggests that the fear is overblown: environmental regulation like other regulation has the practical burden of proving its necessity and merit. Regulators do not control their own destiny in bearing this burden – with every attempt to articulate, implement, and enforce rules, regulators meet resistance from both the regulated entities and from the other instruments of government. Even more broadly, popular will is something approaching a condition precedent for regulation, however vacuous and ephemeral such a concept may seem. Popular will is a construct that may simply represent the agglomeration of individual perception. But even if so, in a democratic fashion based on some underlay of majoritarian sentiment, it exists, and it lurks as an impediment or facilitator to governmental, corporate, or institutional decision-making.

Popular sentiment tends to mobilize expeditiously in response to significant stimuli that impact human emotions. Significant events of a personal nature engender speedy and pronounced responses. People experiencing trauma place obvious priorities on threat mitigation, as well as retribution against perceived bad actors. And if there is the possibility of additional trauma, for example future terrorist attacks, threat sensitivity may well lead to further exaggerated and inaccurate risk perception. To be sure, the accuracy of risk perception is a largely

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60 Kysar, supra note 50, at 17. In the United States, the default condition was created from a constitutional perspective by assertions that the federal government is one of limited powers and Fifth Amendment protections of private property rights. The constitutional elements are probably properly viewed as both the reflection of popular sentiment and the creator of cultural perceptions.

61 For example, while the entire country was mobilized to one degree or another following the Gulf Oil Spill, those whose livelihoods were directly impacted by the spill understandably had the strongest responses.
a chimera, as distinguished from an aspiration – even if the risks could be precisely measured, the proper course of action may not be so clear because valuation and aversion to risk vary widely among communities, let alone individuals. What is clear, however, is that crises (especially those with a possibility of recurrence) tend to prompt action, whereas risks that are plagued by uncertainties lend themselves to analytical processing that tends to be languid and weak. The observation then is simple: some risks seem obvious and we react to them quickly and other risks are less clear and we react to them slowly, often through methods such as cost-benefit analysis.62

The distinction between risks that are addressed speedily in sometimes emotional ways and those are dealt with through what is often dilatory and sterile analytics has a strong temporal dimension. Risks addressed quickly have often come to fruition and therefore inflicted harm, whereas risks that are uncertain have not yet clearly inflicted harm, leading many to doubt whether they are in fact harmful. Debate ensues ad infinitum with the quantification of risks taking on a robotic rigidity deferential to scientific assessments, yet the science does not yield precise results or clear courses of action. And even when the science becomes reasonably clear, industry is prepared to manufacture paralytic doubt – the purveyors of ambivalence ossify the status quo. Informational voids either cannot be filled except through blunt estimation or are filled with misrepresentations or prevarications. Oddly, many environmental law theorists and regulators maintain hope that the information will come in and that corporations will help provide us with the information.63 As Wendy Wagner writes, “[E]nvironmental law innocently assumes that information linking actors to resulting invisible harms will arise serendipitously, and, even more surprising, that the actors will either volunteer or accept

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62 An important caveat is that there is also a tendency to fear the unknown, especially if it is susceptible to the creative capacity of imagination. But some unknowns such as terrorist attacks are easy to imagine and other unknowns such as heart disease are more difficult to imagine.

this incriminating information without fuss or fanfare.”⁶⁴ Corporations, acting rationally to avoid litigation, have a vested interest in reducing obvious risks for which they are more easily held accountable, and in making sure that less obvious risks remain shrouded in uncertainty.

B. The Failure of TSCA to Fill Informational Voids

Some commentators have suggested that if information on chemical risks will not arise easily and will not be proffered up by companies that either already have information or could develop it, then concerted legal or regulatory effort may be needed to develop the information.⁶⁵ Recognizing the failure of TSCA to generate meaningful information on chemical risk, many put hope in Congress to amend TSCA to revolutionize chemical regulation in the United States. While the ultimate outcome of TSCA reform is uncertain, its orientation tends to be toward remediying scientific gaps in knowledge regarding chemicals. Since the passage of TSCA in 1976, the EPA has tested only about 200 of the 84,000 chemicals listed on the TSCA Inventory and banned only 5 chemicals.⁶⁶ While the 112th Congress’ consideration of TSCA reform remains to be seen as of the writing of this Article, the bill considered in the 111th Congress recognized the failures of TSCA and would have required the chemical industry to provide data to the EPA to conduct testing, as well as empower the EPA to mandate testing by companies. In many regards, TSCA reform looks aspirationally to Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) in the European Union. As its name suggests, REACH would subject chemicals to layers of analysis, starting with basic information provision by manufacturers and importers and continuing with testing of chemicals based on characteristics including bioaccumulative

⁶⁴ Id.
⁶⁵ Id. at 1624.
capacity, persistence, and toxicity.\textsuperscript{67} While some maintain hope that the United States could implement a statutory program similar to REACH and that REACH itself will compel companies to sell products globally, including in the United States, that comply with European requirements,\textsuperscript{68} others remain doubtful that the vagaries of the American political process will produce an outcome sufficiently protective of consumers any time soon.

\textbf{C. New Approaches to Chemical Regulation: Duty-to-Test and Trespass}

In order to bridge the gap between the present and an imagined future of adequate statutory requirements and enforcement not undermined by regulatory capture, Albert Lin favors a legal establishment of a duty-to-test and advocates a cause of action sounding in public nuisance against companies that fail to test their products for chemical safety. As Lin himself acknowledges, however, this perhaps idealistic notion rests on a belief that it is possible to test our way out of uncertainty regarding chemical effects: “[T]he level of toxic ignorance that surrounds us is not the inevitable result of the limits of scientific inquiry. Rather it is the consequence of deliberate decisions by the chemical industry and by those who incorporate chemicals into their manufacturing processes to avoid testing that would identify at least some of the likely harms.”\textsuperscript{69} Lin’s intention of essentially “calling the bluff” of the chemical industry is certainly not counterproductive, but the creation of a cause of action based on public nuisance theory for nondisclosure of information assumes that the disclosure of accurate information, even if it comported with the standards established by REACH, is sufficiently protective. However, as Lin acknowledges, it is easy to imagine the construction of safe harbors that would enable a corporation to establish compliance with disclosure requirements.\textsuperscript{70} The

\textsuperscript{69} Lin, supra note 67, at 957.
\textsuperscript{70} Id. at 1010.
difficulty is that it is only possible to disclose what is known, and it is likely that at any point in time much remains unknown. Of course it may be the case that a degree of concealment is in fact occurring, as irrefutably occurred with regard to lead, asbestos, and tobacco. If this were the case with regard to flame retardants or other chemical products satisfying the criteria outlined in the Article, shifting the burden of proof would address the problem – industry would have prove that the product was safe. To be sure, shifting the burden of proof would not result in the divulgence of concrete proof of harm – corporations would not self-incriminate because they would want to promote the public perception that products are safe and would not want to risk liability in the tort system for prior acts. In summary, by shifting the burden of proof, if the chemical industry can establish the safety of a chemical, then all the better, but if not, it strains credulity to assume that chemical companies would serve up direct evidence of the harm of their products.

While perhaps all commentators concerned about environmental health support scientific investigation and the accumulation of more information regarding the effects of chemicals, some remain doubtful that scientific testing will significantly dampen uncertainty surrounding chemical harm. Among them, Carl Cranor has written of the need for a trespass model of regulation, whereby “firms seeking to market products should test substances to determine whether they can invade human (mammalian) bodies and cross the placenta or be present in breast milk.” An affirmative finding would then trigger further testing requirements with particular attention to developmental effects. The virtue of the trespass approach is that it establishes a bright-line ex ante standard to attempt to prevent harm. However, its weakness, apart from the inevitable questions surrounding the monumental resistance it would receive from the chemical industry, is that it would simply trigger further testing. This represents a recognition that the mere presence of chemicals in the

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72 See id.
human body may not motivate a regulatory response—hundreds, if not thousands, of chemicals are present in all of us, and, perhaps because we are accustomed to the collective experiment relegating humans to guinea pig status, cause for alarm must be grounded in something more than mere physical presence. Thus, in spite of new ideas such as Cranor’s trespass model, the search for proof of harm continues unabated, as the Enlightenment mentality embarks on a “rationality project” at the nexus of rational choice theory, microeconomic efficiency models, and cost-benefit analysis. Regulators conveniently become technocrats, wondering if beans of data will grow into illuminating beanstalks of cost-benefit analysis. And faced with uncertainty, bean counting essentially doubles down on itself, with cost-benefit analysis proponents arguing for the application of a number of methods to bring certainty to uncertainty. These methods include Delphi analysis (surveying of experts in relevant fields regarding their assessments of unknown risks) and Monte Carlo analysis (computer simulations of policy outcomes in thousands of different possible worlds). All of these methods however have a unifying feature—they permit the continuation of cost benefit analysis in the face of uncertainty.

D. The Failure of Cost-Benefit Analysis to Deal with Uncertainty

Cost-benefit analysis then pastes a veneer of rationality on a system afflicted by genuine uncertainty. Cost-benefit analysis draws our collective attention to the knowable, thereby further reinforcing its importance, while simultaneously discounting the value and meaning of the unknowable. Yet Knightian uncertainty, or immeasurable risk, remains—despite the best efforts of the assessors of chemical harm, science tends to languish behind. While the acute effects (especially death) of chemicals are obvious,

73 Id. at 255.
74 Deborah A. Stone, Clinical Authority in the Construction of Citizenship, in PUBLIC POLICY FOR DEMOCRACY 46 (Helen Ingram & Steven R. Smith eds., 1993).
75 DOUGLAS A. KYSAR, REGULATING FROM NOWHERE: ENVIRONMENTAL LAW AND THE SEARCH FOR OBJECTIVITY 93 (2010).
the chronic effects are not. Our rudimentary methods of dose-response toxicity assessments do not capture the issues of latency periods, synergistic interactions among chemicals, susceptible populations such as infants and the elderly, relationships between genetic predisposition and environmental exposure, and particular developmental windows. The primary methods used to determine the potential for chemical harm have changed little over 30 years, in spite of developments in our understanding of how complex systems operate and chemicals behave.\(^6\) Complexity theory, apropos in many environmental and chemical contexts, posits that complicated systems are often highly fluctuative, adaptive, and self-reinforcing, exhibiting phenomena such as “fat tail” distributions in probability graphs, where highly anomalous occurrences become less anomalous and much more severe than a normal distribution would predict.\(^7\) Even rudimentary chemical research is often scant; more sophisticated chemical research reflecting complexity theory is practically nonexistent. As Wendy Wagner writes,

> Although scientists have progressed in developing a mechanistic understanding of cancer, they have made only limited progress in determining how to assess, much less screen, hazardous substances for other harms, such as reproductive, neurological, hormonal effects, or how to account for variability in human susceptibility. Regulators essentially cross their fingers and hope that current primitive carcinogenic assessments protect against these other harms, while toxicologists struggle to develop tests for amorphous changes in neurological and endocrine function.\(^8\)

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\(^6\) See Wagner, supra note 63.

\(^7\) See Kysar supra note 50, at 15-16.

\(^8\) Wagner, supra note 63, at 1626-27.
E. Additional Problems: Individual Beliefs About Chemicals, Consumption and the Justness of the World

While the problem of ineradicable scientific uncertainty is formidable, the holy grail of accurate chemical harm assessment is surrounded by additional layers of complexity relating to decision-making structures that are in turn influenced by individual beliefs. It is, of course, inaccurate to view political actors, corporations, regulators, and consumers as clearly demarcated and differentiated groups, and more appropriate to realize that individuals operating in each of these groups and systems bring with them preconceptions about how the world operates. The world is filled with people and their unique beliefs. These beliefs tend to be heuristical simplifications of a complex world, and they are certainly useful in eliminating anxiety and promoting a blissfulness, ignorance, escapism, or belief construction itself. In order to protect this simplified worldview in which chemicals are safe and all is well, people take on a certain defensiveness when presented with the possibility that chemicals can pose dangers. This stems from two facts: 1) chemicals are immensely beneficial to our society and are central to modern life and 2) there is a human need to believe in a just world. There were entire generations that grew up on propagandistic mantras such as “better living through chemistry” and the “future is plastics”, and to a large extent, chemicals in consumer products have enabled considerable improvements in the standard of living. Perhaps even more important in terms of sculpting individual perception, consumer products are enjoyable. Noted environmentalist Gus Speth has stated,

> beyond meeting basic needs consumption brings us pleasure and helps us to avoid pain and, worst of all, boredom and monotony. Consumption is stimulating, diverting, absorbing, defining, empowering, relaxing, fulfilling, educational, rewarding. If pressed, I would have to confess that
I truly enjoy most of the things on which I spend money.  

Whether the plush mattress, the car, the HDTV, or the computer, new consumer products provoke a sense of wonderment, especially when juxtaposed against historical predecessors. The comparison, particularly among technological products, leaves us with a sense of impressive progress, even if the dimension by which we are measuring improvement is not precisely clear. And most of us scarcely even broach the question of environmental or health impacts of the products we are buying—how many of us questioned the chemical content of the mattresses we have purchased? Part of the reason for this is that there tends to be an inverse relationship between a product’s benefit and its perceived risk, hypothesized by some as a way to avoid the discomfort of dissonance. When confronted with the possibility that chemicals in useful products may pose risks, there is a powerful tendency to discount the risks and to disparage the people questioning safety as hyperbolic promoters of a “sky is falling” mentality, concocters of bogeymen, and “boys who cry wolf.” Richard Posner has noted as a general matter, that there is not a positive noun in the English language for someone who warns. Instead Posner points out that we derisively term these people prophets of doom or “Eeyores,” and when it turns out that their warnings start to come to fruition we call them “Cassandras.” Some may construe warnings as overly pessimistic doomsaying that is un-American and the mark of pusillanimous femininity. Perhaps reinforcing a masculinized construct of invincibility in the context of chemical regulation is the notion that only pregnant women and children have to be seriously concerned with chemical exposure. Ad hominem attacks on warners constitute part of the story, but people who are convinced that chemical are safe also make specific defensive, heuristical maneuvers, that are so entrenched

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79 JAMES GUSTAVE SPETH, RED SKY AT MORNING 125 (2004).
80 See George F. Lowenstein et al., Risk as Feelings, 127 PSYCHOL. BULL. 267, 280 (2001).
82 Id.
that they amount to sayings in the English language: “a small amount won’t hurt you;” “as long as you don’t eat it, it’s ok;” “it won’t kill you;” “what we don’t know won’t hurt us;” “don’t worry about it because we are all exposed to it;” “the dose makes the poison;” and “as long as you aren’t a baby or pregnant, then you will be fine.” Some of the defensive posturing is slightly more clever – people will note that everything in the world is made of chemicals and just because something is manmade does not mean it is unsafe (e.g. stainless steel), nor that because something is natural that it is safe (e.g. spider venom). Others will argue that at a high enough dose, all chemicals, including water, are toxic and can cause death. These views are not simply held by individual people in society – they agglomerate and emanate upward to become the shorthand approaches of regulatory agencies. The FDA, for example, has adopted the “substantial equivalence doctrine” to evaluate new products for risks, whereby a new product of similar chemical composition to an already known product is deemed equivalent and safe. Commentators have pointed out the potentially problematic implications of this approach, especially in the context of the relationship between genetically modified foods and their nonmodified counterparts.

More recently, as it has become clear that hundreds of industrial chemicals are in our bodies and are reaching the fetus during gestation, chemical companies, relying on the “dose makes the poison” argument, have emphasized that the mere presence of a chemical does not imply that it is causing harm, even though it turns out that we do not know the level of exposure, the level that may cause harm, or synergistic effects of chemicals.

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83 See Kysar, supra note 50, at 17.
84 See PHILIP SHABECOFF AND ALICE SHABECOFF, POISONED PROFITS: THE TOXIC ASSAULT ON OUR CHILDREN 95 (2008) (noting that Alex Avery of the Hudson Institute is known for stating that in sufficient amounts, “water will kill you”).
85 Kysar, supra note 75, at 91.
86 Id.
87 Shabecoff, supra note 84, at 45. Body burden studies have consistently demonstrated that a variety of chemicals reach the fetus. In 2004 a study of ten newborns from across the United States found that they had between 154 and 231 chemicals in their umbilical cord blood, implying that the chemicals had entered the fetus.
interacting with each other. The response of chemical companies seeking to maintain revenue streams and avoid liability is not surprising, nor is the extent to which people want to believe they are safe – it is a generally adaptive trait that reduces worry and anxiety and makes it easier for us to get through daily life. Many observers have emphasized that the desire to reduce cognitive dissonance is pervasive and powerful – when a chemical product has unequivocally positive effects, people have trouble accepting that it may also have negative effects. Psychologist Melvin Lerner famously observed that the human tendency to yearn for justice is so powerful that when faced with apparent injustice that cannot be stopped, we will draw the conclusion that the victim of injustice must somehow deserve to suffer. Jon and Kathleen Hanson have observed that Lerner’s results suggest that “we abhor, not injustice, but the dissonance that perceived injustice creates within us.”

Lerner’s “just world hypothesis” suggests that the tendency to eliminate dissonance when confronted with injustice affects not only isolated situations but our entire worldview: “we do not believe that things just happen in our world; there is a pattern to events which conveys not only a sense of orderliness or predictability, but also the compelling experience of appropriateness expressed in the typically implicit judgment, ‘Yes that is the way it should be.”

When confronted with the possibility that chemicals present harm, the absence of conclusive evidence is interpreted as evidence for the absence of harm. Seeking to validate a chemical production system that serves so many useful purposes, including, for example, the prevention of mattress fires, the tendency is to view chemicals as safe, or at least innocent until proven guilty. Not finding clear evidence of harm, we optimistically assume that all is well, particularly when we juxtapose the unclear harm against

88 Upton Sinclair famously stated, “It is difficult to get a man to understand something when his salary depends upon his not understanding it.” UPTON SINCLAIR, I CANDIDATE FOR GOVERNOR, AND HOW I GOT LICKED 109 (1935).
89 Jon Hanson and Kathleen Hanson, The Blame Frame: Justifying (Racial) Injustice in America, 41 HARV. C.R.-C.L.L. REV. 413, 419 (2006).
90 Id.
the clear benefits. On the other hand, when clear evidence of chemical harm does come in, there is a tendency to act quickly to punish the chemical in question with intensive regulation or outright bans. This exorcism of dangerous chemicals tends to affirm the overarching belief that chemicals are safe.

The point in describing common perceptions of the safety of chemicals is to emphasize the obstacles that effective chemical regulation faces. Not only are the likely harmful effects of chemicals extremely difficult to scientifically assess from an ex ante perspective, but we, all of us, have constructed beliefs, usually unwittingly, about safety. The mattress case study, to which we now turn, will illustrate the impediments faced by chemical regulators and will be used to generate a contextualized approach for the application of the precautionary principle.

IV. THE MATTRESS CASE STUDY AND A RULE PROPOSAL

A. A Brief History of the American Mattress

The January 1913 issue of Good Housekeeping stated: “All of us, it is safe to say, have at one time or another slept on a pile of rags gathered from a city dump and never disinfected.”92 In the early 20th century, mattress companies were faced with increasing cotton costs and began to make supposedly new mattresses by taking the stuffing from old mattresses together with wool rags obtained from garbage dumps and repackaging it in a new mattress cover.93 This was the era in which the admonition “Don’t let the bed bugs bite” had literal meaning. The Good Housekeeping expose led state governments to respond.94 States began to pass laws requiring mattress makers to affix labels to mattresses stating the material composition and including whether the material was new or used. The extent to which these laws were adhered to is unclear, largely because there is little evidence that there was an

93 Id.
94 Id.
enforcement mechanism. Few, if any states, had agencies during this time that actually inspected mattresses. The central issue of course was that the internal composition of mattresses was not ascertainable by consumers. Consumers had no way to evaluate the content of mattresses – as long as the mattresses did not smell and the outer cover appeared new and clean, the consumers would live in state of blissful obliviousness, that is until they started to get sick due to insanitary conditions.

During the 1940s and 1950s innerspring mattresses became widespread. The postwar growth in the middle class and in the general standard of living allowed many people to spend more on mattresses, and many of the problems with insanitariness went away. But a new problem soon developed. In the ceaseless drive to create a mattress that would sell better and yield more profit, mattress makers latched on to a new substance: polyurethane foam. Unfortunately, it turned out that petroleum-based polyurethane is extremely flammable and people smoking in bed would set the mattress on fire. As a result, beginning in the 1970s, state governments, led by California, mandated fire retardant standards for mattresses. In 1973, the Federal Standard for the Flammability of Mattresses went into effect to reduce the ignition potential of mattresses, but notably did not stipulate how flame retardance could be established, instead deferring to industry to devise its own methods. The prevailing method became the usage of polybrominated diphenyl ethers (PBDEs). Crucially, partly because the Consumer Product Safety Commission was implementing and enforcing the regulation, PBDEs escaped the potentially more stringent review of the EPA. In the decades to come, many states implemented laws requiring even less mattress flammability than the federal government, and PBDE usage became pervasive.

In 2006, the federal government adopted a new federal standard for mattress flammability, with the CPSC Chairman Hal Stratton stating: “The rule which we have put in place is the culmination of careful thought and hard work by Commission Staff and by private and public sector stakeholders. But most of all, it

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95 Id.
96 Id.
was fused by the commitment to improve to improve the safety of the American consumer. Yet again, however, the CPSC did not stipulate how mattress companies should achieve compliance. Recognizing growing concerns about PBDEs, the CPSC itself hypothesized that the chemicals used would include antimony trioxide, boric acid, melamine, decabromodiphenyl oxide, vinylidene chloride, and ammonium polyphosphate. Most recently, PBDEs have come under the scrutiny of the federal government, with the EPA announcing an “action plan” in 2009 to address the health concerns associated with PBDEs.

This Part will next examine more specifically the crucial lessons from the experience of mattress flammability regulation in the United States and use it as the basis to form the proposed rule: if there is exploitation of the availability heuristic by economically motivated actors to create systemic demand, then regulators should shift the burden of proving safety to industry and work to develop substitute methods to solve the underlying problem.

B. The Availability Heuristic

As previously discussed, the availability heuristic is the tendency for people to overestimate the likelihood of an event if it is easy to imagine the event. Research suggests that fires are particularly vulnerable to overestimation as a perceived threat. According to Paul Slovic, when respondents were asked to rate the likelihood of death from different threats, “fire/flame” was among the categories most prone to overestimation, meaning that people thought they were more likely to die or be maimed by fire than the historical evidence suggests. Interestingly, several other seriously overestimated threats, such as homicide, venomous bites or stings, and floods, tended to fall into the category of primordial

98 Id.
fears that are perhaps evolutionarily developed and justified for most of our species’ existence—perhaps modern man still perceives threats as a primitive man.101 Alternatively, perhaps media coverage tends to highlight house fires and shark attacks.

Whatever the case, the specter of a mattress fire leads to the development of terrifying mental imagery and the commission of the availability heuristic error. The tendency to overestimate the threat of a mattress fire is borne out by the data, which, oddly, the CPSC uses to justify its extreme actions: “When fully effective, CPSC estimates the new mandatory [2006] standard for mattresses is likely to save as many as 270 lives, preventing 78 percent of the deaths, and 1,330, or 84 percent of the injuries currently occurring every year.”102 While the deaths of 270 people is a source of concern, by any measure, the death of 270 number people a year is small. Some historical perspective is appropriate in order to assess the 1973 Flammability Standard. In the period from 1965 to 1977, approximately 35,000 burn cases were reported to the National Institute for Burn Medicine (“NIBM”).103 Of these, fewer than 1% (269) were caused by beds or bedding, but many of these burns were quite severe in nature since the victims were usually either asleep or resting.104 In addition, from this data set, about 83% of all mattress-burn victims were either smoking or drinking while burned.105 This is not to suggest that smokers and drinkers, through a theory of contributory negligence, deserve the outcome that they receive, but instead to highlight that mattresses fires could be avoided through other means such as norm shifting that reduce the likelihood that people will smoke in bed.

It is also worth emphasizing that while the CPSC mentions the injuries that its regulation will prevent, the emphasis is clearly on saving people’s lives. This is part of a recurring regulatory focus on death which itself results from the ease of imagining

101 Id.
103 Peter Linneman, The Effects Of Consumer Safety Standards: The 1973 Mattress Flammability Standard, 23 J. LAW & ECON. 461, 464. (Linneman notes, “Private correspondence with NIBM officials suggests that their data record between 10% and 35% of all burn cases annually.”).
104 Id.
105 Id.
death and hence its susceptibility to the availability heuristic. Many regulatory approaches are measured in terms of the number of lives saved. Indeed, there is also evidence that there is a focus on preventing particularly painful deaths. Cancer is widely construed to be a painful and usually terminal illness, and there is little doubt that carcinogenicity is perhaps the crucial criterion in the assessment of the danger of chemicals. As Stephen Breyer writes, “The public’s fear of cancer currently drives the system.”

Why is there such a focus on death and cancer? There are multiple theories, some of which are in direct tension with one another. First, preventing death may simply be a proxy for generally effective regulation – the notion would be that death correlates to the other outcomes that we are trying to avoid such as injury and emotional trauma. Second, death is easier to measure than other possible metrics. Third, and counterintuitively, people are desensitized to the idea of death. It may be easier to talk about how many people died in a war rather than how many people were terribly maimed. There is also a phenomenon known as Weber’s law, which claims that people’s ability to observe changes in a physical stimulus decreases rapidly as the magnitude of the stimulus increases.

Applying this to increasing numbers of deaths implies that there is “psychophysical numbing” of our ability to appreciate loss of human life. As Joseph Stalin famously stated, “One death is a tragedy, a million is a statistic.” The point then is that in the context of regulation, people focus on death because we are surprisingly comfortable with the subject. Fourth, and in some tension with the third, there is intrinsic human fascination with the macabre and grotesque, partly resulting from our fear of it. Most of us are very afraid of death, and the focus on death in the context of regulation is appropriate. Suffice it to say that putting these considerations aside pertaining to the underlying reasons and explanations for the focus on death, the reality is that


107 Slovic, supra note 100, at 372-73. Weber’s law has been described in the following manner: “In order for a change in stimulus to become just noticeable, a fixed percentage must be added. Thus, perceived difference is a relative matter. To a small stimulus, only a small amount must be added. To a large stimulus, a large amount must be added to be equally noticeable.”
the concern with death rears itself explicitly and directly in policy analysis. But negative health effects also must be taken into account, particularly when there is the likelihood that these will affect large numbers of people, numbers that are so large in the context of mattresses as to include the entire population of the United States.

In the case of mattresses, the reality is that very few people die or suffer injury in mattress fires, but virtually everyone sleeps on a mattress. The question facing the regulator is how to minimize the number of deaths from fire while ensuring safety for the millions of people who spend one-third of their lives on the product. The history of mattress regulation illustrates the capacity for the public and the regulators to fall prey to the availability heuristic. We are exposing millions of people to flame retardant chemicals in order to protect against a miniscule number of deaths that could be prevented through alternate means.

C. Economically Motivated Actors

Having established the power of the availability heuristic to capture the human imagination, the question becomes whether certain types of actors exploit the heuristic to their advantage. Some commentators have observed that economically motivated actors take advantage of cognitive heuristics to sell products. Jon Hanson and Douglas Kysar, emphasizing that risk perceptions of consumers are framed by companies in ways that maximize profits, state “[o]nce one accepts that individuals systemically behave in nonrational ways, it follows from an economic perspective that others will exploit those tendencies for gain.”\footnote{Hanson & Kysar, \textit{supra} note 3, at 635-36.} The drumming up of problems and the advertisement of products to solve those problems is surely as old as capitalism itself. When problems are especially frightening, products that can successfully mitigate the fear and assuage the psychic pain are especially profitable. The difference that Hanson and Kysar identify is that companies exploit heuristics in ways that consumers themselves are unaware. Similarly, Kuran and Sunstein describe the capacity for interested parties to mount “availability campaigns” that augment fear and
create movement in public sentiment that benefits the interested party.\textsuperscript{109} Kuran and Sunstein emphasize the capacity for exploitation of the availability heuristic by a variety of actors “[l]ocated anywhere in the social system, including the government, the media, nonprofit organizations, the business sector, and even households.”\textsuperscript{110} They write: “We have described the instigators and manipulators of availability campaigns as availability entrepreneurs. Showing at least a working knowledge of the availability heuristic and other cognitive processes, these entrepreneurs seize on selected incidents and publicize them to make them generally salient to the masses.”\textsuperscript{111} Hanson and Kysar go even further. They note that even if companies are not consciously exploiting heuristics, the profit incentive will lead them to act as if they are: “Cognitive biases present profit-maximizing opportunities that manufacturers must take advantage of in order to stay apace with competition. Whether by design or not, the market will evolve to a state in which only firms that capitalize on consumer cognitive anomalies survive.”\textsuperscript{112} The search for profit entails that opportunity to propagate hyperbolic assessments of problems together with ameliorative products that possess little or no downside risks apparent to the consumer will continue to its logical conclusion of profit maximization. The relevant point is that we need not cast corporations as either malevolent actors seeking to exploit our thinking or ruthlessly evil juggernauts seeking to inflict harm – the market system works in a way that companies are not intentionally doing anything other than make money, and all else follows from that simple command.

In response, regulators must confront more directly the implications of corporate law that commands companies to make profits. While we may tend to characterize corporations as focused on growth and profit, our personification of the corporation leaves room for other traits, such as a belief that under certain circumstances corporations will behave responsibly, sustainably, or

\textsuperscript{109} See Kuran & Sunstein, supra note 3, at 683.
\textsuperscript{110} Id. at 687.
\textsuperscript{111} Id. at 733.
\textsuperscript{112} Hanson & Kysar, supra note 3, at 726.
even altruistically. Many in the policy-based and regulatory community then act with surprise that corporations generally do exactly what they are required to do under corporate law: maximize short-term profits for shareholders. What we need to see anew is that the corporation exists for the corporation. Corporations will not volunteer information, they will not act beneficently, morally, or in environmentally sustainable ways unless the action comports with profit augmentation. The notion that the market is facilitative of environmental protection, that robust economic growth can also promote a pristine healthy environment,\(^\text{113}\) has not been borne out in the past 30 years. What is needed by environmental law is not puerile hostile criticism of malevolent corporate disposition, but acceptance, at least for now, that corporations fundamentally do just one thing: maximize short-term profits of shareholders. Hoping that corporations will voluntarily act with a sense of social responsibility is nothing more than a figment of our collective imagination. The potential to change corporate law and corporate behavior is beyond the scope of this Article, but what is within the scope of this Article is to emphasize that environmental regulators must recognize that they are dealing with corporations that will ceaselessly and obsessively maximize profit as they are required to do under law. While the fundamental tenets of economics suggest that free exchanges in the market generate value on both sides of the transaction above and beyond the cost of the trade, and that the increases in wealth associated with these exchanges in some sense accorded to society (putting aside distributional issues), history demonstrates that market manipulation is common, exchanges are not as free as they

\(^{113}\) The Kuznets Curve in the economic literature describes a positive relationship between national GDP and environmental quality. Its central criticism is that economic growth in developed countries may be borne of environmental degradation in developing countries. In other words, environmental damage is merely transferred to other locales. Environmental justice advocates raise evidence for this proposition on an intranational level as well. Internationally, predictions that developing countries will experience disproportionate impacts from global climate change relative to wealthy developed countries in the Northern Hemisphere provide further evidence to support the idea.
A WARNING SIGNAL

appear, and the value created by transactions is not as great as we hope.

The corporate actors in the mattress case study include the PBDE manufacturers, the mattress manufacturers, and the mattress retailers. An initial observation is that the chain from mattress construction to purchase by the consumer involves a formidable bulwark of corporate entities with seemingly aligned interests in selling mattresses. While it is commonly supposed that the market generates value on the basis of competition, it is less commonly highlighted that variously demarcated industry sectors have symbiotic relationships with others that reinforce mutual augmentation – as more mattresses are sold, mattress retailers and PBDE manufacturers will both make more money. If power aggrandizement arises across industries involving flame retardant mattresses, to what extent can we rely on competition within industries to mollify power concentration? Looking to the relative level of consolidation in the industry, the trend in the mattress industry has been toward consolidation, and this trend accelerated greatly as a result of the implementation of the 1973 Mattress Flammability Standard. Peter Linneman hypothesized that the 1973 Mattress Flammability Standard benefited large mattress makers relative to small mattress makers.\textsuperscript{114} The underlying assumption on which this claim was based was that the flammability standard did not require the development of new technology – most of the large mattress makers had already achieved compliance with the flammability standard ex ante.\textsuperscript{115} The reason for this was that sans regulation, the pursuit of a profit-maximizing strategy would still lead to creation of at least some modicum of flame retardance in the mattress, as manufacturers do not want to be held liable for dangers associated with obviously dangerous products. Linneman bolsters his theoretical claim by noting the importance of fixed costs and barriers to entry.\textsuperscript{116} Since a large part of the compliance costs were fixed costs involving the process and machinery required for the insertion of flame retardant materials, many small firms would be less able to absorb this cost.

\textsuperscript{114} See Linneman, supra note 103, at 474.
\textsuperscript{115} Id.
\textsuperscript{116} Id.
since it would be more difficult to distribute the fixed cost over additional production units. Hence there would be a barrier to either the continued existence of a small firm or entry of a new firm. While this theoretical story is intuitively appealing, it means little unless there are observable phenomena that support it, but Linneman was able to present data that validated the theoretical analysis. Among other forms of data, he presented the following: 1) regarding compliance violations, 81% were by firms with annual sales under $500,000 compared to 5% by firms with annual sales over $3.5 million and 2) average sales of the smallest firms fell by 11% while the sales of the largest two groups of producers rose by 8% and 44% respectively. This led to the conclusion that “large, significant, and predictable income redistributions from small to large producers resulted from the 1973 flammability standard.” Not surprisingly, today in terms of the relative strength of the largest players, the top four manufacturers of mattresses and foundations operate about one-half of the 639 U.S. establishments producing these products.

One way that powerful companies stay powerful is by working to develop rules, laws, and regulations that serve their interests. Sometimes this simply takes the form of an industry lobbying the legislature and agencies for beneficial rules and regulations, or lack thereof. Other times, the rules may at least facially have the intention of serving the public interest, when in fact they are more likely to serve a particularized corporate interest and maintain existing power distributions. In a statement that applies readily to both contexts, Adam Smith himself acknowledged the caution that must be exhibited when it comes to the interaction between corporations and government:

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117 Id, at 474-76.
118 Id, at 478.
121 Id. at 218.
The proposal of any new law or regulation of commerce which comes from the [mercantile] order, ought always to be listened to with great precaution, and ought never to be adopted till after having been long and carefully examined, not only with the most scrupulous, but with the most suspicious attention. It comes from an order of men, whose interest is never exactly the same with that of the publick, and who accordingly have, upon many occasions, both deceived and oppressed it.\textsuperscript{122}

It should come as little surprise then that among the foremost proponents of the New Flammability Standard was Serta.\textsuperscript{123} Serta portrayed its support of the regulation as indicative of the company's altruistic concern with the safety of its customers, stating “we believe we have a responsibility to offer safer mattresses as soon as possible.”\textsuperscript{124}

And mattress makers of course do not operate in isolation—the flame retardant industry itself has historically been sizable and extremely consolidated, described by the Chemical Marketing Reporter as “an oligopoly controlled by Albemarle, Great Lakes, and the Dead Sea Bromine Group.”\textsuperscript{125} And while these companies have recently had to make concessions regarding the sale of their products due to enhanced scrutiny in at least some states, as will be discussed below, a recent report on the flame retardant industry states: “Global flame retardant demand will rise 6.1 percent annually through 2014. Gains will be driven by trends toward more stringent flammability standards in the developing world, and by the rising use of plastic products. The Asia/Pacific region will

\textsuperscript{123} Testimony of Al Klancnik, Serta Group Vice President, before the U.S. Senate Comm. on Commerce, Science & Transportation, 108th Cong., (July 14, 2004).
\textsuperscript{124} \textit{Id.}
\textsuperscript{125} \textit{Methyl Bromide Bill Riles 'Greens,'} 248 \textsc{Chemical Marketing Reporter}, July 3, 1995.
continue to be the largest and fastest-growing market.” Even if there is increasing awareness of the dangers of flame retardants in Europe and the United States, the game is not up, it is merely moving elsewhere and creating new markets along the way.

An honest baseline understanding of corporate behavior must guide regulatory perception and response and our construction of rules and guideposts to ensure safety. In other words, if the corporate profit motive is accepted, then palliative and mitigative measures take on crucial importance and should be implemented preventively as this Article describes. It is surely the prerogative of corporations to exploit heuristics such as the availability heuristic – we should expect nothing less than avaricious viciousness. This competitiveness and ceaseless search for profit is precisely what creates the bountiful effects of capitalism. But in response, having recognized this tendency, it is within the power of regulators to shift the burden of proof of safety to corporations before they bring products to market. In concrete terms from a legal perspective, a statute could be drafted that would empower regulators who make a finding of corporate exploitation of the availability heuristic to shift the burden of proving safety to industry. As will be discussed below, REACH provides one possible model to suggest how a legal burden can be shifted. If it is suspected that corporations are exploiting the availability heuristic, a statutorily empowered agency could look to evidence of market behavior designed to create systemic demand. As demonstrated by antitrust laws in the United States, regulators are capable of observing when there is manipulation of supply. Evidence of market manipulation of demand could also be ascertainable, as for example, laws against planned obsolescence have demonstrated. But how will regulators know when there is systemic demand construction?

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D. Systemic Demand Construction

Economically motivated actors working to augment the availability heuristic create artificial growth in demand. Demand is understood both in the narrow economic sense of consumer demand and the broad systemic sense that includes public demand for quiescence of horrifying thoughts, corporate demand for profit, and regulatory demand to protect the public interest. More than a simple bandwagon effect among consumers or a groupthink mentality within regulatory agencies, demand is comprehensive; it suffocates dissent and establishes inertial consensus that maintains the status quo.

Public demand for reducing the fear created by the availability heuristic, as discussed above, is a major part of the story, and so too is corporate demand for profit. But there are additional demand propellants that build on overall demand construction. First, there is consumer demand itself. Proponents of law and economics attach a sacrosanct meaning to consumer purchases because they represent evidence of underlying individual preferences that come to fruition through seemingly unfettered choice. At its base, proponents of traditional economic constructs argue, there are genuine human needs, even if they merely nakedly and unapologetically represent the need for prosperity (i.e. greed is good because it improves living standards). Underlying these claims, however morally grotesque, are, admittedly, rationalities with a ring of irrefutability. For example, in the context of mattresses, the development of polyurethane foam created a superior product for consumers – not only did mattresses become more comfortable as a result of the soft resilience of foam, but mattresses became significantly cheaper. And when it became clear that foam mattresses posed a flammability hazard, flame retardants provided an easy solution. On its face, any flaws in the logic of consumer demand are difficult to ascertain.

Viewed in an isolated context, consumer demand for foam mattresses does not appear problematic because the traditional market flaws are not apparent. While a strong case can be made that flame retardants create negative externalities in the form of harm to public health, it is difficult to predict these externalities by looking only at consumer demand. Instead, what is needed is to
view consumer demand in relation to other actors. Most notably, the possibility of market manipulation arises when the availability heuristic is exploited by corporate interests. In addition, regulators themselves, often utilizing methods such as cost-benefit analysis, are prone to errors that increase demand.

As the gatekeepers of the public interest, especially when the public-at-large embraces cognitive bias, regulators have a responsibility to provide a check against demand. While many view the orthodoxy of cost-benefit analysis as a lens that corrects irrational demand inflicted of excessive harm, cost-benefit analysis can legitimize harmful social responses and ineffective regulations. In the context of mattress fire regulation, benefits of flame retardant standards were reasonably clear and hence measured, and the costs in the form of diminished public health were uncertain and therefore not measured. Cost-benefit analysis takes into account that which is easily measurable, such as avoided mattress fire deaths. Moreover, the cost of inserting flame retardants into mattresses was not especially high, and a large portion of this cost was in the form of revenue to the flame retardant maker. The actual cost of the regulation is partially recoverable under a cost benefit analysis because it is synonymous with benefits to the flame retardant maker. By saving lives for relatively little additional increase in mattress prices, the stage was set for clearing the cost-benefit analysis hurdle with room to spare. In addition, the cost-savings to consumers from being able to buy cheaper mattresses made from polyurethane foam adds to benefit side of the ledger, as do the increased revenues from selling mattresses. All other things being equal, cheaper mattresses tend to equal more sales, meaning that the revenues to the mattress manufacturers, flame retardant manufacturers, and mattress retailers all are benefits in the analysis. As noted by other

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127 Kuran & Sunstein, *supra* note 3, at 744. On a rudimentary level, flame retardant mattresses fit into the category of a regulatory “no brainer” because the literal, measurable cost of flame retardants is so little. The regulator is likely to perceive flame retardant standards as possessing a significant “bang for the buck.” Kuran and Sunstein note examples: “At one extreme, the cost of regulations on steering columns and space heaters is only $100,000 per saved life. At the opposite extreme, that of regulations on certain carcinogens cost well over $10 million per saved life.”
commentators, this reveals one of the central flaws with cost-benefit analysis: economic output is measured irrespective of whether it is profligate or superfluous. While government is often correctly criticized for wasteful spending that involves “digging holes and filling them back up again,” private economic activity avoids such characterizations and is able to claim that any judgment of the worth of economic activity is paternalistic and should be avoided.

On the cost side of the ledger, regulators trying to ascertain the dangers of flame retardants in the 1970s faced uncertain terrain. Scientific evidence on the possible health effects of flame retardants was scant and even today it remains far from conclusive. Unable to be precisely measured, the possible costs were not incorporated into the analysis. The implementation of flame retardant standards for mattresses passed the cost-benefit analysis test with flying colors. As a result, regulatory demand for flame retardant standards ensued. Regulatory sanctioning of flame retardants led to enhanced consumer and public demand, which then opened the door for further corporate demand: flame retardants began popping up in a variety of household products including furniture and electronics. As Douglas Kysar notes, regulations and public behavior are prone to feedback loops such that regulatory support for a course of action increases consumer and public demand, which in turn is interpreted under cost-benefit analysis as an enhanced benefit of a regulation, thereby further solidifying the status quo.128

Cost-benefit analysis is also prone to another significant problem: privatized gains tend to be measurable and therefore incorporated into the analysis, while public harms, or “socialized risks,” are hard to measure and therefore are left out of the analysis. The distribution is askew: public harms are borne by all and result in universal exposure, while privatized gains are particularized and concentrated. To be sure, the analysis of flame retardant standards is not reducible to such a simple analysis: public benefits in the form of a reduced likelihood of death in a mattress fire and of a reduced price and increased mattress comfort surely accrue to society, but at what cost in terms of public harms?

128 KYSAR, supra note 75, at 116-17.
The short answer from an ex ante perspective is that we simply do not know.

E. What is the Danger?

Faced with uncertainty regarding public harms, why should there be any cause for concern? It would be hyperbolic to assume that the mere fact of uncertainty presupposes harm – after all, none of us really know for sure what the future will bring. That is precisely why this Article establishes a set of experientially generated observations that provide guideposts for future action. Nevertheless, it also is clear that there lurks in the background of the paradigm a baseline potential for realistic harm, which constitutes what Stephen Gardiner terms a “credible threat.” The precise nature of the threat need not be specified, but the threat must possess a degree of realism that pulls it down from the realm of “any imaginable outcome.” Gardiner views this as at most an implicit condition in his Rawlsian description of a core precautionary principle that simply points out to potential critics that we are not in fantasy land, a geography that opponents of the precautionary principle may inhabit because it allows them to conjure up bizarre slippery slope scenarios that tie into the precautionary response. Critics assert that even if there is a slight chance of something going wrong, however outlandish, precaution will require banning a procedure. These critics then assert that we must rely on the “rationality project” to establish proof of harm. For example, one response to the question of the safety of flame retardants would have been for the regulators to conceptualize the problem as a “risk-risk” proposition, with dangers associated both with allowing mattress fires to persist and potentially with the health effects of flame retardants. The difficulty with this endeavor is that it remains reliant on the development of conclusive evidence, which may never be

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129 Gardiner, supra note 39, at 51.
130 Id.
131 Id.
132 Id. at 37.
133 Id.
134 Kysar, supra note 50, at 13.
available. At the same time, the mattress example risks overgeneralization and excessive extrapolation outward from what could be an anomalous example. Why should we have any confidence that the mattress example has general meaning? The mattress example affords us the benefit of partial hindsight (as the evidence of harm from PBDEs still remains somewhat uncertain), but it is first helpful to describe the aspects of the situation that were problematic before any evidence of harm from PBDEs came in.

1. Consensus That Engulfs Dissent

From a truly ex ante perspective, the exploitation of the availability heuristic by economically motivated actors to construct systemic demand creates several dangers.

First, agglomerated power working in unison steamrolls potential opposition. Construction of systemic demand leads to a culture of consensus that suffocates any skepticism and labels those who warn of potential dangers extremists outside of the mainstream. This judgment perhaps represents a valuation that egalitarian dissent is preferable to authoritarianism because it enables greater freedom of thought and originality that is likely to generate creative solutions. Specifically, herd mentalities should justify close scrutiny precisely because they may rest on premises that have not been fully tested by disparate actors and are therefore more likely to be incorrect. For example, the widespread consensus that home prices would continue to go up indefinitely in the lead up to the recession of 2008-2009 was clearly based on faulty premises that resulted in massive damage to the economy. Before comprehensive approaches, whether in the form of regulatory regimes or economic methods, become entrenched, the purveyors and accepters of the approaches should test the assumptions that undergird the potential outgrowth before the creation becomes too much to control or modify. Having observed the widespread consensus that exists around the issue of mattress fires as a major problem, an ex post criticism of the concern as excessive seems insensitive, until at least the evidence comes in that the flame retardant solution to the mattress fire problem is more harmful than the original problem. A danger lies in the
ossified thinking borne of the inertia that develops when assumptions are determined to be beyond rebuke.

2. Unjust Enrichment

More concretely, unified thinking tends to enable unjust enrichment: economically motivated actors can generate profits at the expense of public health. This stems largely from the failure of the tort system to handle uncertain or unprovable causality. When the harm may not show up for decades and its traceability to particular actors is impossible, the tort system fails. To be sure, exposing companies to potential liabilities is not the only way to deter behavior that has negative externalities: in the case of run of the mill pollution, for example, the government can adopt regulations or implement taxes that seek to get the price right, and establish the true cost of a good or service. In the case of exploitation of the availability heuristic however, the negative externalities of the products that quell the fear remain relatively uncertain, especially when juxtaposed against the certain harms associated with the underlying fear. As a result the risk associated with the product, in terms of its harm to the environment, tends to be underestimated, while its benefit is overestimated. When fear borne of the availability heuristic causes the severity of a problem to grow in the public consciousness, society overvalues the reduction of the problem. All of this translates to increases in the bottom line of the company making the product: product benefits are overvalued and product costs are undervalued, meaning that profit accords to the producer in a way that is discordant with a competitive market that, ostensibly, properly accounts for benefits and costs.

3. Unsustainable Practices

A third concern from an ex ante perspective is that superfluous products, almost definitionally, damage the environment. Lauding products that meet a compelling need not imply an obsession with austerity, but more positively, a renewed focus on sustainability. Meaningful sustainability must be more than carbon footprint reduction and green purchasing – it should
instead focus on creating, buying, and using only what we need. Determining what is needed is a tricky subject, well beyond the scope of this Article. Also, legal paternalism stipulating what a society needs conjures thoughts of command and control economies producing only what a nameless, faceless bureaucrat decides is needed. Suffice it to say that the point of discussing harm is to conceptualize it in the broader more holistic terms demanded by a complex system that features nonlinearity and nonsequentialist relationships. As an example of the complexity of the system, flame retardant use in mattresses was soon followed by use in a variety of other products throughout homes, businesses, and vehicles such as furniture, electronics, car seating, carpet, textiles, and plastics. Corporate actors use of the availability heuristic to increase demand and profit, here by applying a solution for mattress fires to other consumer products, shows the capacity of the availability heuristic to amplify and augment an existing risk and thereby increase consumer demand.

4. Market Manipulation

From an ex ante perspective, then, the fundamental story is that the exploitation of the availability heuristic amounts to one form of market manipulation, which constitutes one type of market failure. While economists are quick to acknowledge that market failures should be corrected, their list of market failures (monopolies, externalities, information asymmetries, and collective action problems) overlooks the increasing clarity that consumer preferences not only are not always individually or aggregately rational or natural. They can also be potentially harmful, especially when malleable and manipulable by vested interests. While it is convenient to suppose that the problem with flame retardants may be that they have negative effects not fully accounted for in their price (an externality problem) or that their possible risks are merely unknown but knowable (an information problem), the overarching problem of uncertainty is not fully addressable.

135 Hanson & Kysar, supra note 3, at 447.
136 Id.
137 Id.
through market mechanisms, nor through a tort system that relies on proof of causality. Uncertainty remains and harm, borne of the exploitation of the availability heuristic by economically motivated actors, is a potentiality.

5. Potential Health Effects

Clearly, immersion in an ex ante state, or proverbially putting ourselves in the shoe of the decisionmakers at the time of the promulgation of regulations, shows that the potential for harm is discernible, though perhaps still difficult to determine precisely. If it were easy to see, of course, we would assume that the demand for flame retardants probably would have been dampened. What, then, does the mattress case study reveal with the benefit of hindsight?

While a comprehensive recitation of the health effects of flame retardants, some more conjectural than others, is beyond the scope of this Article, the following summary demonstrates that there is mounting evidence that flame retardants have serious impacts on human health and the environment. PBDEs are brominated flame retardants that are similar in chemical structure to PCBs, the class of chemicals that was banned in 1977. There are three main PBDE products, Penta-BDE (“Penta”), Octa-BDE (“Octa”), and Deca-BDE (“Deca”). A large percentage of the weight of polyurethane foam in mattresses consists of PBDEs, often as much as 30 percent. PBDEs are believed to escape the products in which they are placed at very high rates.

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139 Of these, Penta and Octa were taken off the United States market in 2004.


141 U.S. Environmental Protection Agency, *Polybrominated Diphenyl Ethers (PBDEs) Project Plan* (March 2006). The U.S. EPA states “The mechanisms of pathways by which the PBDEs move into and through the environment are not known, but are likely to include releases from manufacturing of the chemicals, manufacturing of products like plastics or textiles, aging and wear of products like sofas and electronics, and releases at the end of product life (disposal, recycling).”
not exactly known how this happens, a study by the Environmental Working Group found that household dust contained unexpectedly high levels of PBDEs.142 This provides a route of exposure through inhalation, ingestion, and dermal contact. Children are particularly susceptible to exposure through household dust.143

In terms of the extent of PBDEs in the environment, we know that all of us, especially Americans, have high levels of PBDEs in our bodies.144 Certain types of PBDEs are persistent organic pollutants and also bioaccumulative, meaning that they build up in people over time. Concerns have become particularly pronounced of late because several studies have demonstrated both that the developing fetus is exposed to PBDEs that have accumulated in the mother and because PBDEs are present in breast milk.145 This is especially worrisome because studies also demonstrate that prenatal and neonatal exposure to PBDEs has potentially serious effects. Studies with animals have found that the effects of PBDEs include: impaired memory and learning, altered behavior, delayed sexual development, and altered thyroid levels, particularly when the exposures to the PBDEs occur at crucial developmental periods.146 With respect to mammals the EPA acknowledges that there are studies that PBDEs have pharmacokinetic effects, hepatic effects, immunological effects, endocrine disrupting effects, reproductive effects, and carcinogenic effects.147 Specific to humans, a study found that there are higher rates of hypothyroidism among people who were exposed to brominated flame retardants while at work.148 There is lack of clarity as to whether PBDEs cause cancer in humans. Based on a

143 Id. at 25.
144 Id. at 10-11.
146 EPA, supra note 141, at 361-63.
147 Id. at 349-50.
study in which mice exposed to Deca developed liver, thyroid, and pancreatic cancer, the EPA classified Deca as a “possible human carcinogen.”  

The concern surrounding PBDEs has been strong enough to cause many governmental actors and other entities to take action to ban and reduce usage. In Europe, companies in Germany, Sweden, and the Netherlands voluntarily phased PBDEs out of use in the mid-1980s. The European Union banned two forms of PBDEs, Penta and Octa, in 2004 and banned Deca in a majority of electronic equipment in 2008. While this could provide some hope that differences in corporate law and behavior, consumer perception, and cultural preferences may be facilitative of heightened concern for public health, it is important to emphasize that European countries still permitted flame retardants to be used for years before they were banned. True prevention eluded even the Europeans.

In contrast, the United States lags behind. On a practical level, this means that IKEA mattresses that meet Europeans standards must be altered to make them more flame retardant for American consumers. On the federal level, PBDEs are not banned, although Penta and Octa are no longer produced in the United States, partly due to decision of the sole domestic producer, Great Lakes Chemical (now Chemtura), under considerable political pressure, to terminate their production in 2004. The EPA acknowledges, however, that importation may still be occurring. By and large, the federal government is still in a research and assessment phase, with the EPA likely to hinge further regulatory decisions on TSCA reform in the United States Congress. On the state level, California outlawed the manufacture and distribution of Penta and Octa, effective June 1, 2006. Hawai‘i, Illinois, Maine, Maryland, Michigan, Minnesota, New York, Oregon, and Rhode Island, Oregon, and Washington have adopted laws similar to

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149 EPA, supra note 141, at 20.
150 Brim, supra note 148, at 799.
152 EPA, supra note 141, at 4.
153 Brim, supra note 144, at 801.
California, and other states are considering similar laws. No specific governmental action has been taken at the federal level with respect to Deca. The reason that is given for the lack of action on Deca is that Deca is hardly ever absorbed by people. However, recent evidence suggests otherwise. Deca has been detected in human hair, fat, blood, and breast milk, sometimes at high levels. Perhaps more importantly, when Deca breaks down in the environment there is evidence that it converts into the more toxic forms of PBDEs when it loses its bromine ions. At the state level, Washington has banned the use of Deca in mattresses, televisions, computers, and upholstered furniture. Maine banned Deca from mattresses and upholstered furniture in 2008 and from televisions and other plastic encased electronics in 2010. Other states, including Maryland and Oregon, are considering similar bans. Some private actors have also taken action, with Wal-Mart recently banning the use of PBDEs in all goods that it sells.

In sum, the evidence of harm from PBDEs is not yet conclusive, but PBDEs present potential concerns relating to

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154 EPA, supra note 137, at 10. While this may provide some evidence that states have the capacity to respond to corporate exploitation of the availability heuristic, it more likely demonstrates that there are some political constituencies and state legislatures that have heightened concern about the impact of chemicals on human health. There is no evidence that state legislatures passed flame retardant legislation in response to corporate exploitation of the availability heuristic, but instead because of the mounting weight of evidence that PBDEs are harmful.

155 Id.

156 Sharp & Lunder, supra note 142, at 13-14.

157 Id. at 14.

158 Id.


developmental neurotoxicity, developmental toxicity, liver toxicity, and thyroid toxicity. In addition, there is a substantial body of evidence linking PBDEs to environmental harms impacting a variety of wildlife. In spite of these substantial concerns, PBDE regulation in the United States is partial and tentative. Part of the reason is that the usual historical rationales for regulation fail us in this context. For example, going back to Sunstein’s argument about catastrophic and irreversible scenarios that justify the precautionary principle, the difficulty in countless examples regarding chemical regulation is that for most of us the calamitous apocalypse is not coming. In other words, in order to justify public concern and regulatory scrutiny, we want to see immediate death from chemicals or rampant debilitating disease that leads to death, such as cancer. When it comes to IQ points lost here or there, or asthma, or children born with autism, or early onset puberty, or an increased incidence of Alzheimer’s, we all may be suffering, some more acutely than others, but life goes on, and chemicals are weakly regulated. The causal requirements of tort law fail us. Regulators are captured by industry, and the wonders of modern life placate us. Infliction of perhaps relatively small harms on a great number of people does not receive the same attention of the infliction of large harms on a small number of people. This is not to say that we should revert to a cost-benefit calculus more sensitive to multitudinous small harms, but instead that small harms may be more difficult to notice. Our health is compromised, even if only when we are old and decrepit. The mobilizing crisis never comes and our attention is diverted to more immediate crises, such as mattress fires and oil spills. In this sense, then, the application of Sunstein’s thesis to chemicals directly undermines effective chemical regulation. Sunstein’s thesis actively propagates continued fetishism of hysteria and reduces the importance of harm from chemicals by focusing on mass death: “let us simply understand a catastrophic harm to involve a large number of human deaths – not thousands, but at least hundreds of thousands, or perhaps millions.” Sunstein also references Richard Posner’s definition of catastrophe as a threat to

162 EPA, supra note 141, at 5.
163 Sunstein, supra note 36 at 870.
the survival of the human race.\textsuperscript{164} With regard to catastrophe as it is commonly understood, chemical harms are unlikely to be catastrophic, even if they include transferable alterations to the genetic code or endocrine disruption that compromises reproductive ability. But the potential for serious harm abounds.

V. THE PRECAUTIONARY RESPONSE

The literature on the precautionary principle is voluminous and, not surprisingly, there are myriad conceptions of what the precautionary principle means. Clarity and precision in the definition of a precautionary response is crucial, if for no other reason than regulators, faced with unclear commands, may tend to ignore them. In the context of chemical regulation and the proposals in this Article, the precautionary response should include two pieces, with the second contingent on the failure of the first: 1) shift the burden of proof of the safety of a product from the government to industry and 2) develop substitute products or approaches that are safe.

A. Burden of Proof Shifting

The issue is whether the government, seeking to protect the public and faced with seemingly ineradicable certainty, should bear the burden of proving the safety of chemicals and products. When there are sufficient reasons for heightened scrutiny as outlined in this Article, chemicals should no longer be treated with the leniency of criminal defendants, innocent until proven guilty – the threat that they pose is simply too great. Instead, corporations must sometimes prove that their products are safe. It is a bizarre and immensely damaging precedent that chemicals, themselves and by extension the companies that produce them, are accorded the constitutional rights of criminal defendants, rather than subject to, for example, negligence-based duties. The heightened scrutiny regime this Article proposes strips back this precedent in certain circumstances and asserts that a corporation does not have a right to insert a chemical into the stream of commerce unless it is safe.

\textsuperscript{164} See id. at 862-63.
While many versions of the precautionary principle include shifting the burden of proof from the government to the regulated entity, the standard of proof is rarely stated. From the standpoint of consistency, the standard of proof required to put a chemical into the stream of commerce should be the same standard required of the government in order to ban a chemical. As its name suggests, the burden of proof burdensomely implies the generation of a certain quantum of evidence – if the burden is in fact shifting from the government, then it must shift in full: the government no longer bears any of the burden, and the burden does not otherwise diminish.

Historically, the government must satisfy a high standard of proof in order to ban a chemical. Pursuant to TSCA, if the EPA finds that a chemical poses an unreasonable risk to health or the environment, then the EPA may implement restrictions “to the extent necessary to protect adequately against such risk using the least burdensome requirements.” Corrosion Proof Fittings v. EPA led to the definitive judicial interpretation of this provision in a case that itself represented the culmination of an EPA effort to restrict asbestos. After a decade of accumulating scientific evidence to support its rule regarding asbestos restrictions, the EPA was nevertheless overturned by a Fifth Circuit court that found the restrictions were insufficiently supported by the record and by EPA’s analysis. The court found that the language in TSCA requiring the agency to consider least burdensome alternatives had not been satisfied by the EPA’s methodology and its incorporation into the analysis of “unquantified benefits.”

One interpretation of the court’s decision was that the court construed the statute to require a heavy dose of scientific evidence and the agency had simply not been able to provide that science. Others believe that the court’s decision was politically motivated, with, for example, John Applegate stating that the Fifth Circuit “happens to be located in the heartland of chemical

166 See 947 F.2d 1201 (5th Cir. 1991).
167 Id.
manufacturing.”168 In the aftermath of the Corrosion Proof Fittings decision, it seems, based on the agency’s lack of action, that the EPA has concluded that it is too difficult to satisfy the burden of proof required to ban or significantly restrict a chemical.169

While many critics of the Corrosion Proof Fittings decision argue that TSCA reform is imperative, the supporters of the decision argue that the failure of Congress to amend TSCA suggests that the decision was not so contrary to legislative intent as to require immediate statutory clarification. Recent general congressional languorousness and ossification probably indicate, however, that structural political issues, rather than congressional acquiescence, currently preclude meaningful amendment of TSCA. In this sense, it could be argued that government’s burden of proof reflected in Corrosion Proof Fittings is a greater burden than Congress intended. If the stringency of the decision were reduced and, as a result, the burden of proof borne by the government were weakened somewhat, the original legislative intent of TSCA may more fully be revealed. Importantly for this Article, if the burden of proof shifts from the government to industry, then the burden should also be slightly lower than it currently is.

In the context of burden shifting, David Dana, on the other hand, rather than supporting an only slightly less burdensome standard than is currently required of the government, recommends a much weaker burden of proof to be borne by industry, stating:

> [b]ecause the principle leaves open how much proof of safety is required, it arguably is better understood as merely shifting the burden of production – that is, advocates of a certain activity that is suspected of causing a health and environmental risk must produce at least some factual evidence or theory in support of the conclusion that the activity is acceptably safe.170

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170 Dana, supra note 3, at 1345 n. 4.
However, it strains credulity to suppose that lack of preexisting standard of proof implies that when we first articulate it, it should be incredibly lenient in a way that is massively discordant with the standard of proof that the government has assumed for decades. It would be exceedingly facile for a corporation to comply with Dana’s proposal. The precautionary principle must be understood as something more than a mechanism for laying the groundwork for litigation and instead as a regulatory approach that ensures safety. Once we are in the realm of heightened scrutiny, the standard of proof assumed by industry should approximate the standard of proof borne by the government under the current regime, or at least comportional with the legislative intent of TSCA, notwithstanding the Corrosion Proof Fittings decision. It may well be the case that industry will not be able to meet this standard, and if so then the second step – the development of substitutes – would be triggered.

B. Development of Substitute Approaches and Products

In recognition of the severity of the underlying problems, whether mattress fires, terrorist attacks, or oil spills, that are subject to the availability heuristic, even if they are hyperbolized, substitute approaches to address the problem should be developed. It is important to emphasize that the approaches should be comprehensive, broad-based, and multidimensional – while the development of a substitute chemical may be one way to solve the problem, governments can work to develop new laws (e.g. mandating smoke detectors) and companies can engage in research and development, perhaps subsidized or otherwise incentivized by the government, to develop new substitute products.

As the mattress case study illustrates, a strong foundation for the narrower approach of the development of safe chemical substitutes may be found in the REACH system in the European Union. After the application of REACH’s chemical testing provisions leads to a determination that certain chemicals are a cause for concern, REACH establishes substitution requirements and incentives, seeking to “encourage and in certain cases to ensure that substances of high concern are eventually replaced by
less dangerous substances or technologies where suitable economically and technically viable alternatives are available.\footnote{Commission Regulation 1907/2006, Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH), 2006 O.J. (L 396).} To be sure, the “substitution plan” envisioned by REACH inhabits the realm of technical voluntariness and collaborative relations between government and industry in order to develop new safer chemicals. But it also relies on the stigmatization resulting from deeming a chemical dangerous in order to generate market-based reactions relying on consumer aversions to potentially dangerous chemicals. Simple information dissemination and transparency clearly can play a role in generating demand-side reactions that force suppliers to change behavior. Nongovernmental organizations can play a role as well – an NGO project called the Substitute It Now! (or SIN!) List currently lists 356 chemicals that are identified as substances of concern based on REACH criteria. By disclosing dangerous chemicals and stating which products contain them, consumers stand to increase the pressure on producers to develop safer alternatives.

Opponents of the precautionary principle often falsely claim the benefit provided by a product can only be obtained by the particular product in question – we must choose between mattress fires and flame retardants. The proponents of flame retardants tend to suggest that the critics of flame retardants fail to appreciate the dangers of fires. In the defense of chemical production and usage, supporters tout flame retardants as a triumph of human engineering that save lives, insinuating that the critics of PBDEs are merchants of death. This polarizing characterization of the issue overlooks the fact that critics of flame retardants centralize the importance of health and safety, not just in terms of prevention of fires but also in terms of management of long term chemical exposures. Critics of PBDEs recognize both the dangers of fires and the dangers of PBDEs, and have worked to avoid both problems through the development of alternative methods to counteract the underlying problem.

In the case of mattress fires, the cause of the problem was the polyurethane foam in the mattress, which allowed manufacturers to reduce the cost of making mattresses, as well as
the price paid by consumers, and also provided superior comfort and quality to non-polyurethane foam mattresses. As an opening maneuver, polyurethane foam could be eliminated and manufacturers could make mattresses of cotton and wool as they were in the pre-polyurethane days. It strains credulity to suppose that the elimination of relatively inexpensive polyurethane foam would raise the price of a mattress so tremendously as to make it unaffordable for consumers. However, if this were the case, then owing to the relatively inelastic demand for mattresses, government could subsidize mattress purchases by providing tax credits to those who buy a mattress and are below a certain income level or by providing the equivalent of a “food stamp” for mattresses. With regard to the possible diminution in mattress comfort if polyurethane foam were eliminated, it is plausible that market innovations could lead to the development of new comfortable substances that are not flammable.

Critics of substitution emphasize that regulators are often faced with an array of choices which function as substitutable outcomes, but that each of these outcomes possesses different costs and benefits that must be converted into the common currency of dollars. Termined “risk-risk tradeoffs,” substitution regimes can initiate a string of substitutes, each problematic in its own regard, and emanating outward from the originally identified problem.172 For example, if the original problem is mattress fires, then the “first-order” substitute is PBDEs, and the “second order” substitute could be a flame retardant chemical other than PBDEs.173 These critics claim that to stop the substitution analysis at a particular point in the sequence is arbitrary and represents a value judgment that certain substitutes are worse by virtue of their temporal proximity to the original problem. As this Article has demonstrated however, these “first order” substitutes are not problematic because they happen by sheer chance to be conceived soon after the development of the original problem – they are problematic because they develop in response to an economically motivated actor exploiting the availability heuristic to construct demand. The experiential record does in fact suggest that the “first

172 Dana, supra note 3 at 1333.
173 See id. at 1334-35.
order” substitute is problematic precisely because it is an offshoot not only of a cognitive bias, but also of a cognitive bias that is selfishly exploited for economic gain. Those who genuinely treat the original problem as more likely to be harmful than the “first order” substitute are not only potentially the victims of the availability heuristic, but also the unwitting victims of the economically motivated actors exploiting the heuristic.

The analysis of course cannot stop there, but must continue on to second order substitutes and all other possible substitutes. Critics of the precautionary principle have correctly pointed out that second order substitutes may be just as harmful as first order substitutes. Indeed, it may, and for this reason all responses to our by now familiar confluence of circumstances should be evaluated in the context of safety thresholds in which the burden of proof is satisfied. If for example, we simply substituted asbestos in bedding for PBDEs, we would not be reaching a sufficient level of protection. Once the need for heightened regulator scrutiny is triggered, then the industry must satisfy the burden of proof for all of its proposed responses. Once we find ourselves in the domain of the precautionary principle, then the precautionary principle should attach to all responses triggered by the original taint.

Faced with the burden of demonstrating safety for all of its desired responses to the original problem, industry may not be able to bear the burden, just as the government is often unable to bear the burden of establishing that a product is unsafe. However, history has demonstrated that environmental regulations have the potential to be technology forcing and there may well be new products developed that could address the underlying problem. While in many cases it will be economically advantageous for a company to work to develop a substitute through its own research and development, it also may be the case that industry will not step up to solve the problem on its own. To the extent that the government views the original problem (e.g. mattress fires) as

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174 Dana supra note 39, at 5-6 (citing Marko Ahteensuu who states that “[i]f a precautionary response to a threat imposed another risk . . . that is regarded as unacceptable, both risks should be considered symmetrically” and Per Sandin who states that the precautionary principle should be “applied also to the precautionary measures prescribed by the precautionary principle itself”).
requiring redress, it may well be the case that industry will have to adapt. Hopefully, industry, regulators, and society-at-large can begin to focus on first principles referential to meaningful goals rather than continue to engage in obsessive devolutionist searches for safer substitutes that preclude holistic and comprehensive assessments of problems. Citing references to “best available pollution abatement technology” in federal statutes, Douglas Kysar notes that “doing the best you can” reflects “great collective commitment to the preservation of human life and the environment without requiring satisfaction of Herculean informational demands by regulators.” Substitutability can be less a search for a safe substitute (although that is possible) and more a search for “contextual rationality.” Most obviously in the mattress case study, it would also be the prerogative of industry to lobby the government for alternative forms of regulation such as mandated smoke alarms or sprinkler systems that perhaps could get the government comfortable that the original problem was sufficiently addressed. In a world in which attention to death and injury from car accidents led first to seat belts, then to air bags and cars designed to protect the cabin in the event of collisions, and now to cars that promise to brake themselves and eventually drive themselves, we should not underestimate the potential for market innovations to generate solutions to problems. Perhaps market innovators could develop similar safeguards for the mattress as they have for the automobile. More ambitiously, the government could aggressively outlaw certain behaviors, and if beyond the reach of enforcement, could still influence behavior. For example, anti-littering laws, while sporadically enforced, have changed the social acceptability of throwing trash out of a car window. Likewise, as fantastical as it seems today, if the government were to outlaw smoking in all buildings including private homes or, even more ambitiously, outlaw smoking altogether, evidence suggests that the vast majority of mattress fires would disappear. While laden with value judgments, perhaps society, acting through its elected representatives, would do well to decide whether it places greater value on the right to smoke or the right to be free

175 Kysar, supra note 50, at 24.
176 Dana, supra note 39, at 30-32.
from flame retardant exposure. Solving the mattress fire dilemma of course need not be reduced to such choices. But regulators and policymakers should comprehensively consider alternative approaches and substitute methods, rather than simply acquiesce to systemic demand generated from corporate exploitation of the availability heuristic.

VI. CONCLUSION

The question we face is whether environmental law and chemical regulation should continue to be largely mitigative rather than preventive. The central feature of preventive action is that it tends to rely on suppositions and unprovable assertions – its forward-looking nature implies uncertainty. The central feature of mitigative action is that it allows the damage to occur and then works to clean it up with the hope that the damage is reversible. Environmental degradation all too often is irremediable – species become extinct, habitat is lost forever, health effects are permanent, and chemicals are persistent and bioaccumulative. Faced with the choice between preventive action and mitigative action, the question is whether we can turn preventive action into something more methodologically rigorous. This Article proposes one set of circumstances that justifies precautionary action.

Other commentators have identified other applicable triggers and further research and analysis may well suggest several additional situations that demand application of the precautionary principle. While some scholars claim that the situations facing regulators are highly unique and contextualized, this Article demonstrates that it is possible to provide regulators with general guidance that should require the implementation of legal procedures. The fact that a company is seeking a profit is of course the foundation of a capitalist economic system that has generated immense bounty and led to significant improvements in living standards. And even when paired with the availability heuristic, the existence of economically motivated actors constructing systemic demand should not automatically imply that something is awry. But it does create the possibility that the public interest and, more specifically, environmental and health interests,
which regulators are supposed to be protecting, could be in jeopardy.

While the search for objective truth, especially in the context of environmental health regulation, will remain a work in progress, contextual rationality based on experiential evidence can help to tell us when to be concerned. The observable triggers described in this Article could lead to the creation of additional procedures consistent with mitigating the risk of threat to the environment, health, and safety while simultaneously allowing expression of other values such as the ability of the people to operate in a free market, of companies to sell products, and of people to buy them. If we accept certain critiques of a wholesale precautionary principle, not the least of which is the practical impossibility of achieving its implementation in an American society that centralizes the importance of economic growth, then the best we may be able to do is establish warning signals that will alert us of the need for greater scrutiny.