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Demarketing fear: Bring the nuclear issue back to rational discourse



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HIGHLIGHTS

- Both cognition and emotion are critical in decision-making processes.
- Dealing with the emotion of fear is essential for resolving the nuclear issue.
- Fear should be mitigated to make rational discourses on nuclear power happen.
- Fear can be mitigated by manipulating issue familiarity and response feasibility.
- Using equivalency and issue framing may alter public perceptions of nuclear power.

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ABSTRACT

This paper attempts to explore the strategies for breaking the deadlock between the demand for resolving climate crisis and the resistance to deploying nuclear power. Since our present renewable technology is not advanced enough to replace fossil fuel power plants, nuclear power becomes the only available means that can buy us more time to explore better energy sources for coping with the dilemma of global warming and energy security. Therefore, this paper proposes an elaborated fear appeal framework that may shed light on the intervention points for mitigating fear. By examining the influence of fear appeal on the nuclear issue, three strategies for demarketing the nuclear fear of the public are recommended. The paper concludes that only when energy policy makers and the nuclear industry recognize the significance of minimizing fear and begin to work on removing the sources of fear, can we then expect to bring the nuclear issue back to rational discourse.

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1. Introduction

The so-called “Frankenstorm” Hurricane Sandy, which smashed Cuba, Jamaica, the Bahamas, Haiti, Florida, the East Coast of the United States and Eastern Canada before the Halloween of 2012, has caused more than \$65 billion in economic losses and widespread havoc to millions of people. Hurricane Sandy may be the first Frankenstorm, but for sure it will not be the last one if global warming and climate change continue to exacerbate as Al Gore (1992, 2006) has unremittingly warned.

In recent years, an increasing number of people and organizations have expressed apprehensions and fears about climate crisis and its formidable impacts on our lives. For example, a report released by DARA and The Climate Vulnerable Forum (2012) points out that the present carbon-intensive economy and climate change will cause six million deaths and 3.2 percent of global GDP losses by 2030. To mitigate the threats of global warming and

climate change but also meet the future global energy demands of our consumer society, some scientists and nuclear professionals suggest the only feasible emissions free base-load energy source is nuclear power (Deutch et al., 2009; Ferguson, 2011; Kessides, 2012; Macfarlane, 2010; Stieglitz and Docksai, 2009).

However, since the inception of nuclear technology, a deep fear has been planted in the innermost place of many people’s hearts (Hohenemser et al., 1977). To make matters worse, the manipulation and selective use of scientific information by politicians and some independent scientists has contributed to eliciting greater fear and facilitating the antinuclear sentiment (Surrey and Huggett, 1976). The Fukushima calamity further reinforced the nuclear phobia and led more people to consider nuclear power an unfavorable source of energy (Davies, 2011).

Due to the current overwhelming state of nuclear fear, mitigating global warming through nuclear energy is impossible unless the scared people are willing to change their antinuclear attitude. Therefore, an examination into the nature of fear and the fear arousal process may provide valuable insights for breaking the deadlock between the demand for resolving climate crisis and the resistance to deploying nuclear power.

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Based on this concern, the following sections of this essay will first review the literatures concerning fear and fear appeals. By examining the mechanism of fear appeals, the moderators that may have effects on the functionality of fear appeals are illuminated and added to the fear appeal model. Second, for the sake of exploring the resolution of global warming and nuclear threats, three policy leverage points for improving energy policy design are discussed. Third, based on the elaborated fear appeal framework, the strategies for demarketing nuclear fear are recommended. Finally, this essay discusses the contributions of this study to the field of energy policy, followed by the conclusion.

2. Fear appeals as a tool for motivating behaviors

Fear appeals are “persuasive messages designed to scare people by describing the terrible things that will happen to them if they do not do what the message recommends” (Witte, 1992). In the literature, earlier studies tend to imply that strong fear appeals are more persuasive than weak fear appeals, whereas efficacy is an important factor in determining the effectiveness of a fear appeal (Higbee, 1969). Later studies indicate that greater perceived fear yields greater attitude and behavior changes with average correlation coefficients of .20 and .17, respectively (Dillard, 1994). A meta-analysis including 98 studies also suggests that the stronger the fear appeal, the greater the attitude, intention, and behavior changes (Witte and Allen, 2000).

In the area of social marketing, fear appeals have been widely used to change attitudes and behaviors related to public health issues such as smoking, breast cancer, drug and alcohol abuse, sexually transmitted diseases, and nuclear radiation (Dillard, 1994; Hine and Gifford, 2010). Nevertheless, few studies have examined fear appeals that involve multiple interrelated but contradictory issues. Since the fear toward nuclear power is embedded in controversies over the issues of nuclear safety, global warming, and energy security (King, 1993), applying fear appeal theories to the nuclear power issue may not only derive insights from previous fear appeal research but also add new knowledge to existing literatures. In this sense, a fundamental understanding about the reasons why fear appeals work or fail can be essential for proposing demarketing nuclear fear strategies.

2.1. The nature of fear

Fear is an emotional response to a threat that may cause danger and result in impairment (Rotfeld, 2000; Tanner et al., 1991). In the evolutionary process, fear is shaped by natural selection as a functional emotion to improve survival chances (Marks and Nesse, 1994). As a result, human beings who are able to fear threatening events and adopt adaptive actions such as escaping, hiding, or freezing tend to survive and reproduce. By contrast, those who are not scared in dangerous situations are unable to protect themselves and thus are selected out by the nature (Hofmann et al., 2012; Öhman, 2008).

From an evolutionary point of view, failing to elicit defense to a hazardous threat is likely to incur greater losses than eliciting unnecessary responses to false harms. Consequently, our perceptual systems are biased toward detecting threats (Öhman, 2008). The biased perceptual systems, at the same time, may sometimes make misconnections and undue causalities, which in turn may lead to the development of superstitious and irrational fears (Marks and Nesse, 1994).

Traditional cognitive science was apt to stress rationality as the dominant factor for explaining the behaviors of human beings (Lazarus, 1999). However, according to recent research findings in neurobiology, emotion and cognition are interconnected (Storbeck and Clore, 2007). In addition, Pavlovian fear conditioning experiments find

that the emotion of fear often regulate cognitive processing and influence evaluative judgments (Maren, 2008; Öhman, 2008; Storbeck and Clore, 2007). Since doing appraisals that involves meaning in the cognitive process always correlates with emotion (Lazarus, 1999), it may be inadequate and ineffective if we wish to change behavior solely by using reasoning to design persuasive messages but ignoring the emotional aspect.

2.2. The mechanism of fear appeals

Fear appeals, as Rotfeld (2000) pointed out, should be more appropriately called “appeal to audience fears” so as to distinguish fear from threat since “a threat is an appeal to fear, a communication stimulus that attempts to evoke a fear response by showing some type of outcome that the audience might want to avoid” (p. 122). Basically, two types of information are provided in fear appeals. First, information about a threat is presented to arouse fear in the target audience. Second, effective actions for relieving the threat are recommended to the target audience (Lennon et al., 2010). Viewed in this light, a fear appeal should consist of messages not only resulting in fear but also offering hope for releasing people from the fear (Witte and Roberto, 2009).

Some rudimentary studies suggest a positive and monotonic relationship exists between the level of fear and the degree of deterrence resulted from fear appeals (Rotfeld, 2000; Stuteville, 1970). Early research findings also indicate that the intensity of fear appeals is positively related to the level of fear aroused (Witte and Allen, 2000). Based on these findings, a primary conclusion is that the stronger the fear appeal, the greater the effect of the persuasion, *ceteris paribus* (Morales et al., 2012; Rotfeld, 2000). Nevertheless, the above speculation may not always hold when other moderators are taken into account. Consequently, the Extended Parallel Process Model (EPPM) is proposed to explain how and when fear appeals succeed or fail by integrating and expanding previous theories such as Leventhal's parallel process model, Janis's fear-as-acquired drive model, and Rogers's protection motivation theory (Witte, 1998).

The EPPM refined the notion of fear appeal by adding three key constructs—perceived threat, perceived efficacy, and fear (see Fig. 1). First, perceived threat is the cognitions of individuals regarding a threat, regardless of whether the threat actually exists or not. Perceived threat is composed of perceived severity (i.e., the belief of individuals about the significance of the threat) and perceived susceptibility (i.e., the belief of individuals about the occurrence probability of the threat). Second, perceived efficacy refers to the cognitions of individuals concerning the effectiveness of the recommended response, regardless of whether or not the recommended response really works. Again, perceived efficacy is comprised of perceived response efficacy (i.e., the belief of individuals about the feasibility of a response for preventing the threat) and perceived self-efficacy (i.e., an individual's belief about his or her ability to avert the threat by performing the recommended response). Lastly, fear is an

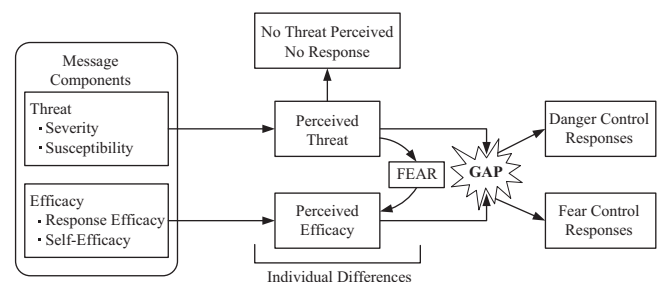


Fig. 1. The extended parallel process model (adapted and revised from Witte and Roberto, 2009, p. 586).

internal negative emotion aroused by a threat that individuals perceive to be serious and personally relevant (Witte, 1992, 1994, 1998).

Two types of audience reactions are depicted in the EPPM. On the one hand, danger control processes are cognitive processes where individuals possess a high level of perceived threat and perceived efficacy. When danger control processes are dominating, individuals tend to perform adaptive behaviors in accordance with the recommended response. On the other hand, fear control processes are emotional processes where individuals have a high level of perceived threat and a low level of perceived efficacy. When fear control processes are dominating, a boomerang effect may occur that leads the individuals to cope with the fear and reject the recommended response (Witte, 1992, 1994).

According to the EPPM, a fear appeal may result in any of the following three possible scenarios. First, the target audience has no response if he or she perceives no threat or considers the threat too trivial or irrelevant to fear and respond. Conversely, fear is aroused when the target audience perceives a high level of threat. The evoked fear may in turn lead the target audience to appraise the efficacy of the recommended response. Second, when both threat and efficacy are perceived to be high, a danger control response appears and the prompted actions are performed as long as the perceived efficacy is greater than the perceived threat. Third, a high level of perceived threat with a low level of perceived efficacy may result in fear control responses. As a result, the target audience tends to display defensive avoidance reactions which render the fear appeal unsuccessful (Witte and Roberto, 2009). However, due to individual differences, different individuals may respond differently to the same fear appeal (Witte, 1992, 1994, 1998).

2.3. Moderators and intervention points

Most fear appeal research in the literature that studies the effectiveness of a fear appeal tends to only involve two parties – the persuader who initiates the fear appeal and the persuadee who is the target audience. However, there may be a third party which intends to intervene in the fear appeal process. The participation of the third party can make the interactions between the persuader and the persuadee and the fear appeal process more complicated.

According to the EPPM, an individual makes appraisals regarding the threat and the efficacy of the recommended response in the fear appeal process (Witte, 1998; Witte and Roberto, 2009). However, it is not clear whether any moderators may exert influences on the individual's appraisals that lead to the perceived threat and the perceived efficacy, respectively. On the other hand, it is also unclear how an individual's fear may be aroused by the perceived threat. Finally, despite that a number of demographic variables and personality traits that are assumed to be related to individual differences have been tested, there is no consensus about whether individual differences have impacts on individuals' reactions to fear appeals (Lennon et al., 2010; Witte and Allen, 2000; Witte and Roberto, 2009).

To deal with the problems discussed above, three intervention points that are relevant to the issues of future research directions highlighted by Witte (1998) can be identified in the EPPM. First, an intervention point exists in the middle of the link between threat and perceived threat. The second intervention point is located between efficacy and perceived efficacy. Finally, the third one is proposed to clarify the relationship between perceived threat and fear. In the next section, three moderators corresponding to the above intervention points are proposed and added to the EPPM. These moderators are discussed according to the elaborated fear appeal framework exhibited below and serve as the basis of exploring strategies for demarketing nuclear fear.

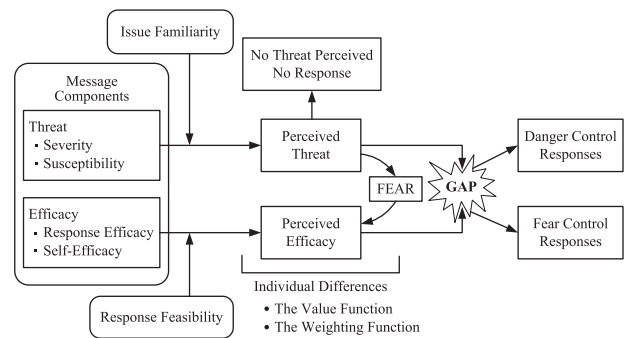


Fig. 2. The elaborated fear appeal framework.

3. The elaborated fear appeal framework

As shown in Fig. 2, the three moderators accommodated into the elaborated fear appeal framework are issue familiarity, response feasibility, and individual differences characterized by the value function and the weighting function, respectively. First, issue familiarity may play a role in weakening the relationship between threatening messages and perceived threat (Pelsmacker et al., 2011). If the threatening messages do not lead to any threat to be perceived, there will be of course no response at all. Second, if the perceived threat reaches a threshold that arouses fear, people will begin the second appraisal regarding the efficacy of the recommended response. At this time, providing evidence regarding the infeasibility of the actions may lead to a lower level of perceived efficacy, which may in turn result in fear control responses. Finally, people are likely to hold different value functions, which may affect their perceptions of threat and efficacy, as well as the threshold of fear arousal. Taking into account the value and weighting functions as a property of individual differences, framing the focal issue differently may lead to different appraisal results. The essence of the three moderators is discussed below.

3.1. Issue familiarity

When processing the information of fear appeals, whether an individual holds sufficient prior knowledge about the focal issue may determine how the persuasive messages are processed (Averbeck et al., 2011). As the heuristic-systematic model suggests, people elaborate on the content of a persuasive message only if they possess sufficient prior knowledge. Otherwise, the message is likely to be processed superficially by using heuristics that may lead to systematic errors (Todorov et al., 2002). Therefore, the same threatening message of a fear appeal may cause two individuals to develop different perceptions toward the threat if their prior knowledge differs (Witte and Morrison, 2000).

Based on the heuristic-systematic model, Averbeck et al. (2011) find that a lack of prior knowledge tends to result in high fear arousal and affective processing. In addition, the high fear arousal often leads to a higher level of perceived risk and a negative cognition toward the threat. Since people who experience greater fear can seldom attend to the content of the threatening message, they are likely to make underinformed decisions and biased judgment.

In a similar vein, Pelsmacker et al. (2011) investigated the effects of issue familiarity on fear appeals. As their research findings indicate, the same fear appeal tends to produce a greater level of perceived threat when an individual is unfamiliar with the focal issue. By contrast, for people who are relatively familiar with the focal issue, the effects of a strong fear appeal on their perceptions of the threat are relatively small. In this sense, strong fear appeals are powerful for arousing fear when the target

audience is inexperienced or unfamiliar with the focal issue. Nonetheless, adding more information to strong fear appeals is likely to result in a habituation effect that often attenuates the influence of fear appeals when people have had enough knowledge about the issue.

3.2. Response feasibility

According to the EPPM, people make the first appraisal about whether the threat is significant. If an individual's perception of the threat is sufficiently high that reaches a certain threshold and evokes the emotion of fear, he or she is supposed to begin the second appraisal. In the second appraisal, the individual will evaluate the efficacy of the recommended response against the perceived strength of the threat (Witte, 1998). At this stage, when the focal issue has been well known, coping efficacy appears to be more important than perceived threat in terms of leading the target audience to take recommended actions (Pelsmacker et al., 2011).

Since the evoked fear alone does not necessarily result in behavior change, providing messages to convince people regarding the feasibility of the recommended response and their ability to cope with the threat becomes essential for pushing the appeal to its end (Lennon et al., 2010). On the contrary, counter evidence that aims at exposing the weaknesses and infeasibility of the suggested actions may induce people to take fear control responses and render the appeal unsuccessful.

In general, public issues always have multiple facets (Nelson and Kinder, 1996). Since individuals usually perceive a public issue from different perspectives and make their judgment accordingly, variations in frames may cause the individuals to focus on specific aspects without considering the focal issue in a comprehensive manner (Druckman, 2001). For example, the same individuals are found to hold different attitudes toward an affirmative action program, depending on whether the issue is framed on the basis of racial prejudice or economic interests (Druckman, 2001; Nelson and Oxley, 1999).

Alternatively, people may also change their opinions toward a focal issue when new perspectives from different angles or at different levels are introduced into the original frames. As a result, the meaning of the major events related to an issue is reconstructed or reinterpreted on the basis of salient cues in sense-making processes. The reconstruction and reinterpretation may in turn lead to opinion changes (Druckman, 2001; Fiss and Hirsch, 2005). For instance, in the public discourse, globalization has been framed positively as a process of facilitating international trade and increasing economic benefits at the beginning. At a later stage, a negative viewpoint on globalization that gives greater concern to its destructive effects on the rights of labors and environmental degradation has also emerged. The contradictory perspectives indicating the coexistence of conflicting perceptions and opinions toward globalization also serve as a good example of issue framing effects (Fiss and Hirsch, 2005).

To sum up, for public issues, especially those issues with strategic implications, the narrowing of one's frame will inevitably result in a limited range of alternatives and suboptimal decisions (Highhouse et al., 1996). For this reason, a recommended solution that was perceived to have high response efficacy and high self-efficacy may become worthless once the original frame is expanded and other critical issues are brought into consideration.

3.3. Individual value and weighting functions

Ray and Wilkie (1970) assume that different groups of people tend to have different fear response functions. Thus, a fear appeal can be effective only if it meets the specific fear response function of the target audience. Stuteville (1970) holds a similar viewpoint

and considers segmenting markets as a precondition for successfully using fear appeals. Based on the segmentation approach, Burnett and Oliver (1979) examined the fear-effectiveness relationship and found some demographic variables and psychographic factors mediating the effect of fear appeals across different segments.

Since the persuasiveness of a fear appeal may vary widely depending on the properties of the target audience and the design of the appeal (Morales et al., 2012), two categories of individual differences can be taken into account for manipulating the fear appeal process. The first category is related to the attributes of the intended audience. Variables such as personality traits and demographic characteristics are suggested to be relevant (Lennon et al., 2010; Witte, 1992). However, a meta-analysis of fear appeals indicates that personality traits and demographic characteristics have little influence over the outcome of fear appeals (Witte and Allen, 2000). Therefore, research findings regarding the effects of the individual differences in this category are not consistent.

The second category of moderators involves the notion of individual value and weighting functions. According to prospect theory, the value function of individuals is an S-shaped curve defined on gains and losses relative to a neutral reference point (see Fig. 3). In addition, the value function is concave in the gains area, convex in the losses area, and steeper for losses than for gains (Kahneman and Tversky, 1979, 1984). The implications of the S-shaped value function are threefold. First, a majority of people display a tendency of risk aversion for certain gains and a tendency of risk seeking for sure losses. Second, both the functions of gains and losses demonstrate diminishing sensitivity. Third, owing to the tendency of loss aversion, most people respond more extremely to losses than to gains. In other words, as human beings, the fear of losing what we already own is more powerful in affecting our preferences than the desire for gaining what we do not have (Tversky and Kahneman, 1981, 1986).

In addition to the value function, prospect theory proposes that the value of an uncertain outcome needs to be multiplied by a decision weight (Tversky and Kahneman, 1986). The weighting function denoted as a subjective probability is different from the risk, which represents objective probabilities (Johnson, 2004). As the weighting function suggests, when the objective probabilities are used in the decision-making process, it is common that low probabilities tend to be overweighted while moderate and high probabilities are often underweighted (Tversky and Kahneman, 1986).

To conceptualize individual differences as the value multiplied by the decision weight may facilitate our understanding about the

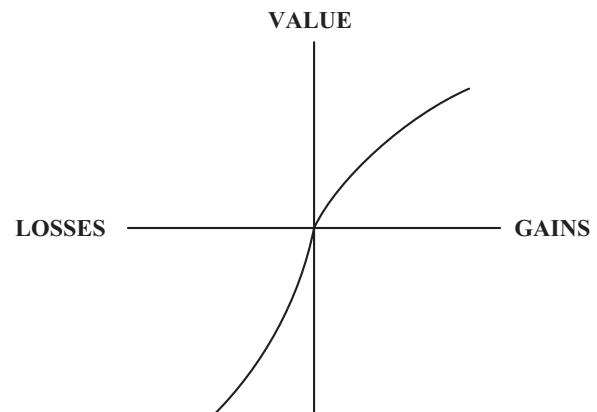


Fig. 3. A hypothetical value function of individuals (adapted from Kahneman and Tversky, 1979, p. 279).

fear appeal process at least in the following two respects. On the one hand, individuals with different value functions and weighting functions may perceive threat and efficacy differently. On the other hand, the EPPM depicted a threshold at which an individual's fear is evoked and he or she begins to respond to the threat by doing the second appraisal (Witte and Roberto, 2009). Viewed in this light, the value function may be critical in determining the threshold since each individual tends to own a unique framing of outcomes to induce his or her decision values.

4. Strategies for demarketing nuclear fear

In fear appeals against nuclear power, the most frequently mentioned threats are nuclear radiation, nuclear waste disposal, and nuclear weapons proliferation (Rossin, 2003; Surrey and Huggett, 1976). In recent years, terrorist attacks, the impacts of natural disasters, and costs and liabilities are also brought into the dimension (Cohen, 2009; Ferguson, 2011; Rossin, 2003; Zehner, 2012b). In fact, all of the above threats can be reduced to radioactive hazards that always result in illness and fatality, which in turn are feared by most people (Beaver, 2010). When the fear dominates, there can be no rational dialogs and deliberations for building a common ground to tackle the problems of nuclear safety, global warming, and energy security all at once (King, 1993; Rosa et al., 2010a).

Since various publics often have different opinions toward a common issue, it is important to identify different types of publics before proposing communication strategies (Grunig, 1979, 1982). Accordingly, the general public is divided into three groups based on the knowledge they have for making decisions. First, uninformed publics are those who have little knowledge for making rational judgments when facing frightening messages. Second, underinformed publics refer to people who are given inadequate information that lull them to believe renewable electricity to be a feasible alternative for replacing both fossil fuel and nuclear power plants right away. Finally, ill-informed publics are people who hold incomplete knowledge about the interconnected nature of the energy policy that make them support a single perspective instead of seeing the whole picture. The strategies for mitigating the fear of the three groups of people are discussed below.

4.1. Providing knowledge about multiple issues to uninformed publics

Uninformed publics are ignorant of the technical terms and their exact meanings. For example, few of them may realize that based on the Linear Non-Threshold Theory (LNT), the concept of “collective dose” is misused and the predicted dangers of radiation are exaggerated by nuclear objectors (Rossin, 2003). As a result, uninformed publics fear nuclear power because of their ignorance and misunderstanding about the real situations.

To alleviate the perceived threat of uninformed publics, the conventional counter appeals proposed by the technical expertise of the protagonists used to focus on defending the safety problems of the nuclear energy in a corresponding fashion. For instance, in order to reduce uninformed publics' suspicions about the catastrophic reactor risk, it was reported that “the probability of a major radioactive release... [is] at 1 in 100,000 reactor-years;... of a loss-of-cooling accident at 1 in 2000 reactor-years” and “the core meltdown probability is 5×10^{-5} per reactor-year” (Hohenemser et al., 1977). The updated nuclear safety information illustrating the calculated risk of newly designed nuclear power plants still employs the same data format (Goodfellow et al., 2011). Does this kind of explanation make any sense to laymen?

More recent counterarguments attempt to convince uninformed publics by emphasizing the safety record of the nuclear power plants in the United States, the stringent monitoring and inspection practices, the upgraded personnel training advances, and the new design of nuclear reactor plants that are asserted to be capable of withstanding earthquakes, airplane collisions, and even terrorist attacks (Cannara, 2010; Marcus, 2011; Stieglitz and Docksai, 2009). However, since most of the counterarguments tend to use either technical terms or unsubstantial, unverifiable instances, it may be very hard, if not impossible, for a layperson to gain a solid understanding about the actual risks accompanied with nuclear power. Therefore, it is not surprising that the counter appeals have generated little effect in convincing uninformed publics about the safety of the nuclear technology.

Despite that certain advocates with technical expertise view the critiques and declaims against nuclear power to be based on irrational dogmas or political considerations rather than solid scientific facts as the most annoying obstacle (Rossin, 2003; Surrey and Huggett, 1976), it is undeniable that nuclear power does pose threats to society due to its catastrophic potential, duration, and uncertainty (Hohenemser et al., 1977). In addition, since nuclear power does carry risks which are perceived to be involuntary, inescapable, inequitably distributed in society, coming from an unfamiliar source, poorly understood by science, and causing dreadful illnesses and irreversible damages, it inevitably becomes less acceptable and more feared to uninformed publics (Nuttall, 2007). As Mariotte (2009) has criticized, “[T]he fundamental safety problems [of nuclear energy] have not been fixed and cannot be fixed with the technology that we are using now. You can't make an inherently dangerous technology safe (p. 23).” The unfamiliar and contradictory nature of nuclear technology may make the objectors easier to evoke fear than the protagonists to eliminate fear.

As a matter of fact, what uninformed publics really care about is how their life will become if they vote for or against nuclear power. Therefore, there should be a holistic picture illustrating the interconnectedness of the key factors depicted in an easily understandable manner. In other words, the issues of nuclear safety, global warming, and energy security have to be illustrated in the same picture and addressed simultaneously (Corner et al., 2011).

In the past decade, much effort has been devoted to improving nuclear safety. First, small modular reactor technologies are employed and advanced reactors such as high-temperature gas reactors using TRISO fuel and the traveling-wave reactor are developed for reducing nuclear risk, cost, waste, and proliferation (Kessides, 2012; Macfarlane, 2010; Marcus, 2011; Schaffer, 2005; Wald, 2009). At the same time, a Global Nuclear Energy Partnership is proposed to help developing countries build small modular power plants that use sealed fuel capsules to reduce the risks of proliferation (Elliott, 2007).

Global warming is another key issue involved in the consideration of nuclear energy development. According to the findings illustrated in an OECD's report, there is a positive correlation between the knowledge of the public and their support to nuclear power. Yet, the report also indicates that a considerable part of the public are “unaware of (or choose not to believe) the potential benefit of nuclear energy to reduce the emissions of climate change related carbon dioxide” (Kovacs et al., 2010). A survey in the United Kingdom indicates that only a minority of British hold an attitude of unconditional acceptance toward nuclear energy. However, when there is no other choice, those who concern about climate change and energy security may reluctantly accept nuclear power (Corner et al., 2011).

Finally, energy security refers to the availability of sufficient supply of energy at affordable price that involves in the question of whether we can continuously maintain or improve our quality of

life (Bahgat, 2008). According to the trend of global economic growth, it is predicted that worldwide electricity demand will increase dramatically by 2030 (Stieglitz and Docksai, 2009). Since more than 80% of global energy supply is dependent upon fossil fuels, replacing the fossil fuels with other energy sources that are able to significantly reduce greenhouse gas emissions is inevitable (Wüstenhagen and Menichetti, 2012). At the same time, the alternative energy sources have to be able to fulfill the requirements of energy security.

Bringing the above three issues together is only a prerequisite for reminding uninformed publics to reconsider the inevitability of accepting nuclear power as one alternative of the energy portfolio under today's technological and institutional constraints. Under the assumption that uninformed publics do not have sufficient knowledge about nuclear safety and the intertwined relationship between nuclear power, climate change, and energy security, providing them with comprehensible knowledge rather than technical information is especially essential for helping them make informed decisions.

4.2. Revealing the infeasibility of recommended responses to underinformed publics

From the perspective of electricity production, wind power and solar energy are usually recommended as the two renewable energy sources for replacing fossil fuels so that we can mitigate the global warming problem yet avoid the threats of nuclear hazards. However, controversies remain over whether these renewable energies are sufficient to fill the gap if fossil fuels and nuclear power plants are decommissioned. As Zehner (2012a) criticized in his new book:

Media and political coverage lull us into dreams of a clean energy future juxtaposed against a tumultuous past characterized by evil oil companies and the associated energy woes they propagated. Like most fairy tales, this productivist parable contains a tiny bit of truth. And a whole lot of fantasy (p. 4).

To examine the efficacy of the recommended responses in nuclear fear appeals, the feasibility of solar cells and wind turbines for fulfilling our future electricity demand is discussed in terms of their availability and affordability.

First, the way of generating electricity from sunshine is usually through photovoltaic panel. However, solar energy can be fully exploited only in regions with extensive amount of sunlight. The best place may be the desert; other areas with less sunlight are unable to fully utilize this renewable energy. In addition, due to its intermittent nature, the electricity generated from solar energy is non-dispatchable. As a result, unless the technologies for building economical massive electricity storage have been developed, it will be unlikely to provide a stable supply of electricity (Elliston et al., 2012; Pickard, 2012).

On the other hand, the cost of exploiting solar energy is astounding. For instance, an optimistically estimated total cost of building a solar array capable of providing global energy consumption is about ten times the gross domestic product (GDP) of the United States. If the estimation is made based on the actual installation cost of the solar projects in California, a global solar program may cost one hundred times the United States GDP. Moreover, in the process of manufacturing solar cells, the emissions of hexafluoroethane (C₂F₆), nitrogen trifluoride (NF₃), and sulfur hexafluoride (SF₆) tend to exacerbate global warming by tens of thousands times more than CO₂ (Zehner, 2012a). In this sense, using solar energy may bear a greater environmental cost than other energy sources.

Second, although wind turbines are less expensive and more capable of generating electricity than solar photovoltaic, they are by no means a qualified substitute of fossil fuels and nuclear power for two reasons. On the one hand, since a line of wind turbines over one hundred miles can only produce the amount of power equaling to a single coal plant, it is estimated that global wind-power generation capacity is less than one percent of global energy demand by 2012 (Zehner, 2012a). On the other hand, similar to solar energy, wind power also has the weakness of intermittency. Therefore, it is not a reliable energy source in areas where the wind is not strong and stable enough for generating electricity in a continuous manner (Pickard, 2012).

In terms of reducing greenhouse gas emissions, the advantage that wind farms do not exhaust CO₂ may be of limited value when the following two facts are taken into account. On the one hand, the name plate capacity of a wind farm tends to be over-estimated, as its realized value is one-third lower than the estimated value. As a result, the cost of using wind power may be two-third higher, whereas the reduction of carbon emissions becomes 40 percent less (Boccard, 2009). On the other hand, when the carbon footprint is calculated on a well-to-wheel basis, building, transporting, and installing wind turbines inevitably generate a variety of greenhouse gases that make wind power not so clean as it was proclaimed (Zehner, 2012a).

Another difficulty of using solar cells and wind turbines is related to the energy infrastructure. Since our electricity systems have been adapted to conventional power generation methods, shifting from fossil carbon and nuclear power to solar and wind power may result in negative impacts on the economy and our daily life (Molyneux et al., 2012; Pickard, 2012). Therefore, unless the energy infrastructure can be renovated, it is unlikely that the renewable energy resources can be exploited effectively and efficiently. In this sense, the costs of renovating the energy infrastructure such as installing robust power distribution grids and building massive electricity storages also should be explicitly illustrated to underinformed publics. Only by disclosing the complete information relevant to all energy sources, can the underinformed publics have the potential to make informed and unbiased decisions in selecting energy portfolios.

4.3. Framing messages to match individual value functions of Ill-Informed publics

A basic assumption of framing theory is that human beings are boundedly rational and subject to information manipulation in the process of preference formation and decision making (Druckman and Lupia, 2000; Kaplan, 2008; Tversky and Kahneman, 1986). Therefore, different descriptions of the same decision problem may influence the perception of the ill-informed public and cause them to alter their evaluation of options. Moreover, even though ill-informed publics strive to make rational choices, most of them often systematically violate the principle of invariance, which is seen as an essential condition of rational choice theory (Tversky and Kahneman, 1981, 1986).

Two types of framing effects are found to be relevant to decision making. First, equivalency framing effects refer to situations where logically identical information presented in either a positive or a negative form may cause individuals to alter their preferences or choices (Levin et al., 1998; Tversky and Kahneman, 1986). Second, issue framing effects occur when situations emphasizing different but potentially relevant issues lead individuals to shift their focus to other considerations (Druckman, 2001, 2004). Although equivalency framing primarily focuses on the frames in thought whereas issue framing puts more weight on the frames in communication, they are supposedly interrelated in the sense that

the former is often shaped by the latter to a certain extent (Druckman, 2001).

According to prospect theory, loss aversion makes people prefer stability to change. In addition, individuals tend to adopt their status quo as the reference point to evaluate the advantages and disadvantages of the outcomes of a decision (Kahneman and Tversky, 1984). In other words, the fear of losing what we already own is more powerful in affecting our preferences than the desire for gaining what we do not have (Levin et al., 1998). The results of a classic Asian disease experiment conducted by Tversky and Kahneman (1981) further indicate that individuals tend to be risk-averse when the outcomes of risky choice options are positively framed. Conversely, they are risk-seeking when the outcomes are negatively framed. That is, most of us have a tendency of risk aversion for certain gains and a tendency of risk seeking for certain losses (Kühberger, 1998). Under the influence of loss aversion, it seems to be simple and easy for ill-informed publics to dismiss nuclear power if no other concerns need to be taken into account.

While variations of reference points may alter an individual's evaluation about whether a given outcome is a gain or a loss, the framing effect is actually the reflection effect that influences the perception rather than the preference of individuals (Okder, 2012). According to this viewpoint, ill-informed publics may perceive the nuclear threat differently when the issues of climate change and energy security are brought into the spotlight. However, providing knowledge about multiple issues and revealing the infeasibility of recommended responses can only affect the cognitive process of ill-informed publics; whether their emotional feelings toward nuclear power will change subsequently may depend on whether the decision frames are in line with the value functions of them.

In compliance with the research findings in the literature, the strategies for reframing the nuclear issue are proposed based on the following rationale. First, under present technological and institutional constraints, radically closing down nuclear power plants and shifting to undeveloped renewable energy sources will inevitably lead to a decline of our economy and life quality. Therefore, adopting an antinuclear standpoint and exclusively placing hopes on wind power and solar energy may not be a wise decision. Second, relying on fossil fuels as the main energy source will inevitably lead to global warming, which is very likely to result in climate change catastrophes. Due to the loss aversion nature of human beings, both the deterioration of economy and life quality and the climate crisis of our Earth will be undoubtedly perceived as severe threats. Any one of them is supposed to evoke fears and neither of them is welcomed. If the above reasoning is valid, the option of deploying nuclear power and refining nuclear technology should be given an opportunity of rational assessment rather than a rebuff of emotional arousal.

However, nuclear power is always perceived as carrying a great deal of risks that are more feared by and less acceptable to the ill-informed public. Moreover, in comparison with the effort devoted to reducing the danger cognition of ill-informed publics, the proponents of nuclear power have paid relatively too little attention to lessening their fear emotion (Nuttall, 2007). How should the dire nuclear issue be reframed when public opinions exhibit a deep fear and a high skepticism toward nuclear safety?

As Kahneman and Tversky (1984) have remarked, the decision values deriving from our framing of outcomes do not always have a counterpart in our actual experiences. Therefore, the outcomes of global warming and electricity supply may be framed in such a way that simultaneously takes into account fossil fuel power and nuclear power so as to modify the decision values of the ill-informed public.

As shown in Table 1, the first column and the second column are fossil fuel power and nuclear power, respectively. The third and the fourth columns are the gains or losses resulting from choosing fossil fuel power or nuclear power. As it is exhibited in

Table 1
The framing of outcomes in three scenarios.

Fossil fuel power	Nuclear power	Quality of life	Global warming
Yes	No	Gain	Loss
No	No	Loss	Gain
No	Yes	Gain	Gain

the first row, if we decide to keep on operating fossil fuel power plants while phasing out nuclear power plants, our quality of life can be sustained but global warming will be deteriorating. In the second row, if the fossil fuel plants are successively decommissioned and nuclear power plants are phased out at the same time, although the problem of global warming can be ameliorated, our current quality of life will be negatively impacted due to the shortage of electricity supply. Finally, the third row refers to the condition that we replace fossil fuel power plants with nuclear power plants. In this case, not only our quality of life sustains, but also global warming problems can be mitigated.

Once the intertwined relationships between fossil fuel power, nuclear power, the quality of life, and global warming are illuminated, the last difficulty that needs to be dealt with is the way of framing nuclear energy itself. In nuclear fear appeals, the opponents of nuclear power always motivate the target audience by highlighting the sure gains of undertaking antinuclear actions. Therefore, the message is framed as “antinuclear actions protect people from nuclear hazards for sure.” In contrast, the proponents are used to refute the attacks with a counter-frame to declare that “nuclear power only has a very low probability of catastrophic occurrences.” Since the opponents used a sure gain frame while the proponents employed a risky loss frame, it should not be surprising that the ill-informed public tended to be risk-averse and successfully persuaded by the fear appeals.

To countervail the fear appeals, the proponents of nuclear power may consider modifying the frame of the message from another perspective. On the one hand, the proponents should keep their own risky loss frame. On the other hand, the proponents may reframe the message delivered by the opponents as “antinuclear actions lead to the deterioration of life quality and global warming for sure.” With these negatively framed outcomes, the ill-informed publics are more likely to become risk-seeking and accept nuclear power to a greater extent.

5. Policy implications and contributions

Since the nuclear power controversy cannot isolate nuclear safety from climate crisis and energy security, the problem of whether to use nuclear power or not is essentially divergent that does not promise a solution (King, 1993). To cope with the unsolvable nature of nuclear controversies, the strategic approaches discussed above advise energy policy makers to reconceptualize the problem by redrawing the boundaries of nuclear power and providing sufficient information so as to facilitate the formation of acceptable resolutions through dialogs (Gamson and Modigliani, 1989; King, 1993; Rosa et al., 2010a, 2010b). Accordingly, the policy implications drawn from these approaches are summarized as follows:

- illustrating the complex nature of the nuclear issue by bringing climate crisis and energy security into the limelight and setting the nuclear debate in a wider context;
- familiarizing uninformed publics with up-to-date nuclear technology knowledge in an understandable format to remove the negative influences of misleading arguments;

- providing underinformed publics with facts regarding the immaturity of renewable energy technologies and the unreadiness of switching current infrastructures to renewable energy resources;
- segmenting ill-informed publics and framing energy policy appeals in accordance with the traits, needs, and interests of different groups of the target audience;
- encouraging public engagement and transparent deliberations by giving people a meaningful role in deciding future energy policy alternatives.

As noted in previous sections, fear is a negative emotion which is likely to result in high risk perceptions. While emotional reactions have been found to exert significant effects on risky decision making, holding discourses on nuclear energy without taking into account the impacts of fear on the risk perceptions of people may reach little consensus. By examining the influence of fear appeals on nuclear issues, this study adds to existing literature and contributes to the field of energy policy in the following ways.

5.1. Mitigating nuclear fear and antinuclear sentiment

An energy portfolio that excludes any one of the available energy sources such as nuclear power may incur unpredictable opportunity costs. However, unless the fear of opponents toward nuclear power is relieved, there can be no rational discourse between the proponents and the opponents, let alone reach any consensus concerning the future of nuclear energy. Based on the EPPM developed by Witte (1992), this study proposed an elaborated fear appeal framework in the third section and identified three moderators which, if appropriately manipulated, can help to reduce people's perceived threats of nuclear power, perceived efficacy of recommended responses, and the extent of nuclear fear aroused by nuclear fear appeals.

According to the elaborated fear appeal framework, this essay suggests energy policy makers to increase issue familiarity and decrease response feasibility by providing sufficient knowledge that can be easily understood by uninformed publics. In addition, the nuclear information should be framed to match the value function of different target audiences. Only by so doing, the opponents' fear toward nuclear power may be expected to alleviate. Consequently, a comprehensive energy policy consisting of every energy source can be formulated and implemented with minimum resistance.

5.2. Improving energy policy communication

Fear appeals that attempt to change the behavior of target audiences by delivering fearful messages have been one of the popular topics in persuasion and communication research. Most fear appeal studies in the literature focused primarily on the interactive relationships between the message sender and the message receiver. Thus, the research findings derived from dyadic interactions always address coding and decoding processes but overlook the fact that a third party may also interfere in the communication process and exert impacts on the effectiveness of communication. By taking into account the third party's interventions, this study highlights the importance of taking counter-appeal actions for eliminating the opponents' fear toward nuclear power so that rational discourses and deliberative dialogues become possible.

On the other hand, many researchers have acknowledged that the existence of individual differences may affect the effectiveness of fear appeals to a certain extent. However, research findings about whether the effects of individual differences really exist when they are conceptualized as demographic variables (e.g., age,

gender) or personality traits (e.g., extraversion, locus of control, and trait anxiety) are inconsistent and uncertain. By referring to the theories of behavioral economics and hedonic psychology which have introduced the concepts of value function, framing effects, and mental accounting, this study conceptualizes individual differences as individual value and weighting functions. From the new angle, the causal relationships between threat messages and perceived threats, efficacy messages and perceived efficacy, as well as perceived threats and the emotion of fear can be reformulated. As a result, how the message of an energy policy should be framed to match individual value functions may become an essential task of policy communication.

5.3. Marketing energy policy through contrary thinking

Public policies always encounter more or less resistances from a variety of stakeholders. While most policy makers intend to eliminate the resistance by providing people with facts about benefit or risk measures, few of them have ever paid enough attention to the feelings and emotional reactions of the opponents. Due to the fact that both emotion and cognition account for the most variance in nuclear support (Truelove, 2012), the persistent negligence of policy makers about the impacts of emotions on people's preferences and choice making is by no means adequate.

Since electricity systems have evolved in consistence with locally available natural resources, renewable energy sources such as wind power and solar energy may not be equally applicable in all countries. Furthermore, aside from nuclear safety, other issues such as climate change and energy security also have to be seriously taken into consideration if our ecosystems and economic systems are to be sustained (Molyneaux et al., 2012). According to the above concerns, this study attempts to look for the intervening factors that may negatively affect the effectiveness of fear appeals and subsequently conceiving strategies for demarketing the fear of the opponents toward nuclear power from a contrarian perspective. Unless energy policy makers and the nuclear industry do recognize the significance of minimizing fear and begin to work on removing the connection between nuclear power and fear rather than solely reducing nuclear risks, there can be little chance for the opponents to perceive nuclear power as an acceptable option in the energy mix (Nuttall, 2007).

6. Conclusion

The aim of this essay is not to support or oppose nuclear energy, but to suppress fear appeals and the resulted unreasonable reactions that interrupts energy technology innovation and blockades energy policy progression. Although there is no solid proof regarding the causal relationship between greenhouse gas emissions and climate change, neither is there any evidence to reject the inference. By contrast, the extent to which the present renewable technology alone is not mature enough to sustain our economic activities and energy demands is extremely high. Therefore, it is not adequate to discuss the fate of nuclear power by isolating it from the other critical issues such as global warming, climate change, and energy security.

Due to the nuclear fear, nuclear power by itself may never be able to earn enough legitimacy and become a socially acceptable energy source. Yet, it is the only available and affordable energy source that can buy us more time for inventing and exploring better substitutes to replace our current means of electricity generation. By means of broadening the frames of the discourse, the nuclear issue is no longer a dead-end argument of gain or loss between two antagonistic parties. As long as our energy portfolio is open to all energy sources without irrationally excluding any

one, there can be ample room for constructing meaning and building consensus about the most available and affordable means for attaining the ends within an overall frame (Gamson and Modigliani, 1989). Only if this precondition holds, can we then expect to bring the nuclear issue back to rational discourse.

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