The physical properties of carbon dioxide are that it is invisible, odorless, and remains in the atmosphere for a century or more, hence carbon pollution accumulates there causing global warming. Production science has made fossil fuels emitting carbon dioxide more available through its innovations of hydraulic fracturing, deepwater drilling, oil extraction from tar sands and the Arctic, etc. Global warming is being locked-in with each new well drilled, oil reserve discovered, each bit of shale hydraulically fractured, and pipeline built because mitigating it would require not only a fossil-fuel write-off but also an infrastructure write-off. Fossil-fuelled social practices, for example flying and cruising, are increasing rapidly. Impact science has demonstrated the risk that will result from these practices and exploiting these valuable but dangerous resources. Berners-Lee and Clark (2013: 2) conclude that ‘the choice we face is between taking unimaginable risks with the planet and leaving vastly valuable fossil fuels in the ground’. Even in the transition period away from fossil fuels towards low-carbon energy, greenhouse-gas emissions would continue to exceed carbon withdrawal and accumulate in the atmosphere. This worsens the fossil-fuelled climate change risk.
Most social action is founded on extrapolating from what succeeded and was safe in the past, but fossil-fuelled climate change is bringing discontinuities. The most general lesson to be learned is that extrapolations from the past can no longer be taken for granted as valid. As greenhouse gases accumulate in the atmosphere, delayed-action solutions rather than prompt ones constitute dangerous brinkmanship on a global scale based on discounting danger. Brinkmanship and blind faith in last-minute technological solutions amount to a failure of foresight and a maximization of risk. The fossil-fuelled climate crisis brings risk and uncertainty, whereas solutions would bring safety and sustainability. Part II of the book now presents an assessment of proposed solutions, hence it begins with an analysis of risk, uncertainty, safety, and assessments (see also Lockie and Wong 2017; Wong and Lockie 2018).

Risk Assessment and Material Risk

Ulrich Beck (1992, 1995, 2007) was the pre-eminent social scientist of risk in the late twentieth and early twenty-first centuries and an influential public intellectual whose writings were disseminated to the general public and served on advisory committees in his native Germany. He (Beck 1992) portrayed modern society as the ‘risk society’ where the very successes of science, technology, the market, and organization result in the creation of new risks. The increasing capacity to produce ‘goods’ results in the side effect of also producing ‘bads’. In his many publications, Beck was not always consistent in his use of the concept ‘risk’. In some instances, he used it the way it is used in the wider society, as a synonym for danger. In other instances, he used it in a narrower sense referring to the subset of dangers that are calculable and are calculated. A simple version of the latter is as follows: risk = impact x probability. In the scientific sense, this conception constitutes assessed risk, which consists of a fallible estimate of a dangerous material referent. Extrapolations are made from past events (floods, wildfires, hurricanes, ice storms, etc.) and from assumptions and modelling scenarios in order to assess the probability and likely impact of future harmful events, hence the risk is calculated. To use an analogy, if a coin is tossed many times, the evidence
indicates that heads will occur 50% of the time and tails 50%, so even though the outcome is unknown, future action can be premised on the probability of 1 out of 2. This logic is used to calculate and manage complex risks in society. If the historical record documents that a high-impact flood occurs in a particular area every three years, then it will be called a flood plain and only parks or farming fields will be sited there. But if the historical record shows that such floods only occur every century, then risk-takers may construct a housing development there together with robust storm sewers, levees, etc., whereas the risk averse will avoid the area. Risk in this sense involves known unknowns: the outcome of tossing the coin is unknown, but the probability is known; similarly, whether a storm, wildfire, drought, etc., will occur in any specific year is unknown, but the chances are known over a large number of observed cases. A hundred-year flood could occur in year 99 or year 2, but at least the historical evidence demonstrates that on average it will occur once every hundred years. Governments, insurance companies, investors, etc., can usually manage risk in this sense, for example, investors can diversify their portfolios.

Modern societies talk more about risk, and their technological successes have brought new risks into being. Nuclear physics gave the world nuclear bombs and reactor meltdowns, which didn’t occur before. Biochemistry gave antibiotics, which resulted in antibiotic-resistant bacteria. They also made old risks more threatening, for example cyclones, drought, and wildfires are intensified by climate change caused by combustion of fossil fuels, land use changes, etc. The modern risk society consists of a hybrid entanglement on the empirical level of risk discourse (including risk calculations) and new material risks. Hence it is necessary to analyse both the cultural assessment of risk and material risk, and especially relationships between them. Beck’s (2015) concept of ‘catastrophism’ refers to the anticipation of catastrophe, which is an extreme form of risk assessment, but it cannot be assumed that risk assessment based on scientific evidence is straightforwardly accepted by the public and decision-makers. And even if risk is acknowledged, it cannot be assumed that decision-makers and the population will act on this risk assessment in a context of competing priorities, particularly near-term economic ones, interests, and cultural predispositions.
It should not be presumed that enlightened discourse results necessarily and straightforwardly in enlightened practices. Such discourse can be what Simpson, Jaccard, and Rivers (2007) called global warming ‘hot air’ and what the teenage climate activist Thunberg called ‘empty words’. Discourse and material practices can be relatively autonomous. It is social practices that are consequential for the material environment. Words only have material outcomes if they affect social practices. Blurring the distinction between material risk and cultural assessments of risk obscures the paradoxical present situation of improved discourse, including policy discourse, coexisting with worsening fossil-fuelled climate change.

Does the assessment of risk correspond to the material reality of risk as potential harm, or is there a mismatch between material risk and risk assessment? Disaster research documented that when a mismatch occurs, so does a failure of foresight and the incubation of man-made disaster (Turner and Pigeon 1978; Vaughan 1996). Assessments of risk or safety are just as real as material risk or material safety, but one should not be reduced to the other. It is necessary to probe more deeply what is meant by ‘risk’, which is a widely used concept not only in the social sciences but also in society. Although the increase in risk calculations and risk discourse constitutes significant change in society, the underlying transformation augmenting biophysical danger is more fundamental: technological innovations unleashing more frequent, intense, or novel dynamics of nature; population growth and movement placing more people in harm’s way of nature’s dangerous forces; etc.

**Risk and Risk Assessment**

The Oxford English Dictionary defines ‘risk’ as the (exposure to) the possibility of loss, injury, or other adverse or unwelcome circumstance; a chance or situation involving such a possibility. It then distinguishes ‘risk’ from ‘risk perception’, which consists of the judgement people make about the severity and probability of a risk, and may vary from person to person and group to group. Thus in society at large a distinction is made between (a) the exposure to the possibility of adverse consequences and
(b) judgements people make about that exposure. In this meaning, risk is the objective, material exposure to a dangerous possibility, whether it is known or unknown, acknowledged, ignored, denied, or exaggerated. Unknown risk refers to threats unknown at the time, and may well be known later, for example after a disaster has occurred. ‘Risk perception’ is used to refer to beliefs in the exposure to danger or on the contrary to disbelief, or some intermediary state such as it being discounted, or even to imagined inexistent threats. The absence of putative risk is only known later, as when the twenty-first century began without the supposedly catastrophic millennium bug causing serious adverse consequences. The Oxford Dictionary captured the commonly understood conceptions of risk and risk perception. Nevertheless, a qualification is needed. Although the adverse consequences of falling off a cliff are perceived as we walk along its edge, modern risks such as the depletion of the ozone layer and fossil-fuelled climate change are not directly perceived. Awareness of these threats depends on scientific knowledge. Hence ‘risk perception’ should be replaced by ‘risk assessment’ in order to include modern global threats like these. Such risk assessments could be scientific, as in formal calculations of probability multiplied by impact. They could also be by non-scientists, as the Inuit observing the shrinking ice cover of the Arctic Ocean or mountain inhabitants noting the receding glaciers and inferring risk of more loss to come. These are all socially constructed fallible assessments of material risk, which is their referent.

Take the following example. The innovation of deepwater oil drilling under enormous ocean pressures creates new risks in the material objective sense of exposure to the possibility of adverse consequences. British Petroleum claimed in its assessments to the regulator that the probability of those harmful consequences was so miniscule because of its blowout protector, which it described as failsafe, that their occurrence was effectively impossible. But discounting risk was literally and catastrophically blown out of the water by deepwater ocean pressures that made its blowout protector fail and become unsafe (Freudenburg and Gramling 2011). Similarly NASA calculated that its safety devices protected the Challenger Space Shuttle from the enormous physical forces acting on it, so it launched the shuttle. But it underestimated risk with calamitous results (Vaughan 1996).
These cases illustrate that reticence to anticipate catastrophe where danger lurks and resulting lack of foresight leads to vulnerability. They demonstrate that the assessment of risk must not be straightforwardly equated with risk, nor the assessment of safety equated with safety. Risk and its opposite, safety, are not necessarily what we think they are. It is necessary to distinguish the cultural assessment of risk or safety from material risk or safety. Risk is material, risk assessment is cultural, and the interaction of the two occurs in the hybrid cultural–material world. Sometimes the cultural assessment is of safety, which steers social practices to continue doing what has been done, even where danger exists, and the consequence is catastrophe (Chernobyl, Challenger Space Shuttle, BP Deepwater Horizon, etc.). Or the cultural assessment is of risk and this determines social practices, even where there is no material risk (millennium bug, claims that vaccines cause autism). The assessment of risk is fallible, with science being the best available way to assess risk in the material world, and it recognizes its fallibility. The other way is by experience, either that of safety or disaster. Sayer (2001: 969) argues that ‘the most compelling reason for accepting the basic realist premise of the independence or otherness of the world is the experience of making mistakes, of having one’s expectations confounded and of crashing into things unexpectedly - in other words, the experience of falsification’. This is particularly true but unfortunate if the mistakes and crash result in catastrophe, and in the case of fossil-fuelled climate change, perhaps an irreversible global one.

Some risks are sociotechnical constructions with unintended consequences, for example innovation of CFCs depleting the ozone layer, but some are constructions of nature, such as the earthquake destroying Messina, Sicily in 1908, the Mount Pelée volcano destroying St. Pierre in 1902, and the storm surge drowning 6000 residents of Galveston Texas in 2000 (Zebrowski 1997; Murphy 2010). The assessment of risk or safety is always a social construction, typically one based on extrapolation from past experiences. There is also risk that is unforeseeable even with the most advanced science (Murphy 2009), which raises the question of how to confront the unforeseeable (CST 1999). A distinction must be made between the underlying material danger and the sociocultural estimation of it, whether by scientific or lay means. In order to
facilitate communication with the lay population, this book will follow the Oxford dictionary by retaining the distinction between risk (and its synonym danger) and risk assessment (often called risk perception) to study their relationships and gradations.

Beck’s (2007: 13) states that ‘the same risk looks like a dragon to some, but like a worm to others … [and] acceptable risks are those which are accepted’. These statements are underpinned by the difference between ‘risk’ and ‘looks like’. Similarly Renn (2008: 2) states that the ‘link between risk as a mental concept and reality is forged through the experience of actual harm (the consequence of risk). … What counts as a risk to someone may be an act of God to someone else or even an opportunity for a third party’. Risk as a mental construct—and its interpretation as undesirable or as an opportunity—is different from risk as material reality. The first constitutes risk assessment, the second consists of risk or danger itself. In order to analyse relationships between the two, material risk needs to be clearly distinguished from its cultural assessment. Conflating the two leads to confusion. Risk-takers rue the day they accepted risk and suffer buyers’ remorse if catastrophe strikes. Defining a threatening dragon as an innocuous worm does not make it so.

Beck makes the astute assertion concerning risk assessment that the ‘risks which we believe we recognize and which fill us with fear are mirror images of our selves, of our cultural perceptions’ (Beck 2007: 13). But it needs to be complemented by a similar assertion about safety assessments, namely that the safety which we believe we recognize and which fill us with complacency and apathy is a mirror image of ourselves, of our cultural perceptions. These are fallible cultural assessments of risk or safety in a real material world with its own dynamics. Whether the assessment is accurate determines vulnerability or robustness and hence the material consequences of social practices.

Beck (1995: 50–51) gave a devastating critique of mistaking verbal designations for their biophysical referents. If material hazards are not dealt with, ‘there remains only the social construction of non-toxicity. It does not, admittedly, inhibit the effect, but only its designation. … That might be a momentary consolation but it is no help against poisoning’. Disaster research documented the superficiality of conflating risk and safety assessments with their material referents. Nature’s dynamics
presumed safe can shock humans into awareness of their erroneous presumptions, as when the extremely improbable tsunami flowed over the supposedly failsafe protective barrier at Fukushima Daiichi drowning thousands of inhabitants and striking the nuclear reactor resulting in a meltdown (Hasegawa 2012, 2015). Sayer (1997: 482) reminded social scientists not to confuse ‘social constructs or interpretations with their material products or referents’.

The Actualization of Risk Potential into Disaster

Beck (2007: 9–10) stated that ‘the moment risks become real, when a nuclear power station explodes or a terrorist attack occurs, they become catastrophes. Risks are always future events that may occur, that threaten us’. ‘Real’ is a poorly chosen word, and should be replaced by ‘actualized’. Before the explosion, the risk was real and threatening, more with lax safety measures than stringent ones, and more than if there were no nuclear station. The risk only became actualized from a potential into a material catastrophe when the explosion occurred. Risks have a reality similar to potential energy. They may become actualized into material catastrophes, much like potential energy may become actualized into forces and kinetic energy. Or action can be taken to prevent risks from becoming actualized into catastrophes: a bomb can be dismantled before it detonates; CFCs with the potential to deplete the ozone layer can be phased out by the Montreal Protocol; fossil fuels have the potential to result in a greenhouse effect pushing global warming to more than 2 °C but can be prevented by replacing them with low-carbon energy, etc. Decision-makers assessed New Orleans as a safe city, hence defensive and preventive measures were not implemented and its risk potential, clearly indicated by prior scientific predictions (Freudenburg et al. 2009), was actualized into a catastrophe when hurricane Katrina struck. Culturally varying assessments of risk interact with the material potential of nature’s dynamics in different ways: by acknowledging risk or denying it; by taking action to prevent disaster or discounting it as too far in the future and choosing to run the risk for economic reasons; by preparing for it by reducing vulnerability; or even by imagining a threat where none exists.
Risk Calculability and Cultural Perceptions

Beck (2007: 12) postulates that the ‘global anticipation of catastrophe for the most part resists the methods of scientific calculation. The less calculable risk becomes, however, the more weight culturally shifting perceptions of risk acquire, with the result that the distinction between risk and cultural perception of risk becomes blurred’. The first assertion needs to be unpacked, especially concerning fossil-fuelled climate change. The anticipation of climate catastrophe has been rigorously calculated by science. What resists calculation are the specific harms, timing, location, tipping points, etc. Concerning the second affirmation, it is true that incalculable risks can be a prolific breeding ground for risk perceptions. The predicted catastrophe of the millennium bug was not calculable, yet that risk was terrifyingly anticipated. Social scares immediately prior to the change of millennium were abundant: computers were predicted to go haywire resulting in planes falling from the sky at midnight 2000, and missile sites and machines in hospital operating rooms running amok. This cultural assessment of risk was wiped out when clocks struck midnight by the evident absence of adverse consequences. However, the blurring of the difference between risk and its cultural perception usually has little to do with the calculability of risk. The risk of catastrophe for New Orleans situated below sea level on the coast of the Gulf of Mexico between an enormous lake and the Mississippi River in an area prone to hurricanes was extensively calculated, but that did not prevent the calculations and risk from being ignored and social practices continued as if the cultural perception was of safety. Near-term economic interests had priority, and the result was catastrophic hurricane Katrina striking unprepared New Orleans (Freudenburg et al. 2009). Fossil-fuelled climate change also demonstrates that its risk or safety assessment varies between countries and cultures even though its scientific risk assessment has been robustly calculated by the IPCC and disseminated internationally (Likskog et al. 2010). The cultural assessment of safety or risk has more to do with interests and social predispositions than with the calculability of risk. This is important because decision-makers often legitimate their complacent actions by claiming that risks were not calculable before a disaster, as
George W. Bush did after Hurricane Katrina, but they were rigorously calculated yet ignored. Will this be the case for scientific assessments of the fossil-fuelled climate crisis?

**Uncertainty**

Calculating impacts and probabilities, hence risk, depends on having evidence about what occurred previously and on continuity between occurrences in the past and in the future. This is what distinguishes risk from uncertainty. To use the previous analogy of the coin, suppose someone weights it and there is no evidence concerning tosses of the weighted coin. Now the evidence from past tosses of the unweighted coin would be misleading for predicting outcomes of tosses in the future. Instead of continuity, there would be discontinuity. Both the outcome (heads or tails) and the probability of occurrence would be unknown. ‘In an uncertain situation, there’s not enough information to establish probabilities. Not only is the outcome unknown, but there’s no reliable way to weigh possible outcomes’ (Agrba 2019: 9). If both probability and impact are unknown, then the situation is a complex one of multiple unknowns. Fossil-fuelled global warming is changing the frequency, intensity, and timing of storms, hurricanes, floods, wildfires, sea level rise, melting Arctic ice cover and permafrost, etc. Hence, extrapolations from the past are misleading, risk calculations based on them are invalid, and fossil-fuelled societies have placed themselves in a situation of uncertainty. What was previously a hundred-year flood in Houston now could occur every ten years. Fifty-year wildfires in California and Australia might occur every five years. Worse still, there is no reliable evidence on how the frequency of occurrences and their impacts are transforming. Because climate change is global, strategies of managing outcomes by diversification don’t work either because the whole world is being affected. Discontinuities of fossil-fuelled climate change are altering the dynamics of nature such that the concept ‘risk society’ needs to be replaced by ‘uncertainty society’. Science informs societies of the fossil-fuelled danger, but does not currently have the
capacity to provide precise measures of its future impact or probability, which remain uncertain.

More complex still, fossil-fuelled climate change engenders different dimensions of uncertainty. One consists of the inability to calculate the probabilities, impacts, location, and timing of *acute, sudden* disasters like hurricanes and wildfires. Another dimension of uncertainty involves assessing the timing (Lockie and Wong 2017) and impact of *chronic, slow-onset* catastrophes, such as melting of Antarctica’s and Greenland’s glaciers and subsequent ocean level rise, displacement of the jet stream, gulf stream, and polar vortex, which will have widely varying impacts and probabilities in different geographical and topographical locations. The biggest uncertainty is whether fossil-fuelled global warming will irreversibly tip the planet into a less hospitable habitat for humanity.

There is one caveat to this discussion of unknowns and uncertainty. The preponderance of the scientific evidence indicates that there is little uncertainty about the overall trend line of increasing global warming. Uncertainty concerning specific harms should never be used as an excuse for not changing socioeconomic practices and technologies to mitigate the trend line of fossil-fuelled global warming. George W. Bush’s excuse for lack of mitigation and preparation for hurricanes in New Orleans (Freudenburg et al. 2009) must not be emulated for fossil-fuelled climate change.

**The Staging of Risk: ‘When You Ride ALONE, You Ride with Hitler’**

These clarifications of the concepts ‘risk’, ‘safety’, ‘uncertainty’ and ‘assessment’ are necessary to assess solutions, which are underpinned by all these concepts. The climate crisis has been caused by fossil-fuelled practices, including voting practices concerning carbon taxes, etc., and solutions will require changes in those practices. ‘We are aware of the existential stakes and the urgency, but even when we know that a war for our survival is waging, we don’t feel immersed in it. The distance between awareness and feeling can make it very difficult for even thoughtful and politically engaged people – people who want to act - to act. … If
we don’t act until we feel the crisis that we rather curiously call “environ-
mental” – as if the destruction of our planet were merely a context – everyone will be committed to solving a problem that can no longer be solved’ (Safran Foer 2019: 13). Presenting research papers and scientific modelling to non-scientists is unlikely to change the social practices of the latter. Staging a problem is important for transforming what science has presented intellectually into one that people perceive, feel, and act upon. The scientific finding of ozone layer depletion was staged as a ‘hole’ in the ozone layer. The danger of smoking was staged with warn-
ings on cigarette packages, and in some places, gory images. Staging is particularly necessary where there is a slow-onset threat that is invisible, has catastrophic consequences, is caused by embedded social practices, and where the risk disproportionally affects those who did not cause it, particularly the poor and future generations.

During the Second World War, ‘the [US] government enacted – and Americans accepted – price controls. … Gasoline was severely regu-
lated, and a speed limit of 35 miles per hour was imposed nationally to reduce gas and rubber consumption. U.S. government posters advocating carpooling declared, “When you ride ALONE, you ride with Hitler”’ (Safran Foer 2019: 8). Taxes were increased dramatically to support the war effort. Material risk has the potential to influence expectations, actions, politics, and transform the world, but whether this potential is actualized depends on many factors, including the staging of risk in competition with the staging of safety. Safran Foer (2019) gave examples of staging that helped alleviate problems, such as the social construction of the iconic status of Rosa Parks on the bus as both a true story and a fable to combat racial discrimination in the USA.

What is staging? Following (Beck 2007: 10), “staging” here is not intended in the colloquial sense of the deliberate falsification of reality by exaggerating “unreal” risks. … For only by imagining and staging world risk does the future catastrophe become present – often with the goal of averting it by influencing present decisions. Then the diagnosis of risk would be “a self-refuting prophecy” – a prime example being the debate on climate change which is supposed to prevent climate change’. Staging consists of drawing attention to an environmental problem and making it relevant. Beck (2007: 98) argues that now the ‘political site
of the world risk society is not the street but *television*, the Internet – in short, the old and the new media. … Its function is assumed by the *staging of cultural symbols in the mass media*. His examples of staging are the ‘Greenpeace people [who] are multinational media professionals who know how self-contradictions between pronouncements and violations of safety and surveillance norms can be presented …. [and he sees] Greenpeace using the instruments of the media age to stage worldwide mass civil disobedience’ (Beck *(2007: 99).*

### The Socioculturally Staged and the Materially Real

Is risk a material reality of potential harm or a staged, socially constructed belief? They are entangled empirically, but analytically blurring the difference between them and conflating the material and the cultural, or worse still reducing the material to the cultural, obstructs understanding of relations between them. Material risk and the staged assessment of risk should not be assumed to be identical. Staged perceptions of risk can promote action that reduces vulnerability, increases prevention and therefore safety when there is material risk, but staged claims of safety and discounting future harm in the presence of material risk fosters apathy and complacency, thereby aggravating risk. The population's assessment of global risk is influenced by the staging of risk versus the opposite staging of safety and discounting danger. Material risk can be diminished by its accurate assessment followed by corrective action. Or it can be exacerbated when safety is persuasively staged and future harm discounted where danger lurks. Risk assessment and action depend on both material risk and on the staging of risk in competition with the staging of discounting danger. The contact sport Schneider *(2009)* described between impact scientists and production scientists is also played between the stagers of risk and discounters of danger.

Beck’s previous hypothesis that danger shapes expectations and becomes a political force coexists awkwardly with his hypothesis here that risk needs to be staged and that it is staging which shapes expectations and becomes a political force. The two can be reconciled by
clearly stating that staging is a crucial intervening variable between (i) material danger or its absence, and (ii) expectations and political action. Beck shows that the staging of risk intervenes between scientific knowledge of material risk and cultural assessments of risk. ‘As a result, their “reality” can be dramatized or minimized, transformed or simply denied according to the norms which decide what is known and what is not. They are products of struggles and conflicts over definitions within the context of specific relations of definitional power, hence the (in varying degrees successful) results of stagings’ (Beck 2007: 30). Staging leads to fallible assessments of risk or safety, whether scientific or lay, which should not be straightforwardly equated with material risk or safety. Sometimes dynamics of nature, which are autonomous from socially constructed definitions of risk or safety, upstage the staged definitions and, contrary to socially constructed expectations, undermine the definitional power of assessments by producing disasters in cases staged as safe, or safety in cases staged as disastrous, as the illustrations given above show.

**Suitability for Staging?**

Beck (2007: 72) argued that ‘there is a striking discrepancy between the material destruction being wrought by climate change, which is irreversibly transforming conditions of life on the planet, and its suitability for staging in the mass media’. Whereas visible evidence of terrorists blowing people up lends itself to media staging and action against terrorism, global warming relies on top-down documentation by scientists, dissemination of research results by the media, and staging by social movements to distinguish fossil-fuelled causes of this creeping global catastrophe from nature’s local disasters which have previously occurred. Planes crashing into the twin towers of New York’s World Trade Center provided an iconic image of terrorism understood everywhere. People aren’t moved by the fate of famished polar bears as much as the fate of people on fire jumping from the 100th floor of the burning towers. ‘The planetary crisis – abstract and eclectic as it is, slow as it is, and lacking in iconic figures and moments – seems impossible to describe
in a way that is both truthful and enthralling’ (Safran Foer 2019: 14). Carbon dioxide is invisible to the senses, as is the excess of emissions over carbon withdrawals, which is cumulative and threatens to unleash further autonomous dynamics of nature that will lead to runaway climate change if social or technological corrective measures are not taken or taken belatedly. This can only be made visible by impact science. Global warming involves an urgency unfelt by the population and decision-makers, which occurs behind their backs if they are unwilling to turn around and see it through scientific conclusions. The problem worsens even as remedial measures are being taken when they are too little, too late.

Erroneous staging of safety is especially likely where danger is slow onset, as in fossil-fuelled climate change. Safety claims based on extrapolation from a safe past are more easily staged than tipping into dangerous discontinuities a century from now, no matter how well documented the science upon which the latter is based. Assumptions of safety drawing on extrapolation from past experience are subtle and taken for granted, much like breathing clean air is taken for granted until it is seriously polluted. Expert evidence resulting in forecasts of harm to peoples distant in time and space can be easily discounted. It is not only the cleverness at staging risk or safety that is important, but also the underlying material conditions that facilitate discounting danger over staging risk, and make the staging of safety easy and the staging of danger for future generations complicated. Near-term economic priorities, cultural predispositions, and normal conditions favour the staging of safety and discounting of future harm, even when they result in practices that produce environmental danger.

**Stagings to Mitigate Fossil-Fuelled Danger**

**Scare ‘em to Death**

The above shows the difficulty of convincing consumers to change their fossil-fuelled consumption practices and voters to vote for policies that mitigate climate change. One solution is to scare them into climate-friendly practices. The choice of book titles and presentations are done
to frighten readers into changing their fossil-fuelled practices. Take a brief sampling of titles: *The World Without Us* (Weisman 2007); *Seven Years to Save the Planet* (McGuire 2008); *Climate Wars: The Fight for Survival as the World Overheats* (Dyer 2008); *Now or Never* (Flannery 2009); *Requiem for a Species* (Hamilton 2010); *Challenging Legitimacy at the Precipice of Energy Calamity* (Davidson and Gismondi 2011); *The Sixth Extinction* (Kolbert 2014); and *The Uninhabitable Earth: Life After Warming* (Wallace-Wells 2019). Beck’s (2015) theory of emancipatory catastrophism also assumes that people can be scared into emancipating themselves from fossil fuels by discourse about a coming global catastrophe. The content of these books is often based on the best available natural scientific understanding of fossil-fuelled climate change, which is admittedly terrifying, and has much to offer. Their frightening titles may prove right in the long run, but they have not succeeded in convincing leaders and populations to reduce greenhouse-gas emissions, which continue to rise. Setting expiry dates is particularly dubious. The ‘seven years’ after the McGuire book was published expired in 2015, so readers might conclude it is now too late to save the planet. Since fossil-fuel practices were not changed ‘now’ in 2009 as Flannery insisted, readers could infer that it will be ‘never’. If societies were ‘at the precipice of energy calamity’ in 2011 as Davidson and Gismondi contended, they must have fallen into the abyss since then because fossil-fuel combustion intensified.

Failed predictions of catastrophe have a long history. The 1972 staging of *Limits to Growth* (Meadows et al. 1972) predicted a planetary collapse, and yet humanity is more prosperous than ever almost a half-century later in 2020. The Malthusian catastrophe (Malthus 1798) has not yet occurred despite more than two centuries of exponential population growth. However well intentioned, these scare tactics didn’t work. Only a small proportion of populations have viscerally experienced calamities from fossil-fuelled climate change until now. All the rest persisted in their greenhouse-gas emitting practices, and so did even the victims of floods, wildfires, Arctic ice melting, etc. Failed stagings undermine the credibility of predictions of harmful consequences. The important issue is the relationship between staged assessments and the underlying material risk. The present book is based on the premise that the evidence should
be presented as accurately and dispassionately as possible. If that scares people into action, then all the better, but scaring is not used here as a tactic. After six more years of increasing emissions and worsening global warming since his 2009 book, Flannery (2015) concluded that hope has more potential than fear, so he published a book entitled *Atmosphere of Hope*.

**Finding a Dramatic Iconic Image**

Some social scientists claim that staging ozone layer depletion as a ‘hole’ inspired action to construct measures to phase out CFCs (Grundmann 2001). That hypothesis strikes me as at best a minor contributing factor. Whether it be the ozone ‘hole’ or ‘riding with Hitler’, an evaluation of these stagings would require comparison with action without them. That has not been done, so it is difficult to determine their influence compared to the influence of, respectively, the scientific documentation of ozone layer depletion (and innovation of technological alternatives) and World War II itself. Moreover, in the three decades since a scientific consensus emerged concerning dangerous global warming, no staging of it has incited safer practices. Images of bleached coral in the Great Barrier Reef haven’t persuaded Australians to go easy on coal nor convinced other populations to restrain their fossil-fuelled practices such as cruising, flying, etc. However, a COVID-19 virus that threatens them personally and immediately has had more effect on flying and cruising, despite having nothing to do with fossil-fuelled global warming.

**Presenting the Climate Problem as Opportunities**

It is possible that people will not be motivated to change deeply ingrained fossil-fuelled social practices by dangers distant in space or in time or by solutions calling for replacing the market or radically restricting consumption. A different solution is to deal with the problem by positive thinking. This assumes that the population and decision-makers will be more motivated by focussing on the near-term, local benefits of the transition to renewable energy rather than the dangers of fossil fuels. Hence,
immediate benefits need to be emphasized. Much like the transition from horses to fossil fuels resulted in new, better jobs, the next energy transition from fossil fuels to low-carbon energy can be portrayed as leading to cleaner, better-paying jobs (Rand 2014; Hawken 2017; Carolan 2018, 2020). In a competitive market economy, the transition can be staged as a race to the top of the green economy, with the countries, companies, and workers that win the race reaping most of the rewards.

A related strategy is to stage mitigation as an indirect consequence rather than tackling global warming head-on. Giddens (2009) makes much of the possibility that policies implemented to attain other goals can better solve the climate change problem as a side effect. He gives the example of Europe’s goal of achieving energy independence and energy security at the time of the 1970s OPEC oil crisis. This prompted Europe to implement high petrol prices and develop efficient public transportation, mostly electrified, and resulted in France developing nuclear energy. The increased petrol prices were not sold as carbon taxes to combat fossil-fuelled climate change, but had that consequence. Giddens generalizes this as a methodology to solve fossil-fuelled climate change: emphasize near-term economic benefits of clean growth rather than long-term environmental dangers of fossil fuels. Harvey and Orbis (2018: 63) argue that most ‘policies that aim to reduce greenhouse gas emissions have co-benefits: positive effects for society other than mitigating climate change. The most important co-benefit is usually an improvement in public health’. Pielke (2010: 232) quotes John Kerry’s logic in 2010 when he was an American Democratic senator arguing in favour of climate legislation: “It’s primarily a jobs bill, and an energy independence bill and a pollution reduction-health-clean air bill. Climate sort of follows. It’s on for the ride”.

Drawing attention to near-term benefits such as jobs from the development of renewable energy is important, and has been frequently tried by decision-makers attempting to mitigate global warming. But although helpful, unfortunately it has not succeeded in decreasing emissions to withdrawal rates. Kerry’s ride proved to be bumpy on a two-way street. The Trump Republican Administration undid all the Democratic climate legislation and promoted jobs and energy independence by deregulating and expanding the fossil-fuel industry. Near-term economic benefits can
be achieved with carbon-polluting fossil fuels. Energy security and independence were attained with hydraulic fracturing and deepwater drilling in the United States, by extracting oil from bituminous (tar) sands in Canada, by prioritizing coal and liquefied natural gas in Australia, etc. Texas has one of the world’s largest wind farms, as well as one of the world’s biggest petrochemical industries. China seized the opportunity of leading the development of solar energy, but remains the world’s biggest carbon polluter by combusting coal. These states added low-carbon energy, but did not reduce their carbon-polluting energy. The greenhouse effect will only be mitigated by decreasing emissions to carbon withdrawal rates, unless there is a miraculous technological breakthrough rendering the combustion of fossil fuels emissions-free. Solutions emphasizing opportunities and indirect solutions have to be assessed according to what is needed. It is necessary to purposefully steer innovations to eliminate dangerous fossil-fuel emissions. Moreover, any strategy of soft-pedaling scientific assessments of danger is disingenuous because it can lead people to claim that they didn’t restrain fossil-fuelled practices because they didn’t know the seriousness of the problem.

Staged assessments of risk are often contested. The debate can then be about the staging itself rather than the underlying material risk, whether the staging represents real threats or are exaggerated or even imaginary unreal allegations. Even for real material danger, staging can have perverse sociocultural consequences that backfire and decrease its recognition. Examples are the scary book titles with expiry dates that undermine credibility when the date has passed with little consequence.

**Staging of Safety and Discounting Danger**

Beck (2007) analysed the staging of risk, but ignored the staging of safety and discounting of danger. He thereby sees the mouse and is blind to the elephant. Hence it is necessary to turn Beck’s approach right side up by examining the staging of safety. In Canada, where Greenpeace originated, it has been ineffective in staging the risk of extracting four million barrels of diluted bitumen from the tar sands daily and exporting
it by rail, pipeline, and ship. On the other hand, the Canadian Association of Petroleum Producers (CAPP) have the resources to employ professionals in media staging to divert attention away from the atmospheric carbon pollution, freshwater contamination, deforestation, etc., of tar sands exploitation, more euphemistically renaming it ‘oil sands’, conflating carbon-polluting fossil fuels with low-carbon wind and solar by using the word ‘energy, labelling the thousands of square kilometres of bitumen an “oil patch” to create the impression of smallness’ (Murphy 2011), and shifting attention away from its long-term danger to its near-term economic benefits, thereby legitimating it (Davidson and Gismondi 2011). Who is winning the media staging battle of risk versus discounting danger? Since anthropogenic climate change results from carbon emissions, the rapid rise of Canadian emissions from tar sands exploitation, notwithstanding the formation of Greenpeace in Canada in 1971, indicates the winner. Despite best efforts by environmentalists at staging the risk of global climate change, the other side discounting danger claiming near-term economic benefits of becoming an oil superpower and staging safety is winning (Murphy 2015). This is true concerning fossil fuels in most countries, so they continue to be combusted at high rates.

The full complexity of staging needs to be analysed. Staging (i) can consist of presenting the best available evidence, both scientific and lay, in ways understandable to non-scientists, or it (ii) can involve misrepresentation, either deliberate or unintentional because of ignorance. Staging of safety and discounting scientifically documented predictions of danger can block the formation of risk expectations and corrective action where there is catastrophic risk, as when authorities in New Orleans claimed it was safe to build canals for economic growth, which amplified vulnerability to Hurricane Katrina (Freudenburg et al. 2009). Research (Jacques, Dunlap, and Freeman 2008; Dunlap, McCright, and Yarosh 2016) has documented how think tanks have been formed and financed by the fossil-fuel industry, tobacco industry, CFC chemical industry, etc., to downplay risks inherent in their products. Freudenburg (2006) showed how scientifically documented environmental problems are staged as non-problems using a ‘double diversion’. If risk makers succeed in convincing the public to discount danger, then preventive
action is not taken, and vulnerability to harm is increased. This constitutes the staging of safety where danger lies in wait. The staging of risk confronts its opposite performative construction: the staging of safety and discounting danger.

Beck argues that diagnosing, imagining, and staging the world risk of catastrophe, such as anthropogenic climate change, creates a self-denying prophecy which helps avert it. But the converse is also true. Staging, imagining, performing, and acting as if safety will prevail, and as if scientific predictions of future harm should be discounted, are leading to the opposite self-denying prophecy that brings on catastrophe. Claims of safety-as-usual and disregarding danger result in failure to enact precautionary measures in the context of dangerous forces of nature, hence susceptibility to harm persists, and safety threatens to be replaced by catastrophe. The prophecy of safety incites practices that result in its denial in fact. This occurred for local disasters. In communications with regulators, BP claimed the blowout protector on its Deepwater Horizon oil rig was failsafe. However, the material reality of risk under deep ocean water pressures was at odds with this staged discourse, the blowout protector failed to protect safety, and the result was a catastrophic explosion, workers killed, and a two-month-long oil gusher that contaminated the Gulf of Mexico (Freudenburg and Gramling 2011). Concerning fossil-fuelled climate change, if one judges by social practices resulting in a net increase in the carbon content and temperature of the atmosphere despite scientific warnings, globally the staging of safety is winning out over the staging of risk and danger is being discounted. The following are examples of strategies that are being used to stage safety.

**Staging of Faith in Market Miracles**

Simon (1981, 1996) and Lomborg (2001, 2007, 2010) present an economist’s formulation of staging safety widely believed in society. They dismissed risks of depleting resources by claiming that as long as technological innovations and market dynamics of supply and demand are fostered, there will never be scarcity because reason will always invent new products, create substitutes when resources become scarce, and
devise solutions to problems as they arise. If technological innovation and the market are allowed to work their magic, they will bring abundance and affluence to everyone forever. The main risk is that irrational social movements will shackle the invisible hand of the market and impede technological ingenuity. These assertions are, however, refuted by the evidence because profit-driven technological innovations have hitherto failed to reduce carbon emissions and have worsened such pollution by innovating new ways to extract carbon from the ground, where it has been stored safely by nature’s processes, and emitting it into the atmosphere where it becomes dangerous. There are no substitutes for the atmosphere and oceans as carbon sinks. Market-based technological innovations have filled them with carbon having deleterious consequences. Wishing for last-minute, end-of-pipe, profit-driven technological solutions, so as to avoid restraining fossil-fuelled practices, constitutes dangerous brinkmanship.

**Staging Mitigation as a Job Killer**

Fossil-fuel promoters often depict policies to solve the climate crisis as job killers. Thus carbon taxes, cap and trade, fuel-efficiency standards, and the like are demonized as destroying jobs and prosperity. Such staging is contradicted by documentation that the transition from fossil fuels to low-carbon energy results not in jobs lost but rather jobs shifted (i) from high carbon-emitting fossil fuels to low-carbon sources of energy like solar, wind, hydroelectric, and geothermal, (ii) from the pursuit of extraction to the pursuit of efficiency, and (iii) from the manufacturing sector to the service sector. Far from being killed, jobs are re-energized and could become more abundant and more lucrative, as occurred with other energy transformations. The best climate performing states with high taxes on fossil fuels, such as Sweden and Switzerland, are also the most prosperous (Yale University 2018).
Staging Fossil Fuels as Poverty Reduction

Another claim is that fossil fuels reduce poverty (Lomborg 2019: A15). Whereas those concerned about fossil-fuelled climate change want carbon taxes, which will impact the poor, fossil-fuel extractors keep fuel prices low by increasing supply through the growth of extraction. In his attack on Greta Thunberg, Lomborg contends that it is fossil-fuel tycoons, not activists like Thunberg, who are alleviating poverty. The degradation of the natural environment and of nature’s services by fossil-fuelled climate change threatens, however, to increase poverty in the long run. And carbon taxes can be recycled back to the poor in ways that incite them to use public transit and fuel-efficient vehicles.

Staging Blamelessness

For the fossil-fuelled climate crisis, blamelessness takes many forms. A significant one is that fossil-fuelled companies are irreproachable because consumers demand fossil fuels. This demand–supply issue was examined in Chapter 4. Another is the assertion that we are all fossil-fuel sinners. Everyone who drives a car, takes a plane, turns on a furnace or air conditioner, or uses a social media server is at fault for fossil-fuelled climate change. Disproportionality (Freudenburg 2006) of blame is ignored. The difference between big and little blameworthiness is intentionally blurred. Coal miners toiling underground are as much to blame as billionaire coal mine owners who make fortunes by not paying the health and environmental costs caused by their carbon pollution, and then use those fortunes to lobby politicians to oppose regulating carbon pollution, e.g. the Koch brothers in the USA. If everyone is equally to blame, then no one is to blame. The grain of truth in such stagings masks how misleading they are.

One reason for the predominance of blamelessness is politeness. For example, all the participating countries at the 2019 Arctic Council except the USA agreed with a declaration that recognized climate change as a serious threat to the Arctic. The Americans led by Secretary of State Mike Pompeo did not want any hindrance to the exploitation of oil and gas
in the Arctic. The Inuit representative called the American position ‘a moral failure’. However, the Finnish Foreign Minister, who chaired the meeting, recognized the urgent need to mitigate, adapt, and strengthen resilience but said ‘he did not want to name and blame anyone’ (Dickson 2019: A7). Those who promote, disproportionately use, or profit from fossil fuels are mainly responsible for fossil-fuelled climate change, but people are reluctant to lay blame in polite conversation.

**Staging Fossil-Fuel Critics as Hypocrites**

A particularly aggressive staging is to label as a hypocrite anyone who points out the adverse consequences of fossil fuels yet drives a car, flies in a plane, uses air conditioning and social media servers. The American Al Gore, Canadian David Suzuki, climate scientist Stephen Schneider, and other fossil-fuel critics have been pilloried by fossil-fuel promoters for taking planes to give speeches on the dangers of global warming. At present, there is no alternative to flying for necessary, long-distance travel. These detractors of climate scientists and activists are using the rhetoric of hypocrisy to shut them up. The implication is that the way to avoid hypocrisy is to deny that fossil-fuel combustion causes climate change, then you can fly as much as you want without hypocrisy. But biophysical dynamics don’t cooperate with such discourse, the fossil-fuelled greenhouse effect marches ahead unimpeded, and future generations suffer the consequences.

Staging of safety when conditions are dangerous leads to failure to acknowledge the underlying material risk and retards improvements of social practices and of technologies to avoid calamities. Other strategies to frame fossil fuels and climate change as non-problems, which involve various forms of staging, are examined in Murphy (2015).

**Learning from Disaster Research**

It is important to learn from disasters. Researchers (Turner and Pidgeon 1978; Vaughan 1996) have long found that disasters are typically
preceded by a ‘failure of foresight’ when evidence of the impending disaster was available but discounted, and by an ‘incubation period’ when the disaster could have been averted or at least greatly diminished if corrective action had been taken. For example, promoters of economic growth in Louisiana claimed there was little risk even though evidence suggested otherwise, and the result was the Hurricane Katrina and BP Deepwater Horizon calamities (Freudenburg et al. 2009; Freudenberg and Gramling 2011). These were therefore ‘man-made disasters’ (Turner and Pidgeon 1978) based on a failure of foresight even though they involved powerful forces of nature because the available scientific evidence of danger was discounted during the incubation of avoidable disasters. This is well-expressed by the title of Freudenburg et al.’s study of the Hurricane Katrina disaster: Catastrophe in the Making: The Engineering of Katrina and the Disasters of Tomorrow. This shows the importance of foresight which takes into account rather than discounting the available evidence, and acts according to it to prevent ‘man-made’ complacency and reduce vulnerability in order to promote safety and sustainability.

Studies of disasters typically end with ‘lessons learned’. The traumatic experience usually results in better technical protection against the kind of catastrophe that occurred in the recent past. After Hurricane Katrina, levees were repaired and reinforced and more efficient pumps were installed (Freudenburg et al. 2009). After the BP disaster, better blowout protectors were mounted on oil rigs (Freudenburg and Gramling 2011). Earthquakes motivated charting of geological fault lines and earthquake zones and building codes were then implemented. Floods promoted mapping of flood plains, building dykes, constructing river bypasses to protect cities (e.g. Winnipeg), and restricting development on flood plains. Wildfires prompted the documentation of areas prone to them and preparations to reduce fatalities and property damage. The enormous cost in lives and money of the Indian Ocean 2004 Boxing Day tsunami inspired countries to pay for tsunami early warning systems. Disasters are important prompts to make infrastructures more robust to withstand hazards similar to those which have already occurred, called ‘yesterday’s disasters’, in order to reduce vulnerabilities, and to make societies more resilient so they can bounce back (Murphy 2009).
But the prompt is not always acted upon except in a minor technical way. After the experience of a disaster, the question is: will adequate mitigation to avoid recurrence be done or will the prompt be minimized when such mitigation involves cost or disruption of social practices? In many cases the danger is discounted and the risk is run. It is more convenient to believe that the hazard will not appear with destructive force for another century, or at least not during the mandate of political and economic leaders nor during the lifetime of citizens who must pay the cost, so why bother. The costs of prevention and disruption of social practices are immediate whereas the dangers are distant in time and can be contested. Hence ‘repeat disasters’ happen (Platt 1999).

With fossil-fuelled climate change, the threat is not a repeat of a disaster that has already happened but rather the scientific prediction of a catastrophe that is likely to occur. If there is a reluctance to change and pay the costs of mitigation after the experience of disaster, then imagine the reticence concerning the mere prediction of disaster, scientific though it may be. Nevertheless, the most general lesson learned from disaster studies is a sociocultural one: pay attention to warning signs and modify social practices and technologies that threaten to lead to calamity. Applying this broad lesson to fossil-fuelled climate change means taking seriously the scientific evidence as well as visible indications of danger (receding glaciers, melting Arctic ice cover, more frequent and/or intense extreme weather such as wildfires, floods, and hurricanes, etc.), and letting them incite less risky social practices and safer technologies.

The Uncertainty of Whether There Will Be Foresight or Danger Will Be Discounted

Flannery (2015: 194) documents how much best practices using existing technologies can do to limit fossil-fuelled climate change and concludes that ‘we clearly have the tools needed to avoid more than 2 °C of warming. But will we use them?’ Writing about the fossil-fuelled climate crisis, Rand (2010: 212) argues that ‘the ten clean technologies in this book are a roadmap of where to go. Getting there is up to all of us’. Is the road being taken and are we getting there? Harvey and Orbis
(2018: 299, 303) state that ‘although the technology exists today and is falling in cost, significantly reducing global greenhouse gas emissions is a Herculean task, one that will not simply happen on its own even with cheap clean technology. … So the challenge is not technical, nor even economic, but rather is a matter of enacting the right policies and ensuring they are properly designed and enforced’. To accomplish such a Herculean task, everyone, especially those with power, have to do their part. No free-riders allowed. If our generation does not practice fossil-fuel restraint through enforced measures like carbon taxes, then our grandchildren could be forced to practice fossil-fuel abstinence (little if any cruising, flying, even driving). ‘The habit of focusing on the present and discounting the future leads away from a thoughtful appraisal of long-term consequences and the world we are making’ (Speth 2012: 6–7). Short-sightedness is related to the priority given to near-term economic benefits and cultural predispositions, leading to danger being discounted.

Note the difference between this conception of discounting future harm and the theoretical conception of discounting the future by economists. In the latter, a hundred dollars today is worth more than a hundred dollars in ten years because the money could be used immediately, in particular to accumulate more money, hence the fixed amount of future money is discounted. However, this logic does not apply to people being killed or species being wiped out by extreme weather. A flood today is worse than the same flood in ten or even a hundred years only if the threat of a future flood is not discounted, that is, only if measures are taken in the interval to mitigate it by modifying the cause of the flooding, restoring wetlands, building flood walls, etc. Discounting danger of future harm is invalid if present practices lead the danger to cumulate, like fossil-fuelled global warming, and if preventive measures are not implemented. The increase in carbon emissions which have been documented and accumulated demonstrates that the kind of discounting danger which is currently being practised consists of refusing adequate mitigation in order to enjoy the near-term benefits of inexpensive fossil-fuel combustion. In such cases, discounting scientific predictions of future harm is not only invalid but also dangerous. It is this form of discounting danger that is referred to by the subtitle of the book.
Societies are currently conducting an unplanned, trial-and-error alteration of the global climate, with the possibility of tragic error looming large. Nevertheless the solutions to fossil-fuelled climate change are known and not very difficult technically. They consist of reducing emissions to withdrawal rates by regulations and pricing carbon pollution, increasing carbon withdrawal, and doing this globally by implementing a binding, enforced international agreement to avoid free-riders, much like what the Montreal Protocol accomplished for CFCs depleting the ozone layer. Making the polluter pay for externalities would act as a powerful stimulus to innovate and implement emissions-free, clean renewable technologies. This would result in decarbonizing transportation, industry, and the energy supply. Increasing withdrawal of atmospheric carbon could be done by replanting many of the forests cut over the past two centuries and using environmentally friendly agriculture. Technological barriers and knowledge insufficiencies will only become major problems if humanity continues fossil-fuelled social practices at all levels that open further the Pandora’s Box of nature’s safe storage underground of valuable but dangerous hydrocarbons and unleash runaway climate change. Solutions to fossil-fuelled climate change are technically available. The incubation of disaster results from a failure of foresight and social resistance to changing fossil-fuelled social practices and to paying for needed improvements.

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