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## **Supplementary Information**

### **Written Submission from William Leiss**

In the Matter of

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Proposed Environmental Impact Statement  
for OPG's Deep Geological Repository  
(DGR) Project for Low and Intermediate  
Level Waste

Joint Review Panel

**September 16 to October 12, 2013**

## **Renseignements supplémentaires**

### **Mémoire de William Leiss**

À l'égard de

#### **Ontario Power Generation Inc.**

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Étude proposée pour l'énoncé des incidences  
environnementales pour l'Installation de  
stockage de déchets radioactifs à faible et  
moyenne activité dans des couches géologiques  
profondes

Commission d'examen conjoint

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# Stigma and the Stigmatization of Place:

A Paper commissioned by the Canadian Nuclear Safety Commission

## *Final Report*

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### Abstract

The concept of stigma, and especially the notion of “stigmatization of place,” has a long history in discussions of the siting of hazardous-waste facilities, and notably the siting of repositories for safely sequestering high-level and other forms of nuclear waste. The word “stigma” refers to some kind of mark that could be placed on a person in order to signify shame, disgrace and disapproval. It was originally applied only to *people*, but some later usage has extended it to *places* and *technologies* and sometimes to *products* as well. “Environmental stigma” is thought to become attached to contaminated places or sites, and its connotations include a high perception of risk, inequitable distribution of risk, and consequences flowing from the damage to places that are severe and long-lasting for the local communities that are in close proximity to such places. Part 1 of this paper discusses some of the analysis and conclusions that have been undertaken in many studies of stigma; it finds that, whereas stigmatizing persons (notably social minorities) is a serious, ongoing issue for public policy, stigmatization applied to technologies, products and even places is a much more ambiguous process, especially over a longer period of time. Part 2 selects a few more recent studies from the academic literature, out of a much larger bibliography, to illustrate the analytical approach to the subject, focusing on perception of risk, community impacts, and consequences, especially property-value losses. Part 3 offers short country case studies of recent developments in Canada, Finland, Germany, Sweden, and the United States; hot-links to excellent websites are provided for further inquiry. Part 4 offers some general conclusions, with the prediction that a siting strategy centred on a willing host community is likely to become the preferred option around the world. Part 5 provides short responses to two questions addressed to me. Part 6 is a comprehensive reference list.

## *Introduction.*

In Parts 1 and 2 of this paper I review the concept of stigma as it has been explored in the academic literature for many years. In Part 3, applying this theoretical discussion, I explore some case studies in five countries of actual ongoing community involvement in nuclear waste disposal issues and facilities. In Part 4 I offer some conclusions drawn from this discussion. Part 5 provides short responses to two questions addressed to me. In Part 5 I provide a bibliography of sources.

## **Part 1: The Idea of Stigma**

### *Overview.*

“Stigma” is an ancient Greek word meaning a “mark” placed on a person that would signify shame, disgrace and disapproval by the larger community. It was originally applied only to *people*, but some later usage has extended it to *places* and *technologies* and sometimes to *products* as well. As applied to people it signifies a powerful and indeed dangerous concept and practice, for the simple reason that within human groups the division between insiders and outsiders (and outcasts) is neither trivial nor benign. Properly understanding this form of stigma, including its implications as a public policy issue, remains an important challenge for democratic societies, communities, and their governments.

More recent usage applies the concept of stigma to places in the landscape that have come to be associated with serious and long-lasting damage, and in this context we encounter the idea of *environmental stigma*. Perhaps the best-known examples are hazardous waste disposal facilities of many different types, either as ongoing operations or as sites where operations have ceased but which need expensive remediation. In addition, people can be appalled when products they know well, especially those that are highly prized, such as blood, become tainted and unhealthy. Finally, the concept of stigma has also been applied to technologies that are thought to be problematic or unacceptable to many people; some of these overlap with operating sites, such as nuclear power stations, but others are as diverse as toxic chemicals (like dioxins) or genetically-engineered food crops.

Clearly something or someone that is stigmatized is perceived by some others as representing *potential harm* to those others' well-being, their families (especially children), personal security, livelihood, health, private assets, particularly property values, and other goods. Thus this mental process falls under the general category of what is commonly known as *risk perception*, that is, the belief that some harm might befall one by being exposed to a hazardous agent through some specific means. In general risk perceptions by individuals can have a very rational basis, since all of us face this type of exposure every day – in terms of infectious diseases, toxic chemicals, accidents causing injury and death, lifestyle choices (tobacco and alcohol use, dietary options), cancer-causing agents, and so forth.

Individuals require both abundant and credible information sources in order to understand what is known scientifically about these and other risks, and what impact their own personal choices may have on the level of risk they face and how those risks may be mitigated. (For those unfamiliar with the concept of risk, see a short paper of mine, “Thinking about risk and safety,” available on the Internet: [http://www.nwmo.ca/uploads\\_managed/MediaFiles/1673\\_nwmosr-2010-10\\_paper1\\_thinking.pdf](http://www.nwmo.ca/uploads_managed/MediaFiles/1673_nwmosr-2010-10_paper1_thinking.pdf))

But stigmatization seems to be a special category of perceived risk, where the nature of the risk itself seems to be “abnormal” or “unnatural” or “excessive.” Thus in such cases some people will react with a similarly excessive response, to the effect that only complete avoidance of what is causing the offense – as opposed to a lessening or mitigation of it – will restore the sense of normality. These themes will be explored more fully in what follows.

My discussion will seek to show that although “stigma” is a very important and useful concept with respect to people – I call this the “strong” version of stigma – it is much less fruitful when it comes to products, places or technologies. This is not to say that many people do not have fundamental and legitimate concerns when it comes to contaminated sites or products or certain types of modern technologies. However, those concerns can be, in my opinion, appropriately addressed within the overall framework for risk-based decision making. This framework is committed to dealing seriously not only with the expert assessment of risk, but also with the risk perceptions of the general public and community groups. In short, as I shall argue, one does not

need to add “stigma” to this mix because there is no evidence that doing so helps people to understand the issues before them or to resolve the differences among them over how to proceed where public policy choices have to be made. Therefore I call this second category the “weak” version of stigma.

There is a sizable academic literature on diverse subjects related to the concept of stigma that will be summarized and discussed in this paper. However, special attention will be paid to the implications of the concept of stigma for the general area of storage and disposal of nuclear waste (both high-level waste and low-and-intermediate-level waste). This paper was commissioned in the context of the environmental assessment now under way for the Deep Geologic Repository (DGR) for Low and Intermediate-Level Waste proposed to be situated at the Bruce Nuclear Site ( <http://www.ceaa.gc.ca/050/details-eng.cfm?evaluation=17520> ) within the municipality of Kincardine, Ontario. Here the discussion will be informed by what has been happening at similar sites, some planned, some operating or under construction, in the United States, Canada, Sweden, and Finland.

### *Stigma: Persons.*

As the strong version of this concept, stigma attached to persons is undoubtedly a very old and deeply-rooted phenomenon in human societies, one that persists into our own period:

As used today, the word denotes someone “marked” as deviant, flawed, limited, spoiled, or generally undesirable in the view of some observer. When the stigmatizing characteristic is observed, the person is denigrated or avoided. Prime targets for stigmatization are members of minority groups, the aged, homosexuals, drug addicts, alcoholics, and persons afflicted with physical deformities or mental disabilities. (Slovic et al. [2001], p. 91)

Missing from this list are other important categories such as foreigners, aboriginal peoples, racial, ethnic or religious minorities, or even entire very large racial or ethnic groupings. Stigmatization is a primitive way of arousing and reinforcing social bonds among a dominant majority in a population by calling attention to a minority group for disapproval or persecution. In modern times the paradigm case of this phenomenon is of course Nazi Germany, which not only singled out minority groups (Jews, homosexuals, Roma, the mentally ill) as objects of

hatred, persecution and extermination, but also entire so-called races, notably the Slavic peoples. Forcing Jews to wear the “Star of David” on their outer clothing is the most obvious example of “marking.” But it would also be uncharitable not to mention, as any visitor today to Berlin and other German cities could not avoid noticing, the huge, permanent public memorial sites which call attention to these atrocities, confronting the evil legacy of stigmatization in the hope that these reminders can help to prevent a recurrence of them.

Within living memory our own country has faced such challenges in a less virulent form. From the once-pervasive anti-semitism, now mostly gone, to widespread prejudices against gays and lesbians, Muslims, Canadian aboriginal peoples, blacks, and others, Canada has experienced among its dominant majority populations a long series of challenges to the countervailing growth of enlightened public attitudes and values based on tolerance of differences. In my opinion the adoption of the Charter of Rights and Freedoms was a major step forward, in that protection of basic human rights for all persons received the support of law. Social changes of this type sometimes seem to have a “snowballing” effect, accumulating strength as time passes. Thus all evidence indicates that the current generation of younger persons in Canada is the most tolerant, and the most protective of minority rights, in our history. But eternal vigilance is the price of liberty, as the saying goes.

### *Stigma: Places, Products and Technologies.*

Here we shift from “people” as potentially bearers of stigma to the broad category of “places, products and technologies” as possibly being marked by stigma. Such a shift immediately raises questions about whether the concept of stigma can be stretched this far while retaining any of its usefulness as a descriptor of social behavior. What are the essential elements in this shift?

Stigmatized places, products and technologies tend to share several features. The source of stigma is a hazard with characteristics, such as dread consequences and involuntary exposure, that typically contribute to high perceptions of risk. Its impacts are perceived to be inequitably distributed across groups ... or geographical areas.... Often the impacts are unbounded, in the sense that their magnitude or persistence over time is not well known. A critical aspect of stigma is that a standard of what is right and natural has been violated or overturned.... (Gregory, Flynn & Slovic [2001], p.4)

In the following brief discussion I shall separate *products and technologies* on the one hand from *places* on the other, suggesting that stigma applied to places has some limited explanatory power, whereas this is not the case with products and technologies.

To take products first, some prominent examples frequently cited in the literature are the Tylenol episode in 1982 and the “Alar and apples” one from 1989. Tylenol is a case of poisoning of customers through deliberate tampering with the product container, an event that imposed large costs on its maker, Johnson & Johnson. Alar was a pesticide once used on apple crops; as a result of a CBS *60 Minutes* segment, which said that Alar was known to be a carcinogen, apple sales plummeted and apple growers lost significant sums of revenue. So far as technologies are concerned, leading examples are biotechnology (including genetic engineering of animals and plants), nuclear energy, chemicals generally, and, more recently, electromagnetic radiation as a result of widespread use of cellular telephone technologies. (In terms of chemicals, there are separate structures of perceived risk associated with chemical-industry plants, on the one hand, and consumer products incorporated advanced chemistry, on the other.)

All of the instances cited above revolve around strong public perception of risk, in some (but not all) of which such perceptions differ from the risk estimations of experts. But in all cases good explanations can be offered for what the public believes or happened to believe at specific times and places. First, in the case of products, the examples of public avoidance cited (Tylenol and apples), as well as others, are usually event-driven phenomena that last for relatively short periods of time, after which the sales of products rebound. The risks as perceived in the cases of Tylenol or Alar were not irrational or trivial – but they were most certainly temporary or fleeting. One would be hard-pressed today to encounter anyone whose attitudes toward either of those products were influenced by those long-past episodes.

On the other hand, risks associated in the public mind with the technologies mentioned tend to reflect longer-lasting structures of belief, which form and change more slowly. At some level they can appear to be unreasonable, but, I would argue, again, they are not in most cases irrational – in other words, the perceived risks can be explained. For example, biotechnology can seem to reflect a human capacity to manipulate life, which makes some people uneasy.

Nuclear energy has strong associations with nuclear war for some. And so far as chemicals are concerned, some explanation can be found in the fact that the most frequent references in media reporting are to toxic chemicals, that is, specific compounds that can have life-threatening properties.

Yet the plain fact of the matter is that, in Canada and all other developed societies, the majority of people live comfortably in close proximity to these and other technologies. Products from the chemical and biotechnological industries are everywhere in the consumer marketplace. For a long time, in three provinces, we have depended on electrical energy from nuclear generating stations; we would see this technology in more of our provinces, I am convinced, if cost-effective alternatives (coal, hydro) were to be less readily available.

To be sure, nuclear energy may be a special case, one where industrial accidents with a very high global profile (Three Mile Island, Chernobyl, and Fukushima) legitimately have made a strong impression on public attitudes. Human error at the plant level, in terms of radical deficiencies in both advance planning and daily operations, played a leading role in all of them, and some of those errors, especially at Chernobyl and Fukushima, are literally inexcusable. It is most decidedly not an irrational response for at least some people to think that such a powerful (if undeniably useful) technology – and the long-lasting hazardous wastes that it generates – is simply too dangerous to be left in human hands. But is *stigma* – that is, as defined above, a belief that these are cases marked by “abnormal” or “unnatural” or “excessive” risk – involved here? Perhaps for some people, of course, and if those individuals do frame their belief about the technology in these terms, it is undeniably their right to do so.

I will return to the subject of stigma and nuclear technology again later on. Here I want to note an important distinction among the list of technologies that have been mentioned. Two of them (chemicals and nuclear) have strong associations with *places*, that is, sites where industrial facilities, including waste-disposal facilities, are located; the other two, biotechnology and cellular telephones, generally do not. So this would be a good point at which to take a first look at the idea of stigmatized places.

### *Places and Environmental Stigma.*

In a way the emphasis on places or sites returns us to where we started, that is, with people. For unlike products or technologies, sites are places where people have an intense, ongoing, daily involvement with their local environment and community, an engagement which may persist over an entire lifetime or even across multiple generations. This is why we must discuss places separately and in greater detail in any consideration of stigma.

... [A] place is “stigmatized” if the following three conditions are met: (a) a large number of people feel an imperative to avoid the place, (b) this imperative stems from the fact that there is “something wrong” with the place, and (c) the sense of “something wrong” is represented by some sort of mark.... [T]he sense of “something wrong” can stem from many distinct perceptions: dangerous, contaminated, unpleasant, sick, immoral, unnatural, inferior. Environmental contamination and health risks are common sources of stigmatization, but many other sorts of events can stimulate this phenomenon.... Stigmatization also tends to confer negative traits ... on the local residents.... Looking within a stigmatized community, it is not uncommon to find residents feeling victimized by forces beyond their control, leading to a pervasive sense of helplessness. (Easterling [2001], pp. 134-5)

The classic case often referred to in academic literature is what happened in the little city of Goiania, Brazil in 1987. Scrap dealers there had broken open a discarded medical device containing radioactive material which gave off a bluish hue and which was then distributed throughout a community as an entertainment. People were sickened and some died; when the news got out, all over Brazil, visits to the city abruptly ceased, residents were denied access to transportation out of Goiania, and the region’s agricultural produce was shunned.

Some fifteen years ago, when social science researchers were focusing on “stigmatization of place,” a favorite subject was the state of Nevada’s determined struggle – including the filing of lawsuits – to prevent the U. S. government from certifying Yucca Mountain as the central repository for permanent disposal of that country’s high-level nuclear waste (which includes military as well as civilian waste). The state authorities were convinced that siting the repository some 80 miles from Las Vegas would damage or destroy the state’s lucrative tourism industry. Some researchers undertook detailed studies of public values and attitudes, finding (unsurprisingly, in my view, given the “charged” atmosphere of public discussion) that the majority of Nevada residents held strongly negative views about living in proximity to a nuclear

waste storage site. Four separate studies on this theme, included in the stigma book edited by Flynn, Slovic & Kunreuther (2001), pp. 87-171, review not just the case of Yucca Mountain but also a nuclear weapons plant at Rocky Flats, near Denver. One of those studies predicted (p. 105) that “the already strong political opposition to the [Yucca Mountain] site can be expected to intensify, making it extremely difficult for the federal government to proceed with the project.” That prediction has been perfectly validated in the years that followed; at present, the Obama administration’s moratorium on further characterization of the Yucca Mountain proposed site remains in force.

But both those studies, as well as the state of Nevada’s determined political and legal opposition, were based on what might be called *anticipated future stigma*, that is, *a risk of the stigmatization of place that might occur sometime later*, if and when the repository was ever constructed at the designated site and no countervailing forces had emerged in the interim.

Since a nuclear waste repository is a subset of the larger category of hazardous-waste disposal facilities, the widespread public opposition to the siting of such facilities, which had emerged in North America in the last part of the twentieth century, certainly provides relevant background for the nuclear case. In Canada such opposition, for example, derailed a major proposal by the Ontario Waste Management Corporation for a new hazardous waste facility to be located in the township of West Lincoln in southwestern Ontario <http://www.oen.ca/dir/detail.php?id=263>

Although these are complex issues, the public reaction did have a solid basis in “rational” thought processes, including the following factors: (1) the intrinsic problem with any such siting, namely, the excess risk faced by a local subset of the general population, whereas the entire population would be the beneficiaries of the facility; (2) a strong resentment of the loss of control by the local community, since in the past such facilities had often been imposed on them by higher authorities; (3) a growing feeling of lack of trust in the promises about the future (“don’t worry, everything will be fine”) routinely made by politicians and project proponents, who were usually nowhere to be found if and when later problems emerged.

Then, in Canada at least, came the Swan Hills Treatment Centre <http://www.shtc.ca/> in Swan Hills, Alberta, the only new hazardous-waste facility to be started in North America (to the best of my

knowledge) in many decades. Opened in 1987 after 15 years of planning, with the explicit initial support of 80% of the local community, as of now it has been operating successfully for more than a quarter-century. Since then a new trend has emerged, at least in some parts of Western Europe and North America, a trend which seems to be in the process of “changing the game” for hazardous-waste-facility siting. It has an exceedingly simple core concept: namely, “willing host community.”

The working model for the concept of willing host community provides, among other things, a specific set of responses to the earlier bases of community dissatisfaction with such facilities, as described just above:

1. Although the presence of any such facility represents some measure of excess risk in comparison with its absence, project proponents have an interest in providing the host community with a great deal of information about the facility risk assessment, as well as means for securing independent, third-party validation of the risk estimates, as a way of making the case that the facility’s engineering design and operating protocols represent an acceptable level of risk for the community.
2. A community’s right to withdraw its initial willingness to participate extends well into the first series of steps in the facility planning process, up to the point where a “go/no go” decision is required.
3. Permanent community liaison procedures, including performance oversight, are built into the formal agreements that are drawn up once a decision to proceed has been made.

In Part 3 of this paper I will present briefly the case studies of four ongoing projects for nuclear-waste disposal facilities, all of which incorporate a commitment to the idea of a willing host community for the facility: Olkiluoto in Finland; Oskarshamn and Östhammar in Sweden; WIPP in Carlsbad, New Mexico; and the NWMO process in Canada.

In Part 4, where some conclusions are presented, I raise the possibility of predicting a very different type of ultimate outcome than the one that was made some time ago with respect to the prospects for the Yucca Mountain site. The new prediction is this: The accumulating experience in Europe and North America with major project sitings based on the idea of willing host communities will result in a larger number of candidate communities for each of the future projects of this type. This positive evaluation will be based on a clear understanding that risks can be controlled within acceptable parameters and that strong, long-term benefits accrue to the host community. In other words, for this type of project at least, *stigma* may be replaced with *cachet*, the latter term defined as “an indication of approval carrying prestige.”

## **Part 2: Recent Research on Stigma, with special reference to Stigmatization of Place**

Two recent reports sponsored by the OECD (Organization for Economic Cooperation and Development), of which Canada is a longstanding member, summarize much of what has been learned over the past decade, around the world, about siting radioactive waste facilities in willing host communities. They are relatively short and written in plain English, and are publicly available and can be downloaded from the Internet by anyone.

The first was prepared for OECD by Hank C. Jenkins-Smith, University of Oklahoma, and is entitled “Clarity, conflict and pragmatism: Challenges in defining a ‘willing host community’” (21 pages, 2011: <http://www.oecd-nea.org/rwm/docs/2012/rwm-r2012-4.pdf> Jenkins provides a first-rate discussion of basic issues, such as how a “community” is defined and how it exercises its rights in the context of a proposed siting decision. He also has a valuable emphasis on the process of decision-making, which can be expected to evolve over quite a long period of time – as, for example, the developments in Finland and Sweden illustrate well – in matters such as siting of nuclear waste repositories. He proposes that

...[D]ecisions be taken through iterative stages, providing members of the host community (as well as the siting authority) the flexibility to understand and adapt to

contextual changes. This stepwise approach is intended to provide sufficient time for development of a competent and fair discourse with members of the host community and other stakeholders. The sequential decision stages also allow for programmatic and design adaptation to new learning over time. Overall the iterative, staged and interactive process is intended to result in a community that is prepared to express an informed, reasoned and competent response.

The second document is *Reflections on siting approaches for radioactive waste facilities: Synthesizing principles based on international learning* (35 pages, 2012:

<http://www.oecd-nea.org/rwm/docs/2012/rwm-r2012-5.pdf> ). This document lists a number of fundamental objectives for any good siting process:

- “To increase familiarity and control by potential stakeholders.
- To enhance and maintain trust and confidence among the institutional actors and other stakeholders.
- To establish legitimacy and sustainability of the decision(s).
- To promote “ownership” of the policy and of current and future siting decisions, both now and in the future.”

The reader may also wish to consult a short paper of mine, “How might communities organize their discussions about hosting a site for used nuclear fuel?” which is available on the Internet:

[http://www.nwmo.ca/uploads\\_managed/MediaFiles/1671\\_nwmosr-2010-11\\_paper2\\_howmight.pdf](http://www.nwmo.ca/uploads_managed/MediaFiles/1671_nwmosr-2010-11_paper2_howmight.pdf)

In Part 2 I have sought to summarize the results of relevant studies on stigmatization of place that have been published during the preceding five years, plus a selected few from earlier years; there are many other older studies, listed in Part 5 (References), that are not discussed here, although some other published studies are presented in the case-study discussions in Part 3. The dozen or so studies to be referred to here may be grouped under three headings:

- A. Community Dynamics
- B. Risk Perceptions and Public Concerns
- C. Property and Asset Values / Loss Aversion

#### A. Community Dynamics.

**R. S. Gregory & T. A. Satterfield (2002), “Beyond perception: The experience of risk and stigma in community contexts”:**

The authors write: “Stigma involves in part the experience of how one is seen by outsiders and the way the signaling of risk events exacerbates the psychological experience of an ecological or technological risk. The media is often a decisive factor in this amplification (signaling) of risks and the construction of stigma effects.... When the mental and physical experience of place undergoes a rapid and negative change, not only the economic welfare of residents but also their sense of self and well-being can suffer.” This is an older article but it is very well written and has important methodological advances in the study of stigmatization of place. It focuses on resource-based communities, such as ones dependent on logging, and possible adverse effects related to how outsiders might perceive the community when negative events occur (such as criticism of clear-cutting in logging operations). But the article does not show that there are any lasting consequences to these episodic controversies, which always die down after a certain period of time.

**T. Seppälä (2008), “Does nuclear waste stigmatise a municipality selected for final disposal? Experiences and results six years after site selection in Finland”:**

The site selection process for a permanent high-level nuclear waste repository in Finland got under way as far back as 1983. In 1999, after detailed site investigations in four locations, Posiva Oy [the organization designated to manage the facility] recommended that the municipality of Eurajoki be selected as the site for final disposal. “One of the arguments for selecting Eurajoki was the willingness of the municipality to host the final repository.” Between 1998 and 2006, when two separate surveys were conducted, “there have been positive changes in the image of Eurajoki. The residents of Eurajoki appreciate the development of the municipality and consider it as a good place to live. Consumers and representatives of businesses also see Eurajoki as a more dynamic municipality than eight years ago. The influence of final disposal on the attraction of the municipality is now estimated more favourably than before the decision on the site was made. In

comparison with the results of the 1998 study, the residents now considered Eurajoki to be clearly more attractive both to tourists and as a place of residence.”

**J. B. Chung & H.-K. Kim (2009), “Competition, economic benefits, trust, and risk perception in siting a potentially hazardous facility”:**

The Korean government has been seeking a site for a permanent nuclear waste disposal facility since the 1980s, against strong opposition from community groups and environmentalists. In 2005, after a series of local referendums, Gyeongju city was selected, because in their referendum residents of Gyeongju had voted 90% in favour of the facility. The authors comment: “This study showed that while risk perceptions had strong negative effects on local acceptance, the most important factor in the model was not risk perceptions but perceived economic benefits. In addition, the factors of competition and trust were also important factors. This result can be interpreted as demonstrating that local residents in Gyeongju city accepted a potentially hazardous facility because of its potential economic benefits and in spite of the risks posed by the facility. In other words, they felt the risk was not severe enough to reject the benefits that the site might yield.”

**M. R. Greenberg (2009), “NIMBY, CLAMP, and the Location of New Nuclear-Related Facilities: U.S. National and 11 Site-Specific Surveys”:**

“Public and political opposition have made finding locations for new nuclear power plants, waste management, and nuclear research and development facilities a challenge for the U.S. government and the nuclear industry. U.S. government-owned properties that already have nuclear-related activities and commercial nuclear power generating stations are logical locations. Several studies and utility applications to the Nuclear Regulatory Commission suggest that concentrating locations at major plants (CLAMP) has become an implicit siting policy. We surveyed 2,101 people who lived within 50 miles of 11 existing major nuclear sites and 600 who lived elsewhere in the United States. Thirty-four percent favored CLAMP for new nuclear power plants, 52% for waste management facilities, and 50% for new nuclear laboratories. College educated, relatively affluent

male whites were the strongest CLAMP supporters. They disproportionately trusted those responsible for the facilities and were not worried about existing nuclear facilities or other local environmental issues.”

**C. R. Colocousis (2012), “It Was Tourism Repellent, That’s What We Were Spraying”: Natural Amenities, Environmental Stigma, and Redevelopment in a Postindustrial Mill Town”:**

The author writes: “Many rural communities across North America are at a crucial point of transition. Traditional livelihoods in natural resource-based industries have been eroded by a combination of factors involving technological change, global competition, and energy costs. Ideas about redevelopment often hinge on the potential of places to attract tourists or in-migrants....” However, “a complex place stigma, rooted in a history of environmental degradation, presents challenges for economic reinvention and currently constrains the community’s options for the future given that tourism is largely viewed as a desirable development strategy there.” This is an excellent, in-depth study of a single New Hampshire town that had had a pulp and paper mill for over a hundred years before it closed permanently. The study shows that towns in this and similar circumstances can face severe challenges in terms of trying to re-invent their communities for the future.

*Review and Short Commentary:*

The Finland and South Korean studies in this group confirm the growing confidence around the world in the willing-host-community approach to siting hazardous waste facilities, certainly in the nuclear area. In the U. S., which has had so much political trouble over its early choice of Yucca Mountain as a preferred site, a long, slow rethinking is under way; the study presented here adds to the strength of the view that communities that are familiar with other aspects of the nuclear industry are likely to provide a welcome audience for proposals for waste facility siting as well. The Gregory and Colocousis papers, on the other hand, deal with resource-based communities where primary industries are in decline, and no other industrial facilities of a newer type are on offer as a replacement; these are cases that present unique challenges of their own.

**B. Risk Perceptions and Public Concerns.**

**H. C. Jenkins-Smith & C. L. Silva (1998), “The role of risk perception and technical information in scientific debates over nuclear waste storage”:**

Although this paper was published 15 years ago, it is still a valuable contribution, given its substantial, in-depth analysis of one of the key issues in all nuclear waste facility siting developments: namely, the kind of credibility and salience that scientific information, especially risk analysis, has in the mind of the affected public. It also remains relevant because the case-study opinion survey it presents was based in New Mexico and refers to WIPP, which is, of course, still a very relevant facility today in terms of the future of nuclear waste disposal in the U. S. The authors conclude: “Among the more important findings are: (1) members of the public are able to make quite reasonable estimates about what kinds of positions on the risks of nuclear waste disposal will be taken by scientists from differing organizations...; (2) in assessing the credibility of scientific claims, members of the public place great emphasis on the independence of the scientists from those who fund the research; and (3) prior expectations about the positions (or expected biases) of scientists from different organizations substantially affects the ways in which members of the public weigh (and utilize) information that comes from these scientists.”

**J. Baxter & D. Lee (2004), “Understanding expressed low concern and latent concern near a hazardous waste treatment facility”:**

Although this is an older study, it is included here because the subject is a Canadian case, namely, the Swan Hills, Alberta facility. “This case study is an example of a community with apparently pervasive low concern. Swan Hills has lived with a hazardous waste treatment facility for over 13 years, and despite two accidents at the site, one leading to considerable PCB contamination and two large health studies, locals seem to agree that the facility represents minimal risk and is not worth worrying about.... Regardless of the level of danger posed by the facility, the study reveals that the low level of concern in the community can survive numerous insults and remain intact. Even in the face of potentially dangerous facility-related events like the 1996 leak, the residents have remained relatively unswervingly, unconcerned. Yet, as long as the community’s attention is focused on outsider perceived to be threatening the SHTC and the

community, complacency and distrust of negative information about facility hazards will likely remain an issue.”

**P. Hocke & O. Renn (2009), “Concerned public and the paralysis of decision-making: nuclear waste management policy in Germany”:**

Germany is one of a number of countries where the inception of a site selection process for a permanent nuclear waste repository goes back many decades (the 1970s in this case) and is still far from being completed. This article, written in 2008, summarizes the state of the controversy until then. In fact, it closely mimics what has happened in the USA, where an early decision was taken for a single site without considering other options (in Germany’s case, the salt domes at Gorleben). The authors write: “However, public opposition and maneuvering by the major political actors prevented the completion of the site selection process, resulting in decades of political paralysis. The main reasons for this failure were the polarization in advocates and opponents of nuclear energy, the neglect for due process and participatory procedures, the inability to integrate technical, political, and social rationales in designing a viable nuclear waste policy, and the confusing mix of responsibilities between and among political actors.” For an update on the German situation to 2013, see Part 3 below.

**B.-M. Drottz-Sjöberg (2010), “Perceptions of nuclear wastes across extreme time perspectives”:**

This is a unique study in that it is a survey conducted in the two Swedish municipalities that have already been selected for the nuclear waste repository process (see Part 3 below), and also in that it is focused on very long time horizons. “Citizens of the Oskarshamn and Östhammar municipalities (N=1,501) responded to a postal questionnaire regarding their participation in site-specific investigations for the building of the Swedish repository.... The importance of future generations’ life situations was reported as high, and perceived to be of greater importance to oneself than to others. The construction of a safe final repository for spent nuclear fuel ranked the highest on a list of topics when respondents indicated the responsibilities of current generations.”

**R. Seidl et al. (2013), “Perceived risks and benefits of nuclear waste repositories: Four opinion clusters”:**

This is the newest of many articles in the literature on citizens’ views of nuclear waste repositories. “In general,” the authors write, “risk and benefit perception is seen as most essential for the acceptance of contested infrastructure, and affective response to the topic at hand influences both benefit and risk perception.... Furthermore, trust and confidence have been found to provide considerable explanatory power concerning the acceptance of repositories for nuclear waste: the higher both general trust and trust in institutions, the lower the perception of risk, especially of technological risk.” This article looked at a neglected segment of the public, namely, those who express ambivalent, rather than strongly positive or negative, attitudes. “We conclude that a closer look at the often neglected but considerable number of people with ambivalent or indifferent opinions is necessary. Although the extreme factions of the public will most probably not change their opinion, we do not yet know how the opinion of the ambivalent and indifferent clusters might develop over time.”

*Review and Short Summary.*

Two of these articles offer valuable insights into the ongoing controversies about nuclear waste disposal in two important countries, the United States and Germany, which have not yet, after many decades of trying, found their way to a robust siting process. A third piece provides additional information about an important case in Canada, namely the Swan Hills Treatment Centre in Alberta, which is one of the first successful cases in the entire world of longstanding support by a willing host community for a hazardous waste facility. The other two, concerning perception of risk about nuclear waste facilities in Sweden and the United States, provide some recent evidence on a theme that has been much studied in the academic literature for a long time.

C. Property and Asset Values / Loss Aversion.

**J. J. McCluskey & G. C. Rausser (1999), “Stigmatized asset value: Is it temporary or long-term?”:**

This article is based on a case study of the impact of the discovery and cleanup operation of a hazardous waste site. The authors write: “Stigma is a loss in property value beyond the cleanup cost of the [environmental] contamination. There are two externality effects that cause stigma. The first is an environmental externality on the properties adjacent to a hazardous waste site: the contamination causes neighboring property owners to be concerned about health issues. The second is a neighborhood externality: the association with a hazardous waste site can affect the composition of residents in the neighborhood and other attributes that determine neighborhood quality and property values.” The study finds that long-term stigma resulting in reduced property values is a function of proximity to the site involved, with neighborhoods within about 1 mile being permanently affected.

**R. S. Wilson, J. L. Arvai & H. R. Arkes (2008), “My loss is your loss... sometimes: Loss aversion and the effect of motivational biases”:**

Loss aversion is a social-science term referring to the finding that people are more concerned with monetary losses than with gains (and thus more highly motivated to protect themselves against losses than to achieve gains). This is a technical paper which tries to apply loss-aversion theory to what they call “protected values”: “In other words, subjects seem to be insensitive to the type of consequence (i.e., some level of gain or loss) but are sensitive to the fact that a critically important, protected value—such as job security or environmental health—is changing.” Their general conclusion is that “those in decision-making authority should work to incorporate the affected parties into the decision-making process in order to better understand both their attitudes and beliefs, as well as to create the transparency necessary for shared values to be identified and trust and confidence to be built both in the individual and in the decision-making process.” This reinforces what many other studies in this area have recommended.

**J. B. Braden, X. Feng & D. Won (2011), “Waste Sites and Property Values: A Meta-Analysis”:**

“This paper presents a meta-analysis of the literature on North American waste sites issued between 1971 and 2008 measuring the economic impact of waste sites on real

estate values.,,, The estimation results ... suggest that all classes of waste sites affect real estate prices, but sites classified as hazardous, especially aquatic hazardous sites, are associated with the greatest discounts. The estimated impacts of nonhazardous waste and nuclear sites are not statistically different from one another.”

### Review and Short Commentary.

These three studies, like all others in the same area of economics research, use complex methodologies that will be difficult for the general reader to grasp. In addition, the conclusions may be challenged; for example, some later studies take issue with the McCluskey and Rausser finding that relates depressed property values to distance from a contaminated site. So far as the Braden et al. paper is concerned, however, this analysis covers a large sample of actual sites and its conclusions appear to be robust. One possible explanation is that, in the past, citizens have encountered contamination problems with hazardous waste sites for the simple reason that many of these site were very poorly engineered in the first place, making serious problems almost inevitable. Their findings put nuclear sites in a separate category, and the reason may be that much stricter regulations in this area means that these sites are and will be engineered, in countries such as Canada and those in Northern Europe, to a very high level of environmental protection.

## **Part 3: Five Country Case Studies**

### *Introduction.*

In this section there are short summaries of the history and current situation with respect to the siting of permanent high-level nuclear waste facilities in five countries: Canada, Finland, Germany, Sweden, and the United States. Four are in advanced stages of development, and one (Germany) is just now, as of Summer 2013, getting a fresh start under way, after many years of controversy and lack of progress. The other four are all proceeding in accordance with the idea of a willing host community.

#### *1. Canada:*

Canada achieved a new beginning in its search for a high-level nuclear waste repository in 2002, when federal legislation created the Nuclear Waste Management Organization (NWMO) as an arm's-length body charged with fulfilling this task. After an intensive period of analysis, study reports, receipt of submissions, documentation, and consultation with many stakeholders across the country, NWMO announced its goals, processes and objectives in November 2005 in a document entitled *Choosing a Way Forward* ( <http://www.nwmo.ca/studyreport> Summary: [http://www.nwmo.ca/uploads\\_managed/MediaFiles/342\\_NWMO\\_Final\\_Study\\_Summary\\_E.pdf](http://www.nwmo.ca/uploads_managed/MediaFiles/342_NWMO_Final_Study_Summary_E.pdf)

In May 2010 NWMO published its plan for a siting process involving the choice of a willing host community:

[http://www.nwmo.ca/uploads\\_managed/MediaFiles/1545\\_processforselectingasiteforcan.pdf](http://www.nwmo.ca/uploads_managed/MediaFiles/1545_processforselectingasiteforcan.pdf)

Here one can find a current update on the NWMO activities, including the initial screening phase, involving a list of municipalities that have agreed to take part in the siting process:

[http://www.nwmo.ca/sitingprocess\\_whatsnew](http://www.nwmo.ca/sitingprocess_whatsnew)

Finally, here one can find the websites set up by the Community Liaison Committees of various municipalities in order to communicate with their residents about the site selection process:

[http://www.nwmo.ca/sitingprocess\\_clcwebsites](http://www.nwmo.ca/sitingprocess_clcwebsites)

## 2. *Finland:*

Finland began its site investigation activities in 1986, and after little initial success restarted the process in 1995 under new legislation and a new organization (Posiva Oy) and mandate using much improved communication and community consultation procedures. In the late 1990s, studies by Posiva Oy explicitly raised the question about possible stigmatization of place in connection with a nuclear waste repository. In 1999, Posiva Oy determined that the Eurajoki site (including Olkiluoto Island) was likely to represent a willing host community and asked for a “Decision in Principle” from the government on the siting; the municipality ratified this agreement in 2000 and Parliament ratified it in 2001. Construction of an underground site characterization facility began in 2004. Since that time Posiva Oy has continued to sponsor new studies on the community and the facility. Posiva Oy maintains a substantial and effective

English-language website on this project, including a remarkably well-produced interactive program: <http://www.posiva.fi/en/>

*Germany:*

<http://www.dw.de/bundestag-agrees-on-search-for-nuclear-waste-disposal-site-ends-gorleben-debate-for-now/a-16914720>

, June 28, 2013:

“The Bundestag has agreed to allow a commission of experts to launch a search for a new nuclear waste disposal site. The law ends radioactive transports to the controversial site in Gorleben for the time being. In one of its final decisions before adjourning for summer recess on Friday, Germany's lower house of parliament overwhelmingly agreed to launch a nationwide search for a new, more suitable nuclear waste disposal site. Critics of the current repository in Lower Saxony – Gorleben – have hounded politicians to find a safer location. Under the terms of the measure, the government will commission a group of roughly 30 experts to oversee the search. The panel, comprised of members of parliament, scientists and representatives from various interest groups, must present a list of criteria for the search by 2015. It must convene publicly before approving stipulations for the selection process. A federal office for nuclear waste disposal, slated for opening in 2014, is to oversee the project. German parliamentarians must approve a final repository for nuclear waste by 2031 at the latest.”

*4. Sweden:*

As far back as the 1970s Sweden had made a commitment that siting of any nuclear facilities would be contingent upon local community acceptance. Early geological studies of suitable formations were carried out over the ensuing decades, and in the 1990s the designated organization for the management of nuclear waste, known by the acronym SKB, began inviting communities to express interest in hosting a waste facility. In this process SKB made a major commitment to providing abundant information for public discussion. By 1995 some cities had conducted referendums that resulted in decisive rejection for siting, but at the same time six municipalities had agreed to support feasibility studies for their locations. During the period 2007-2009 the two finalists, Oskarshamn and Östhammar (both of which already hosted nuclear power plants), had concluded formal agreements with SKB. The innovative Swedish solution

had divided the responsibilities between them into a central interim storage facility at Oskarshamn and a deep underground permanent disposal facility at Forsmark in Östhammar.

English-language website: [http://www.skb.se/default\\_\\_\\_\\_24417.aspx](http://www.skb.se/default____24417.aspx)

### *5. The United States:*

The Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, managed by DOE (the U. S. Department of Energy), opened in 1999, twenty years after it was authorized by the U. S. Congress. The location is an extensive underground salt basin in the Chihuahuan Desert; the facility takes transuranic (that is, low-level) radioactive wastes. During the 1990s, DOE had submitted the WIPP application to EPA, which undertook a major program of public outreach and meetings as well as engagement with ENGOS; during this decade, regular public opinion surveys showed a gradually increasing level of local popular support for the facility. Then in 1995, DOE decided to transfer all management responsibility to a local on-site office, which strengthened the support of local residents. A detailed review of the establishment and operation of WIPP can be found in a 2011 paper by J. Holm and available online; on page 7 we read: “In contrast to the Yucca Mountain project, WIPP is widely viewed as the model to follow in order to site and construct a repository. One fundamental difference between WIPP and OCRWM [DOE’s Office of Civilian Radioactive Waste Management] was that Carlsbad, New Mexico was a willing host community that had significant political support locally and nationally. The site had been reviewed and analyzed with the help of the state resource agencies and universities. Western states with facilities with waste destined for WIPP could support the facility in principle and that created a different dynamic than that for Yucca Mountain. The western states have few nuclear utilities, but do have most of the defense waste.” For a copy of the paper go to:

[http://www.skb.se/default\\_\\_\\_\\_24417.aspx](http://www.skb.se/default____24417.aspx)

[http://cybercemetery.unt.edu/archive/brc/20120620222914/http://brc.gov/sites/default/files/documents/final\\_paper\\_stakeholder\\_involvement\\_holm\\_1\\_may\\_2011.pdf](http://cybercemetery.unt.edu/archive/brc/20120620222914/http://brc.gov/sites/default/files/documents/final_paper_stakeholder_involvement_holm_1_may_2011.pdf)

Finally, there are two good general websites for information on WIPP:

<http://www.wipp.energy/gov/> and [http://en.wikipedia.org/wiki/Waste\\_Isolation\\_Pilot\\_Plant](http://en.wikipedia.org/wiki/Waste_Isolation_Pilot_Plant)

*Note: Additional Resource available on the Internet:*

The following paper has extensive analysis of the themes stated in its title, including case studies of the process of siting a nuclear waste repository in Canada, Finland, and Sweden: T. Webler, S. Tuler, and E. Rosa, *Options for Developing Public and Stakeholder Engagement for the Storage and Management of Spent Nuclear Fuel (SNF) and High Level Waste (HLW) in the United States*, a paper commissioned by the U. S. Blue Ribbon Commission on America's Nuclear Future, 2011, 139 pages:

[http://cybercemetery.unt.edu/archive/brc/20120620223108/http://brc.gov/sites/default/files/documents/webler\\_et\\_al\\_pse\\_report16june11.pdf](http://cybercemetery.unt.edu/archive/brc/20120620223108/http://brc.gov/sites/default/files/documents/webler_et_al_pse_report16june11.pdf)

## **Part 4: Conclusions**

As of the turn of the last century, around the year 2000, the most prominent discussions of stigma generally, and of stigmatization of place in particular, were dominated by the case of Yucca Mountain in the United States. The U. S. federal government's top-down choice of Yucca Mountain as the preferred site for a permanent national nuclear-waste repository had been greeted, in the state of Nevada, with determined opposition. Some of the stigma studies of this controversy (such as Easterling 2001 and Slovic et al. 2001) had documented the strong connection, in public opinion, between nuclear waste and a host of extremely negative word-associations, and dire predictions were made by state authorities about the expected demise of the state's lucrative tourism industry should the repository plan proceed. By 2010 the Yucca site had been taken off the table.

Meanwhile, elsewhere in the world, notably in Finland and Sweden, the early stages of careful planning and social initiatives had been completed, directed by the overriding idea that only finding a willing and competent local host community could hold out the promise of successfully siting a high-level nuclear waste repository. These initiatives were concluded successfully in both countries within the past decade, and some other countries, notably Canada, began following in their footsteps. At the same time, in the United States, a similar effort had paid off for the siting of a low-level waste repository in New Mexico.

This new pattern of development, where the willing host community becomes the centerpiece of strategy of protracted and information-rich engagement with potential willing host communities,

which retain the right of opting out during the initial stages of the process, may very well become the “standard model” for nuclear waste repository siting around the world.

## **Part 5: Brief Responses to Questions addressed to me**

### *Question 1:*

To what extent would stigma have to be treated differently with respect to aboriginal relations?

### *Response:*

I will respond by referring to the submission by the Saugeen Ojibway Nation [SON], because of its extensive discussion of stigma. I find the other parts of this submission, dealing in great detail with the risks associated with this project – in relation to what is called SON interests and to the unique legal and constitutional situation of aboriginal peoples – to be well-articulated, well-argued, and based on solid research on the key issues. These sections deserve to be read carefully and responded to fully and seriously, both by the Panel and by the many other interested parties who have made submissions to these hearings.

But I am not persuaded that the stigma discussion adds anything at all, of a substantive nature, to this risk-based discussion. These are my reasons: The risk-based arguments, as well as the positions about the relation between those arguments and the unique legal and constitutional situation of aboriginal peoples, are what I call “objective” discussions: they turn on evidence, including scientific evidence, on reasoning from that evidence to conclusions, and, in general, on rational processes of thought. On the other hand, as I have suggested in my paper, the idea of stigma applied to places is a purely subjective and speculative discussion: it says, in effect, that something bad *might* happen, although there is no way of telling whether or not it will happen (i.e., what the expected probability or likelihood is), or if it does, just how bad the consequences might be (i.e., trivial or serious, short-lived or long-lived). In short, I believe that the concept of stigma adds nothing at all to the serious and objective considerations which must be part of a project review of this type.

However, there is one other key consideration that ought to be an important part of these ongoing discussions. In the documents relating to the Kincardine Peer Review Report, which evaluated the Socio-Economic Environment Technical Support Document [TSD], I find that the following commitment was made by the project proponent: “OPG is prepared to address and monitor stigma effects.” Given the importance attached to the concept of stigma in the SON submission, I feel strongly that SON, as well as other groups which have made interventions at these hearings, should take up this commitment by OPG and make it an important part of the project monitoring program, both in the short and the longer term – and to do so right away.

The reason why this must be done now, or in the near future, is that in order to make the OPG commitment meaningful and useful, one must establish a “stigma baseline” against which future “stigma effects” can be objectively measured. What I mean can be understood from the idea of property-value protection plan (discussed in the TSD, p. 224). Such a plan requires an initial benchmarking, and a method for assessing relative changes in property values, against which future changes can be measured. But this approach can be applied to any type of impact which is thought to be associated with a stigma – for example, prices for agricultural products or revenues from tourism.

So my suggestion is that interested parties immediately approach OPG with a request to discuss and negotiate an operational strategy for monitoring potential stigma effects with respect to the project under discussion. This would involve, among other things:

- Agreement on a set of specific types of impacts that are included in the concept of stigma for this project, including the scope of the geographical region at issue;
- Development of a set of benchmark indicators (i.e., present values, including numerical values) for those types of impacts;
- Development of a methodology for measuring future values for those types of impacts;
- Development of a future response plan by OPG for mitigating the stigma effects, if and when future adverse or negative impacts are detected.

I emphasize again the point that, in order to have any objective value, this operational strategy must be agreed-upon well before the project gets under way; it cannot wait until after either a construction license or an operating license has been granted to the project proponent.

In conclusion, this is to my mind the only way in which the stigma discussion can have any useful outcome.

*Question 2:*

What is the burden of proof to show that a host community is willing?

*Response:*

What are the appropriate indicators for showing the long-term commitment of a proposed host community for a project such as a repository for nuclear waste? (In this context I recommend a close reading of the paper by Jenkins-Smith, “Clarity, conflict and pragmatism: Challenges in defining a ‘willing host community’,” cited and discussed at the beginning of Part 2 in my paper.) Of course, the only good answer is that the appropriate indicators will vary according to both the laws and the contemporary political realities of the region and nation in question. Ultimately, any formal agreement between a project proponent and a willing host community must successfully survive two potential challenges: (1) a purely legal battle in the nation’s courts; and (2) a protracted “political” battle among interest groups, which if it persists over a long period of time in delaying the project, may cause the proponent to withdraw even if it has won any formal legal contest.

Obviously, any intent to base a project proposal on the cooperation of a willing host community gives the project proponent an enormous incentive to “get it right” when it comes to evaluating the breadth and depth of the community’s commitment, both initially and in the long run. One way to create a robust operational strategy for this process is to design at the outset a logical series of stages and types of consent, with later stages based on both an increasing fund of information as well as increasing clarity over the nature and scope of the commitments expected by the proponent from the community. These stages can include financial support to the community, including support for independent studies on project impacts and the “safety case”

for the project, and even possibly, at late stages in the process, financial penalties for reversing course after major preliminary investments have been made by the proponent. This means, in effect, that not just the proponent, but the community as well, has large incentives to “get it right” with respect to gauging the mood of the citizenry, ascertaining the type of consent that is necessary, and monitoring closely any changes in those factors.

To the extent that governments are not direct parties to any formal agreements between a project proponent and a community, governments have both a duty and an interest to establish robust frameworks, including legal frameworks, for any such agreements. They must, for example, look at potential impacts in the wider regions surrounding the host community, including transportation corridors, at the integrity of the financial arrangements being made, and at setting up robust long-term monitoring of the agreements for projects with very long time horizons.

## **Part 6: References**

*Note: The author wishes to thank Patricia Larkin of Ottawa for valuable assistance in locating and compiling the References.*

- Ballard, K.R., & Kuhn, R.G. (1996). Developing and Testing a Facility Location Model for Canadian Nuclear Fuel Waste. *Risk Analysis* 16(6), 821-832.
- Bassett, G. W., Jenkins-Smith, H.C., & Silva, C. (1996). On-Site Storage of High-Level Nuclear Waste: Attitudes and Perceptions of Local Residents.” *Risk Analysis* 16(3), 309-319.
- Baxter, J., & Lee, D. (2004). Understanding expressed low concern and latent concern near a hazardous waste treatment facility. *Journal of Risk Research* 7(7-8), 705-729.
- Baxtera, J. (2006). A case study of intra-community conflict as facility impact. *Journal of Environmental Planning and Management* 49(3), 337-360.
- Bechtel, D. (2007). “Session 6 - The National Environmental Policy Act (NEPA): Is it all that it can be? The case for evaluating stigma effects” (June 1, 2007). *International Symposium on Technology and Society*, Paper 24.  
<http://digitalscholarship.unlv.edu/cgi/viewcontent.cgi?article=1036&context=iste>

- Braden, J.B., Feng, X., & Won, D. (2011). Waste Sites and Property Values: A Meta-Analysis. *Environmental and Resource Economics* 50(2), 175-201.
- Burger, J., Gochfeld, M., Clarke, J., Powers, C.W., & Kosson, D. (2013). An ecological multidisciplinary approach to protecting society, human health, and the environment at nuclear facilities. *Remediation* 23(3), 123-148.
- Chung, J.B., & Kim, H.-K. (2009). Competition, economic benefits, trust, and risk perception in siting a potentially hazardous facility. *Landscape and Urban Planning* 91(1), 8-16.
- Clark, D.E., & Allison, T. (1999). Spent nuclear fuel and residential property values: The influence of proximity, visual cues and public information. *Papers in Regional Science* 78(4), 403-421.
- Clark, D.E., Michelbrink, L., Allison, T., & Metz, W.C. (1997). Nuclear power plants and residential housing prices. *Growth and Change* 28(4), 496-519.
- Colocousis, C. R. (2012). “It Was Tourism Repellent, That’s What We Were Spraying”: Natural Amenities, Environmental Stigma, and Redevelopment in a Postindustrial Mill Town. *Sociological Forum* 27, 756–776.
- Drottz-Sjöberg, B-M. (2010). Perceptions of nuclear wastes across extreme time perspectives. *Risk, Hazards & Crisis in Public Policy* 1(4), 225-247.
- Easterling, D. (1997). The vulnerability of the Nevada visitor economy to a repository at Yucca Mountain *Risk Analysis* 17(5), 635-647.
- Easterling, D. (2001). “Fear and loathing of Las Vegas: Will a nuclear waste repository contaminate the imagery of nearby places?” In: Flynn, Slovic & Kunreuther (eds.), *Risk, Media and Stigma*, pp. 133-156
- Elam, M., & Sundqvist, G. (2009). The Swedish KBS Project: A Last Word in Nuclear Fuel Safety Prepares to Conquer the World? *Journal of Risk Research* 12(7/8), 969-988.
- Fischhoff, B. (2001). “Defining Stigma” (2001). In: Flynn, Slovic & Kunreuther (eds.), *Risk, Media and Stigma*, pp. 361-8.
- Flynn, J., P. Slovic, and H. Kunreuther (eds.) (2001). *Risk, Media and Stigma: Understanding Public Challenges to Modern Science and Technology*. London, Earthscan.
- Gallagher, L., Ferreira, S., & Convery, F. (2008). Host community attitudes towards solid waste landfill infrastructure: Comprehension before compensation. *Journal of Environmental Planning and Management* 51(2), 233-257.

- Garrick, B.J. (1998). Technological stigmatism, risk perception, and truth. *Reliability Engineering and System Safety* 59(1), 41-45.
- Gawande, K., & Jenkins-Smith, H. (2001). Nuclear waste transport and residential property values: Estimating the effects of perceived risks. *Journal of Environmental Economics and Management* 42(2), 207-233.
- Greenberg, M.R. (2009). NIMBY, CLAMP, and the location of new nuclear-related facilities: U.S. national and 11 site-specific surveys. *Risk Analysis* 29(9), 1242-1254.
- Gregory, R., J. Flynn, and P. Slovic (2001). "Technological Stigma." In: Flynn, Slovic & Kunreuther (eds.), *Risk, Media and Stigma*, pp. 3-8.
- Gregory, R.S., & Satterfield, T.A. (2002). Beyond perception: The experience of risk and stigma in community contexts. *Risk Analysis* 22(2), 347-358.
- Hocke, P., & Renn, O. (2009). Concerned public and the paralysis of decision-making: nuclear waste management policy in Germany. *Journal of Risk Research* 12(7-8), 921-940.
- Holm, J. (2011). *Innovative stakeholder involvement processes in department of energy programs: A selective accounting*. Paper commissioned by the Blue Ribbon Commission on America's Nuclear Future.
- Holznagel, B. (1986). Negotiation and Mediation: The Newest Approach to Hazardous Waste Facility Siting. *Boston College Environmental Affairs Law Review* 13(3), Article 2 5-1-1986
- Horlick-Jones, T., Prades, A., & Espluga, J. (2012). Investigating the degree of "stigma" associated with nuclear energy technologies: A cross-cultural examination of the case of fusion power. *Public Understanding of Science* 21(5), 514-533.
- Hunold, C. (2002). Canada's Low-Level Radioactive Waste Disposal Problem: Volunteerism Reconsidered." *Environmental Politics* 11(2), 49-72.
- Jenkins, R.R., Maguire, K.B., & Morgan, C.L. (2004). Host Community Compensation and Municipal Solid Waste Landfills. *Land Economics* 80(4), 513-528.
- Jenkins-Smith, H.C., & Silva, C.L. (1998). The Role of Risk Perception and Technical Information in Scientific Debates Over Nuclear Waste Storage. *Reliability Engineering and System Safety* 59(1), 107-122.
- Jenkins-Smith, H.C., Silva, C.L., Herron, K.G., & Rechar, R.P. (2011a). Enhancing acceptability and credibility of repository development for spent nuclear fuel. *13th International High-Level Radioactive Waste Management Conference 2011, IHLRWMC 2011* 1, 166-173.

- Jenkins-Smith, H.C., Silva, C.L., Nowlin, M.C., & deLozier, G. (2011b). Reversing Nuclear Opposition: Evolving Public Acceptance of a Permanent Nuclear Waste Disposal Facility. *Risk Analysis* 31(4), 629-644.
- Juhani, V. (2006). Winning Citizen Trust: The Siting of a Nuclear Waste Facility in Eurajoki, Finland. *Innovations: Technology, Governance, Globalization* 1(4), 67-82
- Kasperson, R.E., Jhaveri, N.J., & Kasperson, J.X. (2001). Stigma and the Social Amplification of Risk: Toward a Framework for Analysis. In J. Flynn, P. Slovic, & H. Kunreuther (Eds.), *Risk, Media, and Stigma: Understanding Public Challenges to Modern Science and Technology* (9-27). London: Earthscan.
- Kasperson, R. E., Renn, O., Slovic, P., Brown, H.S., Emel, J., Goble, R.L., Kasperson, J.X., & Ratick, S. (1988). The Social Amplification of Risk: A Conceptual Framework. *Risk Analysis* 8(2), 177-187.
- Kearney, R. C., & Smith, A.A. (1994). The Low-Level Radioactive Waste Siting Process in Connecticut: Anatomy of a Failure. *Policy Studies Journal*, 22(4), 617–630.
- Kiel, K., & McClain, K.T. (1996). House price recovery and stigma after a failed siting. *Applied Economics* 28(11), 1351-1358.
- Kim, S., & Cho, S. (2009). Is distinction impossible? Comparing risks between radioactive waste facilities and nuclear power stations. *International Review of Public Administration* 14(1), 67-85.
- Kojo, M., Kari, M., & Litmanen, T. (2012). Nuclear community considering threats and benefits of final disposal. Local opinions regarding the spent nuclear fuel repository in Finland. *International Journal of Environmental Technology and Management* 15(2), pp. 124-145
- Kuhn, R.G. (1998). Social and Political Issues in Siting a Nuclear-Fuel Waste Disposal Facility in Ontario, Canada. *The Canadian Geographer* 42(1), 14-28.
- Kunreuther, H, & Easterling, D. (1998). The role of compensation in siting hazardous facilities. *Journal of Policy Analysis and Management* 15(4), 601-622.
- Kunreuther, H., Fitzgerald, K., & Aarts, T.D. (1993). Siting Noxious Facilities: A Test of the Facility Siting Credo. *Risk Analysis* 13(3), 301-318.
- Kunreuther, H. and P. Slovic (2001). “Coping with Stigma: Challenges and Opportunities.” In: Flynn, Slovic & Kunreuther (eds.), *Risk, Media and Stigma*, pp. 331-352.
- Leiss, W. (2001). “Dioxins, or Chemical Stigmata.” In: Flynn, Slovic & Kunreuther (eds.), *Risk, Media and Stigma*, pp. 257-268.
- Lidskog, R., & Litmanen, T. (1997). The Social Shaping of Radwaste Management: The Cases of Sweden and Finland. *Current Sociology* 45(3), 59-79.

- Litmanen, T. (1996). Environmental Conflict as a Social Construction: Nuclear Waste Conflict in Finland. *Society and Natural Resources* 9(5), 523-535.
- Litmanen, T. (1999). Cultural approach to the perception of risk: analysing concern about the siting of a high-level nuclear waste facility in Finland. *Waste Management Research* 17(3), 212-219.
- Litmanen, T. (2008). The Changing Role and Contribution of Social Science to Nuclear Waste Management in Finland. *Energy and Environment* 19(3/4), 427-453.
- Macfarlane, A. (2006). "Is it Possible to Solve the Nuclear Waste Problem? Innovations Case Discussion: Siting of Eurajoki Nuclear Waste Facility." *Innovations Technology, Governance, Globalization* 1(4), 83-92.
- Llurdés, J. C., Sauri, D., & Cerdan, R. (2003). Ten years wasted: the failure of siting waste facilities in central Catalonia, Spain. *Land Use Policy* 20(4), 335-342.
- Marshall, A. (2005). The Social and Ethical Aspects of Nuclear Waste, *Electronic Green Journal* 1(21) <http://escholarship.org/uc/item/2hx8b0fp>
- McCluskey, J.J., & Rausser, G.C. (2003). Stigmatized asset value: Is it temporary or long-term? *Review of Economics and Statistics* 85(2), 276-285.
- Metz, W.C., & Clark, D.E. (1997). The effect of decisions about spent nuclear fuel storage on residential property values. *Risk Analysis* 17(5), 571-582.
- Metz, W.C., & Erikson, K. (1994). Potential negative impacts of nuclear activities on local economies: Rethinking the issue. *Risk Analysis* 14(5), 763-770.
- Parkins, J.R., & Haluza-Delay, R. (2011). *Social and Ethical Considerations of Nuclear Power Development*, Rural Economy Staff Paper #11-01, University of Alberta. Available at <http://ageconsearch.umn.edu/bitstream/103237/2/StaffPaper11-01.pdf>
- Peters, E.M., Burraston, B., & Mertz, C.K. (2004). An emotion-based model of risk perception and stigma susceptibility: Cognitive appraisals of emotion, affective reactivity, worldviews, and risk perceptions in the generation of technological stigma. *Risk Analysis* 24(5), 1349-1367.
- Price, J.R. (1988). The impact of waste facilities on real estate values. *Waste Management and Research* 6(4), 393-400.
- Rogers, G.O. (1998). Siting potentially hazardous facilities: What factors impact perceived and acceptable risk? *Landscape and Urban Planning* 39(4), 265-281.

- Seidl, R., Moser, C., Stauffacher, M., & Krütli, P. (2013). Perceived risk and benefit of nuclear waste repositories: Four opinion clusters. *Risk Analysis* 33(6), 1038-1048.
- Seppala, T. (2008). Does nuclear waste stigmatise a municipality selected for final disposal? - experiences and results six years after site selection in Finland. *American Nuclear Society - 12th International High-Level Radioactive Waste Management Conference 2*, 704-708.
- Sjöberg, L. (2003a). Attitudes and Risk Perceptions of Stakeholders in a Nuclear Waste Siting Issue. *Risk Analysis* 23(4), 739-749.
- Sjöberg, L. (2003b). The Different Dynamics of Personal and General Risk. *Risk Management* 5, 19-34
- Sjöberg, L. (2003c). Risk Perception, Emotion and Policy: The case of Nuclear Technology. *European Review* 11(1), 109-128.
- Sjöberg, L., & Drottz-Sjöberg, B-M. (2001). Fairness, risk and risk tolerance in the siting of a nuclear waste repository. *Journal of Risk Research* 4(1), 75-101
- Sjöberg, L. (2004). Local Acceptance of a High-Level Nuclear Waste Repository. *Risk Analysis* 24(3), 737-749.
- Sjöberg, L., & Drottz-Sjöberg, B-M. (2009). Public Risk Perception of Nuclear Waste. *International Journal of Risk Assessment and Management* 11(3/4), 264-296.
- Sjölander, A. (2003). The nuclear waste discourse in Malå: A truth-seeking practice. In K. Andersson (Ed.), *Valdor 2003, Values in decisions on risk*. Proceedings (p. 169).
- Slovic, P., Layman, M., Kraus, N., Flynn, J., Chalmers, J., & Gesell, G. (1991). Perceived Risk, Stigma, and Potential Economic Impacts of a High-Level Nuclear Waste Repository in Nevada. *Risk Analysis* 11(4), 683-696.
- Slovic, P., Flynn, J., & Gregory, R. (1994). Stigma Happens: Social Problems in the Siting of Nuclear Waste Facilities. *Risk Analysis* 14(5), 773-777.
- Slovic, P. et al. (2001). "Perceived risk, stigma, and potential economic impacts of a high-level nuclear waste repository in Nevada." In: Flynn, Slovic & Kunreuther (eds.), *Risk, Media and Stigma*, pp. 87-105.
- Solomon, B. D., Andrén, M., & Strandberg, U. (2009). *Thirty Years of Social Science Research on High-Level Nuclear Waste: Achievements and Future Challenges*. Paper prepared for presentation at the Conference on Managing Radioactive Waste: Problems and Challenges in a Globalized World, University of Gothenburg, Sweden, December 15-17, 2009.  
Available at [http://www.gu.se/digitalAssets/1291/1291675\\_Solomon\\_\\_paper\\_.pdf](http://www.gu.se/digitalAssets/1291/1291675_Solomon__paper_.pdf)

- Solomon, B.D., Andrén, M., & Strandberg, U. (2010). Three Decades of Social Science Research on High-Level Nuclear Waste: Achievements and Future Challenges. *Risk, Hazards & Crisis in Public Policy* 1(4), Article 2, 13-47.
- Sundqvist, G., & Elam, M. (2010). Public involvement designed to circumvent public concern? The 'participatory turn' in European nuclear activities. *Risk, Hazards & Crisis in Public Policy* 1(4), 203-229.
- Vari, A., Kemp, R., & Mumpower, J.L. (1991). Public Concerns about LLRW Facility Siting, A Comparative Study. *Journal of Cross-Cultural Psychology* 22(1), 83-102.
- Westerberg, W. (2010). Topic 13, *Managing Very Long Term Storage and the Disposal of Spent Fuel Deep Geological Disposal of Spent Nuclear Fuel in the Swedish Crystalline Bedrock*. Presentation at IAEA-CN-178, June 4, 2010. SKB International AB, Stockholm, Sweden. Available at <http://www-ns.iaea.org/downloads/rw/conferences/spentfuel2010/sessions/session-thirteen/session-13-sweden.pdf>.
- Wilson, R.S., Arvai, J.L., & Arkes, H.R. (2008). My loss is your loss... sometimes: Loss aversion and the effect of motivational biases. *Risk Analysis* 28(4), 929-938.
- Włodarczyka, T.L., & Tennysona, J. (2003). Social and economic effects from attitudes towards risk. *Impact Assessment and Project Appraisal* 21(3), 179-185.
- Wulfhorst, J.D. (2000). Collective identity and hazardous waste management. *Rural Sociology* 65(2), 275-294.
- Zeiss, C., & Atwater, J. (1991). Waste disposal facilities and community response: tracing pathways from facility impacts to community attitude. *Canadian Journal of Civil Engineering* 18(1), pp. 83-96.