

1 Article

## 2 **Anti-incinerator sentiment in China: the role of place** 3 **attachment, trust, and fairness**

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12 **Abstract:** Globally, public acceptance of waste-to-energy (WtE) incinerators is a crucial factor in  
13 implementing national waste-to-energy policies. This study adds to the literature on  
14 anti-incinerator sentiment by drawing upon an extended psychological-emotional model that  
15 integrates place-, trust-, and fairness-based pathways. A total of 338 residents in the Asuwei area in  
16 North Beijing completed a survey on a proposal to construct a WtE incinerator in the vicinity.  
17 Hierarchical regression analyses indicate that place attachment positively enhances anti-incinerator  
18 sentiment through direct effects, as well as through moderation and mediation effects between risk  
19 perception and opposing willingness. Further, institutional trust negatively moderates the impact  
20 of perceived risk on anti-incinerator sentiment, in addition to directly reducing perceived risk.  
21 Trust also influences anti-incinerator sentiment via risk perception, attesting to the effectiveness of  
22 a casual model of trust. Likewise, fairness perception acts as another determinant of opposing  
23 sentiment, similar to trust. We further reveal that procedural fairness plays a more significant role  
24 in predicting anti-incinerator sentiment than does distributional fairness. These findings  
25 demonstrate the importance of using a range of instrumental and more affective strategies to  
26 promote social acceptance of renewable energy infrastructure.

27 **Keywords:** anti-incinerator sentiment; place attachment; trust; fairness; waste-to-energy

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### 29 1. Introduction

30 With rapid economic growth and massive urbanization in China, many metropolises face  
31 serious dilemmas regarding municipal solid waste (MSW) disposal. A 2012 World Bank report  
32 estimated that by 2025, more than 11% of the world's MSW will be generated in China. More than  
33 188.5 million tons of MSW were produced in China in 2016 [1]. WtE incineration, which recovers  
34 energy from discarded MSW and produces electricity and/or steam for heating, is recognized as a  
35 renewable source of energy and is the most effective alternative to landfilling, owing to its high  
36 efficiency, minimal land requirements, and ability to substantially reduce solid mass [2-4]. WtE  
37 incineration is playing an increasingly important role in MSW management and in achieving  
38 emissions reduction goals in China [2,5]. According to China's most recent Five Year Plan  
39 (2016-2020), the total investment in waste treatment facilities will amount to 192.4 billion Yuan  
40 (about \$30 billion), almost half of which will be allocated to the construction of new WtE  
41 incinerators. In addition, the proportion of WtE incineration will increase from 28.6% in 2015 to 50%  
42 in 2020 [6]. As of the end of 2017, a total of 339 WtE incinerator projects had been built and put into

43 operation in mainland China, with a total installed capacity of 7.253 million kilowatts and annual  
44 power generation of 37.52 billion kilowatt hours [7].

45 However, the siting of WtE facilities has encountered considerable resistance from local  
46 communities, with concerns stemming largely from perceived risks and threats to the local  
47 landscape, natural environment, economy, and residents' daily lives [8-10]. Social acceptability  
48 becomes a decisive factor in the implementation of WtE incineration policies and programs, and  
49 thus policy makers and incinerator operators are interested in the public's sentiments regarding the  
50 building of WtE incinerators and in what influences these sentiments. To increase public acceptance  
51 of WtE incinerators and other new energy facilities, numerous studies have highlighted the  
52 importance of psychological and social factors (e.g., risk and benefit perceptions, affective feelings,  
53 and social trust), and provided considerable empirical evidence [4,10-15]. Additional literature has  
54 examined socio-psychological factors and how they shape the public's attitudes toward WtE  
55 incinerators [15].

56 In the literature, two persistent approaches are identified [13,16]. First, place-based explanations  
57 focus on how risky energy facilities alter the emotional connections residents have to their  
58 communities. These include the "Not in My Backyard (NIMBY)" concept, place attachment (or sense  
59 of place), and place knowledge. The NIMBY explanation has been dismissed by many scholars given  
60 its simplistic way of analyzing attitudes. Thus, a more universal or novel explanation is needed  
61 [12,13,17]. Besides the disturbance to natural landscapes, it is widely believed that the presence of  
62 energy projects impacts the attachment and identity of local residents to their places [8,18-20]. Given  
63 the disturbance, attitudes toward energy projects may become negative or skeptical, even when one  
64 has a positive attitude toward renewable technology itself. Therefore, place attachment provides an  
65 alternative explanation for opposition that emphasizes psychological processes, such as meaning  
66 making, emotional responses, and action [12-13]. Secondly, trust- and fairness-based explanations  
67 highlight the importance of placing trust in planning authorities and operating companies, which  
68 plan and approve energy projects. Trust in government and scientists are generally represented by  
69 trust in location outcomes and planning procedures in some studies [21,22] and perceptions of  
70 outcome fairness and procedural fairness (or justice) in other studies [23,24].

71 Studies that have sought to systematically and empirically investigate these combined effects on  
72 social acceptance are scarce. Fast and Mabee, for instance, conducted a comparative case study of a  
73 wind farm to assess the impact of policy choices on the place-making and trust-building potential of  
74 wind projects in the host community [16]. Based on a survey, Devine-Wright suggested that place  
75 attachment, perceived impacts, trust in developers, and procedural justice had significant effects on  
76 public attitude toward a proposal to construct a high voltage power line [13]. The present research  
77 fills a gap in the literature by examining the relationships between perceived risk, place attachment,  
78 trust, fairness perception, and anti-incinerator sentiment among inhabitants living near incinerators  
79 in China. Section 2 reviews the literature and develops an extended framework for interpreting  
80 individuals' opposing sentiments toward incinerators, while Section 3 describes the methodology  
81 issues. The final discussion places our findings in context of the literature and suggests policy  
82 implications.

83

## 84 2. Literature review and theoretical framework

### 85 2.1 Hypotheses

#### 86 2.1.1 Place Attachment

87 As a powerful concept in cultural geography and environmental psychology, “place” refers to a  
88 fundamental human trait of creating meaning attached to the spaces we inhabit [25], comprising  
89 physical landscapes, social interaction, person and home experiences, and other human activities  
90 and processes [26]. Disruptions to place-based attachments, identities, meanings, and values can  
91 cause crucial emotional responses, because it is “essential to get to the root of ...emotional  
92 relationship to place in order to understand people’s reasons of blocking or facilitating certain  
93 community-based efforts” [27] (p. 340). The core construct, place attachment, is usually understood  
94 as a positive emotional bond between people and prized socio-physical settings over time at  
95 different scales, such as homes, neighborhoods, and cities [28]. These bonds help cultivate group and  
96 individual identities [29], a feeling of pride, and a general sense of well-being [30]. However, these  
97 links can be disrupted or threatened by diverse forms of change (e.g., landscape transitions,  
98 involuntary relocations, and development of large facilities), leading to negative affects, such as  
99 anxiety, grief, and anger [31,32].

100 In the context of siting WtE incinerators, such developments physically (re)shape places and  
101 socially characterize communities as renewable energy communities. Opposition intention occurs  
102 when inhabitants feel austere external threats posed by environmental changes. According to  
103 Devine-Wright, the influence of renewable energy infrastructure on natural landscapes can be  
104 considered a disruption to place attachment or a threat to place identity, where disruption not only  
105 refers to the physical nature, but also to the symbolic and social values of the landscape [12]. Unlike  
106 wind farm projects, which can be perceived positively and negatively, incinerator projects are  
107 generally considered threats to the primitive landscape [11,33]. The impacts of local energy  
108 development on landscape has been viewed as central to community opposition [34,35]; for instance  
109 an incinerator chimney is typically regarded as a visual perturbation to local landscapes.  
110 Furthermore, the threat of renewable projects to landscapes is not only a problem of aesthetics, but  
111 also represents a loss of symbolic value; that is, people with strong bonds to their community may  
112 view such projects as an “alien invasion” [36] (p. 64). Studies have employed place attachment to  
113 describe the value of landscapes in explaining public opposition to disputed projects [12,36]. Jasper  
114 described the emotions of protest as a continuum from “long term” affects (e.g., love of rural  
115 landscape, “fondness for neighborhood,” or ongoing loyalty to place) to immediate reactions [37].

116 Research has shown that place attachment influences behavioral intention toward place change  
117 caused by energy projects [18-20,38]. Individuals who hold strong place attachment and a more  
118 positive sense of identity from particular rural landscapes are more likely to feel threatened and take  
119 part in oppositional behaviors [12,13,18,39]. As for the relationship between place attachment and  
120 risk perception, Venables *et al.* reported that attachment offers a feeling of safety and leads to a  
121 neglect of nuclear power risk[14]. More generally, Bernardo summarizes that place attachment may  
122 contribute to amplifying high probability risk perceptions (less dangerous, but more frequent),  
123 while attenuating the perception of low probability risks (often most dangerous, e.g., nuclear  
124 accidents) [40]. Such evidence led us to develop the following hypotheses:

125 **Hypothesis 1** Anti-incinerator sentiment toward a community WtE incinerator is a function  
126 of the interaction between perceived risk and place attachment to a dwelling community.  
127 Specifically:

128 **Hypothesis 1.1** People with higher place attachment have a higher level of anti-incinerator  
129 sentiment.

130 **Hypothesis 1.2** People with higher risk perception have a higher place attachment to a  
131 dwelling community.

132 **Hypothesis 1.3** People with higher place attachment have a higher risk perception toward a  
133 community WtE incinerator.

134 In the setting of natural disasters, moderating and mediating effects exerted by place  
135 attachment are found between risk perception and coping behavioral responses. For example, based  
136 on empirical studies in two Italian cities exposed to flood risk, De Dominicis *et al.* found that place  
137 attachment negatively moderated the connection between risk perception and preventive coping  
138 behaviors [41]. Venables and colleagues suggested that sense of place mediates (but does not  
139 moderate) the relationship between the proximity and risk perception for renewable energy projects  
140 [14]. Lima and Marques found that place identity acts as a statistical moderator in the relationship  
141 between proximity and local people's perceptions of risk in relation to the siting of a new incinerator  
142 [42]. However, for controversial energy facilities, this moderating or mediating effect between risk  
143 perception-coping sentiment has not been sufficiently investigated. Therefore, further investigation  
144 must explore how place attachment affects the connection between risk perception and opposing (or  
145 acceptance) sentiment related to WtE sitings.

146 **Hypothesis 1.4** Place attachment moderates the effect of risk perception on anti-incinerator  
147 sentiment toward a community WtE incinerator. Specifically, place attachment increases the  
148 positive effect exerted by perceived risk on anti-incinerator sentiment.

149 **Hypothesis 1.5** Place attachment mediates the connection of risk perception and  
150 anti-incinerator sentiment toward a community WtE incinerator.

151 Moreover, we cannot be certain whether risk perception acts as a mediator between place  
152 attachment and anti-incinerator sentiment. Further, we assume that:

153 **Hypothesis 1.6** Risk perception mediates the connection between place attachment and  
154 anti-incinerator sentiment.

### 155 2.1.2 Trust and Fairness

156 A community's acceptance or opposition attitude is also a question of fairness and trust. Trust is  
157 conceptualized and studied in different literature, such as in management, organizational behavior,  
158 and political science. This term is also a key concept in the literature on the sociology of technology,  
159 and "acts as a substitute for knowledge in complex societies characterized by risk" [43] (p. 3). As "a  
160 psychological state comprising the intention to accept vulnerability based upon positive  
161 expectations of the intentions or behaviour of another" [44] (p. 395), trust means "a willingness to  
162 rely on those who have the responsibility for making decisions and taking actions related to the  
163 management of technology and policy implementation" [45,46] (p. 447). It serves as an indispensable  
164 catalyst for satisfying cooperation of diversified actors striving to solve controversial problems [47]  
165 and is "essential for the capacity of social-ecological systems to adapt to and shape change" [48] (p.  
166 261).

167 The multidimensionality of trust has been presented in selective configurations. Based on extant  
168 research, Fulmer and Gelfand distinguish between *trust at a level* and *trust in a referent*. Three  
169 organizational levels—individual, team, and organizational—and three referents—interpersonal,  
170 team, and organization— are elaborated upon [49]. In the context of siting controversial energy  
171 projects, trust generally denotes an individual's degree of trust in varied organizational entities,  
172 such as operating enterprises, regulatory authorities, and academic circles in incineration area. In  
173 two case studies of power line development, Ceglarz *et al.* developed a conceptual meaning of three  
174 dimensions of trust—interpersonal, social, and institutional—and underpinned the importance of all  
175 of these dimensions in conducting public engagement processes [47]. Additionally, Mah *et al.*  
176 proposed three dimensions of trust: trust in motives (integrity, care, and fairness), trust in  
177 transparency (openness), and trust in competency (credibility, competence, and reliability), within  
178 the context of nuclear power [50]. For our research, we focus on institutional trust, that is, the level of  
179 an individual's trust in authorities from regulatory governments and operating enterprises, and  
180 experts and scholars in the incinerator field.

181 There is substantial empirical evidence that institutional trust interacts with risk perception and  
182 acceptance of local negative changes [4,51,52]. The degree to which host community members trust  
183 the siting process and the wider policy decisions to advance renewable energy programs is of  
184 extreme importance to promote the implementation of renewable energy policy [16,53]. In nuclear  
185 energy decision-making, distrust in key decision-makers in relation to the dimensions of motives,  
186 transparency, and competence is one of the major factors that explains high risk perception and  
187 opposition to nuclear energy [50]. In the Chinese mainland, when unfamiliar with nuclear power  
188 stations, people are inclined to perceive the benefits and risks through emotional identification and  
189 social trust, rather than rational deduction [54]. Specific to the siting of WtE incinerators, trust in  
190 authorities (local government and operators) is found to positively associate with public acceptance,  
191 both directly and indirectly, through risk perception, and promoting public trust can enhance public  
192 acceptance more efficiently than reducing perceived risk [4,55]. Drawing upon these findings, we  
193 hypothesize the following:

194 **Hypothesis 2.1** Institutional trust negatively predicts anti-incinerator sentiment toward a  
195 community incinerator.

196 **Hypothesis 2.2** Institutional trust negatively influences perceived risk.

197 Although it is widely recognized that acceptance, trust, and risk perception often interact, there  
198 is still considerable disagreement about the underlying patterns of causality among the constructs.  
199 As *the casual model of trust* (CMT) indicates, trust affects technology acceptance through risk  
200 perceptions or benefits. In a cross-cultural investigation of 23 activities and technological hazards,  
201 trust in regulatory organizations was found to be directly and indirectly linked with public  
202 acceptance, and perceived benefit plays a more important role than perceived risk in mediating the  
203 trust-acceptability casual chain [56]. Regarding nuclear power plants (NPPs), goodwill trust  
204 improves acceptance of NPPs by decreasing risk perception, while competence trust improves the  
205 acceptance by increasing benefit perception [57]. However, these findings are challenged by *the*  
206 *associationist model of trust* (AMT), which asserts that acceptance drives both trust and risk perception  
207 [58,59]. For example, Boecker and Necella found that risk perception is a precondition for trust  
208 playing a role in decision making, and there was no empirical evidence to show that the impact of  
209 trust on acceptance is mediated through risk perception [60]. Rather than being a determinant, trust



210 in government regulation is an expression or indication of the acceptability of genetically modified  
211 food, and specific risk judgments are driven by more general evaluative judgments, termed “affect”  
212 by Poortinga and Pidgeon [61]. Considering the conflicting results, it is necessary to discuss which  
213 model is supported in explaining the trust-acceptance relationship in Chinese WtE contexts.

214 Additionally, within the context of community energy projects, (generalized) trust is found to  
215 positively predict the willingness to participate and moderates the effect of community identity on  
216 the willingness to participate in a local community energy project [62]. Therefore, in addition to the  
217 direct effect of trust on resistant sentiments, we propose an interaction of trust with perceived risk  
218 and place attachment. We expect that risk perception or place attachment has a positive association  
219 with residents’ anti-incinerator sentiment through changes in trust, and propose the following  
220 hypotheses:

221 **Hypothesis 2.3** Trust moderates the positive effect of perceived risk on the anti-incinerator  
222 sentiment toward a local incinerator. Specifically, when people have a higher degree of trust,  
223 the positive impact of perceived risk on anti-incinerator sentiment will be relieved to some  
224 extent.

225 **Hypothesis 2.4** Trust moderates the positive effect of place attachment on anti-incinerator  
226 sentiment toward a local incinerator. Specifically, when people have higher degree of trust,  
227 even higher place attachment will not significantly increase the intention to resist an  
228 incinerator located in their community.

229 We also assume that risk perception mediates the linkage between trust and anti-incinerator  
230 sentiment, in order to test whether the CMT model is supported. The relationship between trust and  
231 general attitude is also the interest of our paper. Thus, two additional hypotheses are proposed:

232 **Hypothesis 2.5** Risk perception mediates the connection between trust and anti-incinerator  
233 sentiment.

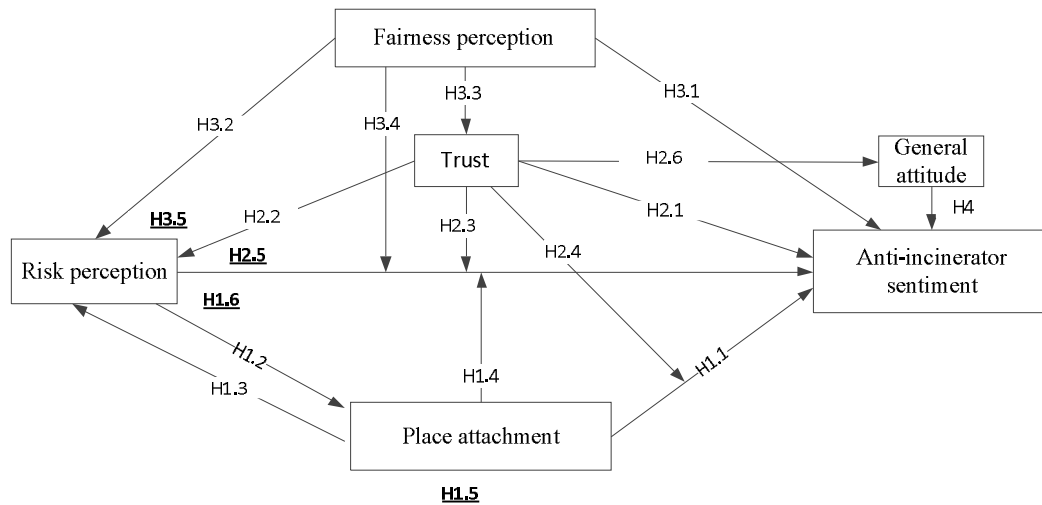
234 **Hypothesis 2.6** Trust positively influences the general attitude (intention to accept WtE  
235 technology).

236 Distrust associates with feeling treated unfairly or unjustly, which is another emotional cause  
237 for oppositional activism, and in this aspect, it can be represented in terms of perceived fairness or  
238 justice, including perceptions of both procedural (how decisions are made) and distributional (who  
239 gets what) justice [36,63]. Perceived procedural fairness/justice is a subjective assessment of  
240 participative and deliberative fora and mechanisms of public engagement [64], including several  
241 issues, such as timing, transparency, and equity (for a detailed discussion, see Goedkoop and  
242 Devine-Wright [22]). Distributional fairness/ justice is about how costs, risks, and benefits are  
243 distributed [34]. A fair settlement plan and transparency in the implementation of the compensation  
244 plan are conducive to lessening the interest conflicts [9]. Therefore, the perception of fairness/justice,  
245 as emphasized by Wolsink [34] and Wester-Herber [8], is another issue of importance in incinerator  
246 siting. Hall *et al.* asserted that distributional justice and procedural justice can foster trust and reduce  
247 opposition to energy projects [23]. As stated by Huijts, Molin, and Steg, judgments of fairness can  
248 lead to trust and vice versa [65]. Although fairness research has uncovered important findings, it  
249 remains unclear whether the effect of risk perception on opposing sentiment is moderated by  
250 fairness perception, and whether fairness perception impacts resistance intention through risk  
251 perception. Thus, we will further explore the connections between these constructs with respect to  
252 incinerator sitings in Chinese society, and the following related hypotheses are suggested:

253 **Hypothesis 3.1** Fairness perception can reduce anti-incinerator sentiment.  
 254 **Hypothesis 3.2** Fairness perception can reduce perceived risk toward a local WtE incinerator.  
 255 **Hypothesis 3.3** Fairness perception positively predicts institutional trust in the authorities  
 256 operating and regulating a WtE incinerator.  
 257 **Hypothesis 3.4** The effect of risk perception on anti-incinerator sentiment is moderated by  
 258 fairness perception.  
 259 **Hypothesis 3.5** Risk perception mediates the connection between fairness perception and  
 260 anti-incinerator sentiment.  
 261 We also hope to understand which fairness perception is more important in predicting  
 262 accepting attitude. Hence, the last hypothesis is assumed.  
 263 **Hypothesis 3.6** In China, distributional fairness perception is more important than procedural  
 264 fairness perception in predicting anti-incinerator sentiment.

## 265 2.2 Theoretical Framework

266 Based on an extant socio-psychological model and empirical studies on renewable energy  
 267 projects, an extended model is developed to investigate the effects of psychological-emotional  
 268 factors on the public's acceptance of WtE incinerators in China's metropolitan settings. **Figure 1**  
 269 shows the hypothesized conceptual model. We integrate place-based and trust-based factors into a  
 270 model of residents' attitudes toward WtE incinerator development. In this model, perceived risk,  
 271 place attachment, trust, and perceived fairness are exogenous variables, and attitude toward WtE  
 272 incinerators is an endogenous variable.



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 274

**Figure 1.** Conceptual model of the study

## 275 3. Materials and Methods

### 276 3.1 WtE incinerator project and local context

277 The Asuwei (meaning “defense” in Mongolian) area is located in Xiaotangshan in the  
 278 Changping District of Beijing and includes several villages (e.g., Asuwei, Erde Zhuang,  
 279 Niufangjuan, and Baishan) and upscale villa communities (e.g., Baolilongshang, Panaxigu, and  
 280 Jujun). According to the three-year (2013-2015) implementation plan for the construction of  
 281 municipal solid waste treatment facilities in Beijing [66], the Asuwei WtE incinerator was planned to  
 282 be placed into operation by the end of 2017, at which time it was estimated that approximately 3,000

283 tons of domestic garbage would be disposed of every day, and the annual power generation would  
 284 reach 350 million kilowatt hours, of which 70% would be integrated into power distribution  
 285 networks. Since being informed of plans for the Asuwei WtE incinerator, villagers and residents  
 286 have expressed their complaints in various ways, including signing a petition against the building of  
 287 incinerator, petitioning government departments, and participating in demonstrations and other  
 288 protests.

### 289 3.2 Procedure and respondents

290 From May–July 2016, a survey was conducted in the Asuwei area. To approach a heterogeneous  
 291 sample, a stratified sampling method was used. First, the communities surveyed were divided into  
 292 rural and urban communities, with the former including the villages of Asuwei, Baishan, and  
 293 Niufangjuan, and the latter including Baolilongshang and Tang House. Second, 100 questionnaires  
 294 were distributed door-to-door by local fieldworkers in each community. A total of 500 copies were  
 295 distributed, and 338 respondents (67.6% response rate) returned a completed survey, with male and  
 296 female participants ranging in age from 19 to 72 years ( $M=45.2$ ,  $SD=12.7$ ). Overall, the participants  
 297 have lived in the area for an average of 22.3 years ( $SD=19.7$ , range: 3–67) and reported an average of  
 298 approximately 110,000 Yuan in annual household income ( $SD=166,000$ , Range=20,000–220,000).  
 299 **Table 1** provides an overview of the sample characteristics.

300  
301

**Table 1.** Sample demographics (N=338)

Variable	Group	Frequency	Percentage (%)	Variable	Group	Frequency	Percentage (%)
Gender	Male	180	53.3	Average annual household income	<50K(RMB)	132	39.1
	Female	158	46.7		60K-100K	61	18.0
Age	18-30	47	13.9		110K -200K	103	30.5
	31-40	89	26.3		210-300K	33	9.8
	41-50	92	27.2		>310K	10	3.0
	51-60	77	22.8	<10 (years)	11-20	76	22.5
>61	33	9.8	21-30		41	12.5	
Educational level	Primary	91	26.9		31-40	20	5.9
	Secondary	158	46.7	41-50	22	6.5	
	Higher	89	26.3	Dwelling time	51-60	25	7.4
Home-ownership	Renter	76	22.5		>60	11	3.3
	Owner	262	77.5	Community type	Urban	170	50.3
					Rural	168	49.7

### 302 3.3 Measures

303 A 34-item questionnaire was designed following reviewed literature to evaluate: (1)  
 304 respondents' resistant sentiment toward the WtE incinerator in a dwelling community; (2)  
 305 respondents' perceptions of risk and place attachment to the dwelling community; (3) respondents'  
 306 institutional trust levels in key actors, namely academics/experts, operators, and regulatory  
 307 agencies, and perceptions of fairness, including procedural fairness and distributive fairness; and (4)  
 308 respondents' socio-demographic characteristics. A seven-point Likert scale (1=strongly disagree,  
 309 4=neutral/undecided, and 7=strongly agree) was used to rate the above constructs. The measures for  
 310 each construct are presented as follows:



311 **General attitude (GA).** Three items (Cronbach's  $\alpha = 0.91$ ) measuring residents' attitude toward  
312 WtE industry or technology are adapted from previous studies [15]. The items are: "I think WtE  
313 incineration is necessary to dispose MSW" (GA1), "I accept incinerators in my city" (GA2), and "I  
314 am not in favor of developing WtE incinerators as a form of disposing garbage" (GA3).

315 **Anti-incinerator sentiment (AS).** First, we adopted an item to identify the basic intention, which  
316 is "I am willing to oppose the construction of a WtE incinerator in my community". Then, four items  
317 were adapted from De Groot and Steg [67] and Prati and Zani [68] to measure anti-incinerator  
318 sentiments (Cronbach's  $\alpha = 0.86$ ). Respondents were asked "If you are willing to oppose the  
319 construction of an incinerator, will you assume the following kinds of behavior?" The four kinds of  
320 actions comprise expressing opinions against the building of incinerators (AS1), signing the petition  
321 against the building of incinerators (AS2), petitioning government departments (AS3), and  
322 participating in demonstrations and other protests (AS4). We averaged scores, and higher numbers  
323 indicate higher anti-incinerator sentiment.

324 **Perceived risk (PR).** To assess risk perception of a WtE incinerator, a three-item scale  
325 (Cronbach's  $\alpha = 0.76$ ) was used, adapted from Brewer and colleagues' meta-analysis of risk,  
326 including perceived likelihood, perceived susceptibility, and perceived severity [69]. They are: "It is  
327 likely that I could get sick from the proposed incinerator" (PR1), "I get sick more easily than before  
328 the incinerator was built" (PR2), and "Pollution from the incinerator can cause cancer and even  
329 death" (PR3).

330 **Place attachment (PA).** PA is measured as neighborhood attachment using a four-item scale  
331 (Cronbach's  $\alpha = 0.89$ ) borrowed from Fornara *et al.*, which measured integration, identity, and  
332 rootedness toward the neighborhood of residence [70]. The items are: "This neighborhood is part of  
333 me" (PA1), "It would be very hard for me to leave this neighborhood" (PA2), "This is the ideal  
334 neighborhood for me" (PA3), and "I do not feel integrated in this neighborhood" (PA4).

335 **Institutional trust (IT).** A list of organizations and institutions was read to participants, and  
336 they were asked how much trust they have in **motives, transparency, and competency**. These  
337 entities were divided into three groups: industry, government, and community of scientists.  
338 Incinerator industry trust (IIT) refers to trust in operators of incinerators, governmental trust (GT)  
339 consists of trust in incinerator regulatory authorities, such as the Environmental Protection Agency  
340 and City Administration Bureau. Academics/experts trust (AT) indicates trust in scientists and  
341 engineers working in incineration related fields. The items (Cronbach's  $\alpha = 0.95$ ) adapted from Mah  
342 *et al.* [50] are: "I trust in operators of incinerators" (T1), "I trust in scientists and engineers in  
343 incineration areas" (T3), "I trust in incinerator regulatory authorities, such as the Environmental  
344 Protection Agency" (T3). Together, the three items formed an internally consistent scale  
345 (Cronbach's  $\alpha = 0.821$ ).

346 **Fairness perception (FP).** Two dimensions of justice as it relates to the location of energy  
347 facilities are procedural justice and distributional justice [71]. Based on the work of Tyler [72] and  
348 King and Murphy [73], a seven-item procedural justice scale (Cronbach's  $\alpha = 0.95$ ) was used to  
349 measure four aspects of procedural fairness perception: voice, respect, trustworthiness, and fairness.  
350 Distributive justice in this study was measured via a two-item scale (Cronbach's  $\alpha = 0.86$ ) borrowed  
351 from Visschers and Siegrist [53]. The items focused on the fairness of decision in general and on the  
352 costs and benefits for the local communities, which included "The financial compensations (e.g., tax  
353 payments of operators) counterbalance the disadvantages (e.g., accident risks and environmental

354 pollution)" and "The wishes of the population at that site are sufficiently considered at the site  
355 selection of WtE incinerators".

### 356 3.4 Data analysis

357 To test the hypotheses, multiple regression analyses and moderation and mediation analyses  
358 were performed using IBM SPSS version 21 and its PROCESS procedures [74,75]. Our study is  
359 divided into three sections: (1) interactions between risk perception, place attachment, and  
360 anti-incinerator sentiment; (2) interactions between risk perception, trust, and anti-incinerator  
361 sentiment; and (3) connections between risk perception, fairness perception, and anti-incinerator  
362 sentiment.

## 363 4. Results

### 364 4.1 Descriptive statistics

365 As **Table 2** and **Figure 2** show, first, residents' general attitudes about WtE incineration as a  
366 means of disposing MSW are positive although anti-incinerator sentiment is slightly higher.  
367 Expressing opinions against incinerators is the most preferred form of protest, while participating in  
368 protests is the least preferred form of protest. Second, the data show higher levels of risk perception  
369 and place attachment than general attitude and anti-incinerator sentiment. The respondents report a  
370 subaverage level of institutional trust and fairness perception, especially about trust in operators  
371 and distributive fairness.

372

**Table 2.** Overview of main constructs

Measures (N=338)	Mean	SD	Measures	Mean	SD
<b>General attitude (GA)</b>	4.46	1.17	<b>Place attachment (PA)</b>	4.82	1.07
GA1 (necessity)	4.46	1.05	PA1 (integration)	4.77	1.10
GA2 (acceptance in one's city)	4.38	1.25	PA2 (identity)	4.58	1.27
GA3 (technological acceptance )	4.55	1.48	PA3 (rootedness)	4.90	1.13
<b>Anti-incinerator sentiment (AS)</b>	4.86	1.24	PA4 (integration)	5.00	1.41
AS1 (express opinions)	5.28	1.22	--	--	--
AS2 (sign petitions)	4.88	1.25	<b>Institutional trust</b>	3.68	1.46
AS3 (petition the gov.)	4.65	1.25	IT1 (Trust in academics)	4.08	1.45
AS4 (participate in protests)	4.20	1.09	IT2 (Trust in operators)	3.09	1.48
<b>Perceived risk (PR)</b>	4.95	0.81	IT3 (Trust in regulatory agencies)	3.87	1.66
PR1 (perceived likelihood)	5.02	1.00	<b>Fairness perception (FP)</b>	3.64	1.26
PR2 (perceived susceptibility)	4.98	0.97	Procedural fairness	3.79	1.60
PR3 (perceived severity)	4.85	1.01	Distributive fairness	3.50	1.32

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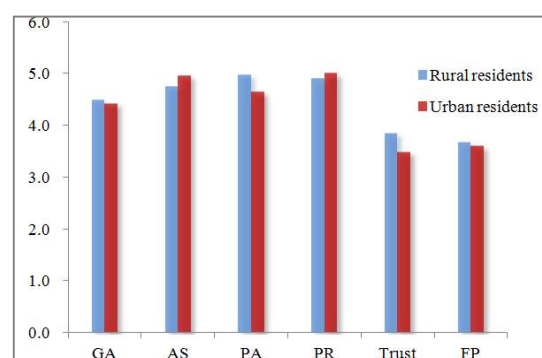
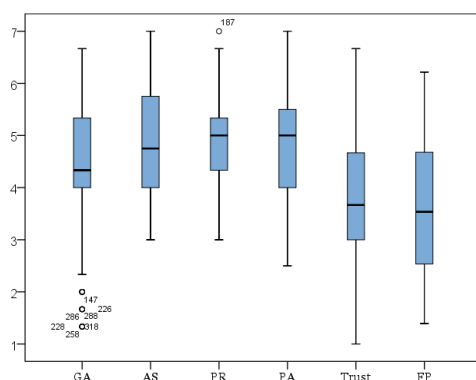
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382 (a) (b)  
 383 **Figure 2.** (a) Box plot of main constructs; (b) Comparison of group arithmetic means  
 384 Note: GA: General attitude, AS: Anti-incinerator sentiment, PR: Perceived risk, PA: Place attachment, FP:  
 385 Fairness perception

386

387 We analyzed whether rural and urban residents hold different perceptions and attitudes toward  
 388 the community WtE incinerator and their dwelling place. As shown in **Figure 3**, for the six variables,  
 389 a comparison of group arithmetic means indicates nearly equal levels, and according to Levene's  
 390 test, the assumptions of homogeneity of variance for all constructs were not rejected (all  $p > 0.05$ ,  $F <$   
 391  $3.03$ ). Thus, using an *independent sample t test* to compare the intergroup differences, we find that all  
 392 other main constructs are not significantly different, excepting place attachment ( $t(335) = 2.92$ ,  $p =$   
 393  $0.004$ ,  $95\% CI [0.11, 0.56]$ ) and trust ( $t(336) = 2.30$ ,  $p = 0.022$ ,  $95\% CI [0.05, 0.67]$ ). In addition, the  
 394 magnitude of difference in the mean is negligible. Thus, we integrated the two groups of data and  
 395 further investigated their characteristics and inner casual relationships.

#### 396 4.2 Correlation analysis

397 Correlations between the variables of interest are shown in **Table 3**. General attitude shows a  
 398 moderate negative relationship with anti-incinerator sentiment; perceived risk, by contrast, shows a  
 399 positive relationship with trust and fairness perception. There is a slightly stronger correlation  
 400 between anti-incinerator sentiment and risk perception, along with trust and fairness perception,  
 401 with which the relationships are negative. Hence, we also find a positive association between  
 402 perceived risk and place attachment, and relatively higher and negative linkages of the former with  
 403 trust and fairness. Finally, trust presents a slightly stronger positive connection with fairness, as  
 404 expected.

405

406

**Table 3.** Constructs' partial correlations

Construct	GA	AI	PR	PA	Trust	FP
General attitude	1					
Anti-incinerator sentiment	-.34***	1	.			
Perceived risk	-.46***	.64***	1			
Place attachment	-.19*	.26***	.49**	1		
Trust	.39***	-.66**	-.56**	-.30*	1	
Fairness perception	.37***	-.57***	-.63*	-.27**	.59***	1

407 Note: \*\*\* $p < .001$ , \*\* $p < .01$ , \* $p < .05$ ; Control: age, educational level, gender, homeownership,  
 408 community style, household income. and dwelling time.

409

#### 410 4.3 Regression analysis 1: Risk perception, place attachment, and anti-incinerator sentiment

411 To avoid multicollinearity problems among predictor variables, the authors examined the  
 412 correlation matrix and avoided using two variables with correlation coefficients higher than 0.5  
 413 in the same model (e.g., risk perception and trust and fairness perception) [76]. All the Durbin-Watson  
 414 test values of the regression models listed on in Tables 4–10 are between 0–4, indicating that the  
 415 observed values of the multiple linear regression are mutually independent. Moreover, the

416 tolerances of all the variables are greater than 0.1, and the Variance Inflation Factors (VIF) are less  
417 than 10, suggesting that multicollinearity is not a serious problem.

418 Given that present research predicts relatively complicated causal relationships, excepting  
419 hierarchical regression analysis, the PROCESS procedure in SPSS was adopted to examine the  
420 hypotheses in the conceptual framework (see Figure 1) for its prominent advantages by centering all  
421 predictors automatically, computing the interaction terms, and providing simple slop analysis  
422 results (see Field [77] for a detailed discussion).

423 As shown in **Table 4**, Model 2 indicates that perceived risk is a significant (positive) predictor of  
424 place attachment toward a dwelling community ( $\beta = 0.42$ ,  $t = 10.19$ ,  $p < 0.001$ ), explaining some  
425 amount of the variance in place attachment ( $\Delta R^2 = 0.16$ ,  $\Delta F = 104.22$ ,  $p < 0.001$ ), supporting the **H 1.2**.  
426 In Model 4, place attachment was significantly positive ( $\beta = 0.57$ ,  $t = 10.19$ ,  $p < 0.001$ ) in predicting  
427 perceived risk with some explanatory power ( $\Delta R^2 = 0.21$ ,  $\Delta F = 104.22$ ,  $p < 0.001$ ). Thus **H 1.3** is  
428 confirmed. Therefore, place attachment and risk perception are inseparable and promote one  
429 another, implying possible mutual mediating effects. In Models 5 and 6, we find that the regression  
430 coefficients of trust and fairness perception are both significantly negative on predicting perceived  
431 risk, which supports **H 2.2** and **H 3.2**. Again, these results suggest a possible mediation effect of risk  
432 perception between trust (or fairness perception) and anti-incinerator sentiment. These results are in  
433 line with the conclusions drawn from most of the reviewed literature.

434  
435

**Table 4.** Hierarchical regression of place attachment and risk perception

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Variables	PA	PA	PR	PR	PR	PR
Educational level <sup>a</sup>			0.14*	0.15*	0.13*	0.12*
Homeownership <sup>b</sup>	0.42***	0.33***	0.24***			
Dwelling time	0.27***	0.21**	0.15*			0.08*
Perceived risk		<b>0.42***</b>				
Place attachment				<b>0.57***</b>		
Trust					<b>-0.33***</b>	
Fairness perception						<b>-0.39***</b>
Adjusted R2	0.34	0.50	0.10	0.315	0.38	0.47
F	25.83***	42.72***	6.34***	20.31***	26.44***	36.40***
$\Delta R^2$	0.36	<b>0.16</b>	0.12	<b>0.21<sup>c</sup></b>	<b>0.28<sup>d</sup></b>	<b>0.35<sup>e</sup></b>
$\Delta F$	25.83***	104.22***	6.23***	104.22*** <sup>c</sup>	148.40*** <sup>d</sup>	218.79*** <sup>e</sup>

436 Note. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ ;  $\beta$  = standardized coefficients; Only significant coefficients are presented.

437 <sup>a</sup> Dummy variable for holding bachelor's degree or higher; <sup>b</sup> Dummy variable for renting tenant (vs. being  
438 owner); <sup>c, d, e</sup> are all relative to Model 3.

439

440 To test the interaction effect of perceived risk and place attachment on predicting  
441 anti-incinerator sentiment, the PROCESS procedure was used. As shown in **Table 5**, analysis reveals  
442 a significant (positive) main effect of risk perception ( $\beta = 0.59$ , 95% CI [0.52, 0.65],  $t = 17.89$ ,  $p < 0.001$ ),  
443 consistent with prevailing views; this suggests that high perceived risk promotes anti-incinerator  
444 sentiment. There is also a significant and positive effect of place attachment ( $\beta = 0.66$ , 95% CI [0.59,  
445 0.74],  $t = 17.19$ ,  $p < 0.001$ ), supporting **H1.1**. More importantly, there is a significant interaction effect  
446 ( $\beta = -0.12$ , 95% CI [-0.17, -0.06],  $t = -4.43$ ,  $p < 0.001$ ), indicating that place attachment negatively

447 moderates the relationship between perceived risk and anti-incinerator sentiment (conditional effect  
448 of  $X$  on  $Y = 0.59 - 0.12M$ ), which supports **H1.4**.

449

450

**Table 5.** Risk perception, place attachment, and anti-incinerator sentiment.

Model	<i>R-sq</i>	<i>R2-chng</i>	<i>F</i>	<i>Sig.</i>	$\beta$	<i>t</i>	<i>p</i>
	0.50		32.06	0.000			
Constant					4.923	162.109	0.000
Perceived risk (standardized)					0.586	17.889	0.000
Place attachment (standardized)					0.661	17.189	0.000
PR*PA		0.009	19.594	0.000	-0.116	-4.427	0.000

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Note: Control= Z-age, Z-educational level, Z-gender, Z-homeownership, Z-community type, Z-household  
452 income, Z-dwelling time

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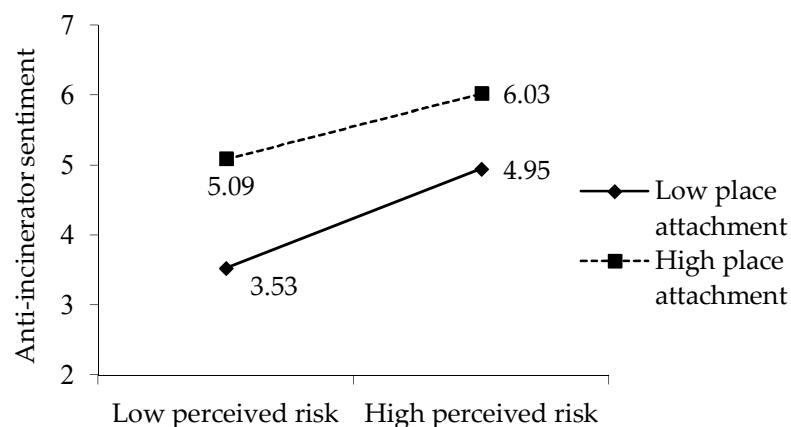
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To further clarify the two-way interaction, spotlight analysis was conducted at one standard  
deviation above and below the mean place attachment using the procedure by Aiken and West [78].  
The result (see **Figure 4**) reveals that when residents maintain higher attachment to their dwelling  
place, there is a significant (positive) but slightly weaker relationship between perceived risk and  
anti-incinerator sentiment ( $\beta = 0.47$ , 95% CI [0.39, 0.55],  $t = 11.30$ ,  $p < 0.001$ ). Similarly, when lower  
place attachment is perceived by residents, there is also a significant (positive) and a slightly  
stronger relationship between perceived risk and anti-incinerator sentiment ( $\beta = 0.70$ , 95% CI [0.62,  
0.78],  $t = 16.63$ ,  $p < 0.001$ ). This indicates that a high level of attachment increases awareness of  
anti-incinerator sentiment, regardless of risk perception, and in the case of lower attachment, the  
anti-incinerator willingness will be constrained to a lower degree, although it rises faster.



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**Figure 4.** Interaction of perceived risk and place attachment

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Next, we tested H1.5 and H1.6. Because H1.1 and H1.2 have been confirmed ( $a$  and  $b$  are both  
significant, see **Table 6**), we expect that there is a mediating effect presented by place attachment  
between risk perception and anti-incinerator sentiment. Thus, the bootstrap method and PROCESS  
Procedure for SPSS were employed to test the interaction of the independent variable (perceived  
risk) and mediating variable (place attachment), and we find that the direct effect ( $c'$ ) of risk  
perception and anti-incinerator sentiment is significant ( $\beta = 0.584$ ,  $SE = 0.035$ , 95% CI [0.532, 0.663],  $t =$   
2.684,  $p = 0.0076$ ), and more importantly, the indirect effect ( $a*b$ ) was proved ( $effect = 0.272$ ,  $SE =$   
0.032, 95% CI [0.204, 0.329],  $p < 0.001$ ). Thus, **H1.5** is supported.



475

**Table 6.** Mediation effect of place attachment

Panel 1:	Mediator (place attachment )				Anti-incinerator sentiment			
		Coeff.	SE	p	Coeff.	SE	p	
Perceived risk	<i>a</i>	0.419	0.041	0.000	<i>c'</i>	0.584	0.035	0.000
Place attachment	-	-	-	-	<i>b</i>	0.649	0.039	0.000
Constant		-0.002	0.386	0.967		4.859	0.027	0.000
Panel 2:		Sobel test ( <i>a*b</i> )			95% confidence intervals			
	<i>Value</i>	<i>SE</i>	<i>t</i>	<i>p</i>	LLCI		ULCI	
Direct effect	0.584	0.034	17.343	0.000	0.518		0.650	
Indirect effect	0.272	0.032	-	-	0.204		0.329	

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Similarly, we tested the possible mediation effect of risk perception between place attachment and anti-incinerator sentiment. It was found that the direct effect (*c'*) of place attachment and anti-incinerator sentiment was not significant ( $\beta = -0.101$ ,  $SE = 0.061$ ,  $95\% CI [-0.220, 0.018]$ ,  $t = -1.667$ ,  $p = 0.096$ ), but the indirect effect (*a\*b*) was proved ( $effect = 0.422$ ,  $SE = 0.049$ ,  $95\% CI [0.325, 0.519]$ ,  $p < 0.001$ ), supporting **H1.6**. In summary, the hypothesized mediation effects of place attachment and risk perception are acknowledged, and risk perception appears to have a higher magnitude on mediation effect than place attachment.

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#### 4.4 Regression analysis 2: trust, fairness, general attitude, and anti-incinerator sentiment

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Then, we added institutional trust, fairness perception, and general attitude in our analysis models. For the main effects tests, as shown in **Table 7**, Models 2–4 indicate that trust, fairness perception, and general attitude all negatively predict anti-incinerator sentiment, and trust provides more explanatory power than the other two variables ( $\beta = -0.55$ ,  $\Delta R^2 = 0.39$ ,  $\Delta F = 253.75$ ,  $p < 0.001$ ). Hence, our findings provide support for **H 2.1**, **H 3.1**, and **H4**. Thus, the greater the amount of trust in authorities, perceived fairness, and more open and inclusive attitudes to WtE incineration (including industry and technology), the less likely one is to object to an incinerator located in the community.

**Table 7.** Hierarchical regression of anti-incinerator sentiment

	Model 1	Model 2	Model 3	Model 4
Variables	AI	AI	AI	AI
Gender			-0.22*	
Homeownership	0.73***		0.49**	0.53**
Community type	0.39*			
Trust		-0.55***		
Fairness perception			-0.50***	
General attitude				-0.34**
Adjusted R2	0.09	0.48	0.38	0.19
F	5.78***	40.65***	26.96***	11.12***
$\Delta R^2$	0.11	<b>0.39</b>	<b>0.29</b>	<b>0.10</b>
$\Delta F$	5.78***	253.75***	156.19***	43.27***

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Similarly, the moderation effect of trust is tested by SPSS the PROCESS procedure. Analysis reveals that, in addition to the main effect of trust ( $\beta = -0.52$ ,  $95\% CI [-0.64, -0.43]$ ,  $t = -9.92$ ,  $p < 0.001$ ), there is a significant interaction effect ( $\beta = -0.12$ ,  $95\% CI [-0.20, -0.05]$ ,  $t = -3.17$ ,  $p = 0.002$ ), indicating

498 that the relationship between risk perception and anti-incinerator sentiment is moderated by  
499 institutional trust (Table 8), supporting H2.3.

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Table 8. Risk perception, trust, and anti-incinerator sentiment

Model	$R^2$	$R^2$ -chng	$F$	Sig.	$\beta$	$t$	$p$
	0.609		50.934	0.000			
Constant					4.680	111.960	0.000
Perceived risk (standardized)					0.446	8.783	0.000
Trust (standardized)					-0.532	-9.920	0.000
PR*Trust		0.012	10.077	0.002	-0.122	-3.174	0.002

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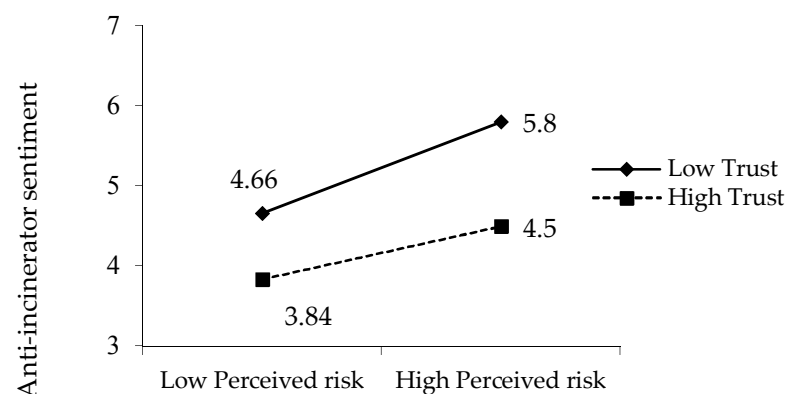
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Spotlight analysis results (Figure 5) reveal that, whether people perceive a lower or a higher level of trust, there is also a significant and positive connection between risk perception and anti-incinerator sentiment (low trust:  $\beta = 0.57$ , 95% CI [0.45, 0.69],  $t = 9.37$ ,  $p < 0.001$ ; high trust:  $\beta = 0.32$ , 95% CI [0.19, 0.45],  $t = 4.86$ ,  $p < 0.001$ ). Specifically, when people perceived a higher degree of trust, the positive impact of perceived risk on anti-incinerator sentiment would be relieved to some extent. Conversely, in the case of lower trust, not only does risk perception give rise to a higher level of anti-incinerator willingness at any level, but the anti-incinerator tendency goes up more sharply.



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Figure 5. Interaction of perceived risk and trust

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Analyses reveal that there is no significant interaction between trust and place attachment on predicting anti-incinerator sentiment ( $\beta = -0.04$ , 95% CI [-0.13, 0.04],  $t = -1.01$ ,  $p = 0.314$ ), rejecting H2.4 (see Table 9).

Table 9. Place attachment, trust, and anti-incinerator sentiment

Model	$R^2$	$R^2$ -chng	$F$	Sig.	$\beta$	$t$	$p$
	0.502		32.824	0.000			
Constant					4.735	97.478	0.000
Place attachment (standardized)					0.081	1.384	0.168
Trust (standardized)					-0.781	-14.756	0.000
PA*Trust		0.002	1.018	0.314	-0.044	-1.009	0.314

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Likewise, the SPSS PROCESS procedure was employed to test the interaction between the independent variable and mediating variable, and we found that the direct effect ( $c'$ ) of trust and anti-incinerator sentiment is significant ( $\beta = -0.362$ ,  $SE = 0.037$ , 95% CI [0.532, 0.663],  $t = -9.723$ ,  $p <$

0.001), and the indirect effect ( $a*b$ ) was proved ( $effect = -0.187, SE = 0.027, 95\% CI [-0.242, -0.139], p < 0.001$ ) (**Table 10**). **H2.5** is supported. As for H3.5, mediation analysis reveals that the direct effects ( $c'$ ) of fairness perception and anti-incinerator sentiment are significant ( $\beta = -0.232, SE = 0.046, 95\% CI [-0.323, -0.142], t = -5.060, p < 0.001$ ), and more importantly, the indirect effect ( $a*b$ ) were also proved ( $effect = -0.265, SE = 0.035, 95\% CI [-0.341, -0.203], p < 0.001$ ), supporting **H3.5**.

**Table 10.** Mediation effect of place attachment

Panel 1:	Mediator ( risk perception )				Anti-incinerator sentiment			
		Coeff.	SE	p	Coeff.	SE	p	
Trust	<i>a</i>	-0.330	0.027	0.000	<i>c'</i>	-0.362	0.037	0.000
Perceived risk	-	-	-	-	<i>b</i>	0.568	0.063	0.000
Constant		6.166	0.106	0.000		3.274	0.407	0.000
Panel 2:	Soble test ( $a*b$ )				95% confidence intervals			
	Value	SE	t	p	LLCI	ULCI		
Direct effect	-0.362	0.037	-9.723	0.000	-0.435	-0.289		
Indirect effect	-0.187	0.027	-	-	-0.242	-0.139		

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530 Last, hierarchical regression analyses reveal that fairness perception significantly and positively  
 531 predicts institutional trust ( $\beta = 0.54, t = 13.40, p < 0.001$ ), with fair explanatory power ( $\Delta R^2 = 0.28, \Delta F$   
 532  $= 179.47, p < 0.001$ ). Similarly, there is a significant (positive) connection between trust and general  
 533 attitude ( $\beta = 0.42, t = 7.80, p < 0.001$ ). Hence, **H3.3 and H2.6** are supported.

534 The PROCESS procedure was used to test the moderation effect of fairness perception between  
 535 risk perception and anti-incinerator sentiment. Analysis reveals that there is a significant interaction  
 536 effect ( $\beta = -0.10, 95\% CI [-0.18, -0.02], t = -2.58, p = 0.010$ ), indicating that the relationship between risk  
 537 perception and anti-incinerator sentiment is also moderated by fairness perception, supporting **H3.4**.  
 538 Moreover, we find that when risk perception is high, the moderation effect of fairness perception is  
 539 greater and vice versa, suggesting that fairness and justice play a larger role in the case of higher  
 540 levels of perceived risk.

541 As for H 3.6, hierarchical regression analyses reveal that both procedural fairness ( $\beta = -0.51, t =$   
 542  $-11.06, p < 0.001$ ) and distributive fairness ( $\beta = -0.43, t = -9.13, p < 0.001$ ) negatively predict  
 543 anti-incinerator sentiment, and the former ( $\Delta R^2 = 0.24, \Delta F = 122.38, p < 0.001$ ) explains a greater  
 544 amount of variance than the latter ( $\Delta R^2 = 0.18, \Delta F = 83.36, p < 0.001$ ), indicating that **H3.6** is not  
 545 supported. Therefore, in China, procedural fairness perception is more important than distributional  
 546 fairness perception in predicting anti-incinerator sentiment.

#### 547 4. Conclusions and Policy Implications

548 This study introduced and tested an extended psychological-emotional model focusing on  
 549 perceived risk, place attachment, institutional trust, fairness perception, and anti-incinerator  
 550 sentiment in the context of a proposed WtE incinerator in an urban-rural fringe area in Beijing.  
 551 Results reveal that people's anti-incinerator sentiment, risk perception regarding a community WtE  
 552 incinerator, and place attachment toward their dwelling place are high, suggesting a generally  
 553 negative attitude toward community-based energy projects and a positive linkage to their  
 554 communities. By contrast, institutional trust, whether in governments or facility operators, is rather  
 555 low, as is fairness perception, including distributive and procedural fairness. Additionally, we find a

556 moderate general attitude toward the WtE incineration industry and technologies, indicating that  
557 WtE incineration is accepted as a necessary way to dispose of MSW.

558 The most intriguing findings of this research are as follows: first, anti-incinerator sentiment is a  
559 function of the interaction between risk perception, place attachment, institutional trust, fairness  
560 perception, and general attitude from a psychological-emotional perspective. Place attachment is  
561 positively associated with anti-incinerator sentiment, consistent with numerous studies on  
562 renewable energy projects [14,19]. One explanation is that people with a higher level of attachment  
563 tend to take their place largely for granted, owing to a lack of competing place experience, refusing  
564 any potential upheavals to the residence place [79]. The higher the degree of immobility and  
565 rootedness in one place, the more the “home” place is regarded as “an irreplaceable refuge, a site of  
566 unreflective security, certainty and familiarity in otherwise insecure, unstable and nameless space”  
567 [80] ( p. 208). Place attachment and risk perception reinforce one another, suggesting that local  
568 residents’ sense of place may actually intensify as a socio-cultural response to a perceived threat or  
569 stigmatization [14], and that, in turn, acts as a situational amplifier of perceived risks. Conversely,  
570 trust in authorities, fairness perception, and general attitude represent the negative predictors of  
571 anti-incinerator sentiment in our study which replicates many studies on technology acceptance  
572 [4,53,62].

573 Place attachment positively enhances anti-incinerator willingness, through both moderating  
574 and mediating paths between risk perception and anti-incinerator sentiment, indicating that it  
575 amplifies the positive effect exerted by perceived risk on anti-incinerator sentiment and serves as a  
576 bridge connecting the two concepts. Conversely, risk perception acts as a mediator in connecting  
577 place attachment and opposing intention toward the incinerator. An impressive body of literature  
578 indicated that place-related constructs exhibit different effects and even a lack of significant effects in  
579 predicting the acceptance of energy projects. For the most of controversial facilities (such as nuclear  
580 power stations, coal mines, and powerlines), the effect of place attachment was negative (e.g.,  
581 Devine-Wright [13], Venables *et al.* [14]), while for many studies about tidal energy facilities and  
582 wind farms, the effect is positive [19,33]; no effect has been found for solar energy development [81].  
583 In addition, a lack of investigation into the moderation or mediation effects of place attachment  
584 between risk perception and opposing willingness may be a possible reason for these contradictory  
585 conclusions.

586 Further, institutional trust not only directly reduces anti-incinerator sentiment and promotes  
587 positive general attitude toward developing incinerator projects, but it also negatively moderates the  
588 impact of perceived risk on protesting willingness, consistent with other studies (e.g. Liu *et al.*, [4]).  
589 In the case of high levels of trust, even a greater magnitude of risk perception would make it difficult  
590 to generate an inevitable anti-incineration tendency. On the contrary, a low level of trust magnifies  
591 the impact of risk perception on anti-incinerator sentiment. That is, trust in authorities generally  
592 contributes to weakening the negative evaluation of the introduction of renewable energy facilities.  
593 Trust also influences anti-incinerator sentiment through lessening risk perception, partially attesting  
594 to the effectiveness of *the casual model of trust* [58]. However, we do not confirm that trust moderates  
595 the connection between place attachment and anti-incinerator sentiment. Because we did not  
596 consider further factors, such as motivation, value [82,83], environmental and climate change beliefs  
597 [15,84], affect [85,86], and personal norms [67], we fail to discuss whether *the associationist model* is  
598 effective in our analysis. As stated by Boecker and Necella [60] (p. 275), “trust and risk judgments

599 are driven by and thus simply indicators of higher order attitudes toward a certain technology  
600 which determine acceptance instead." For example, a study indicated that altruism values buoy  
601 wind energy attitudes, while valued of traditionalism diminishes wind energy support [84].

602 Finally, fairness perception lessens risk perception and objecting attitudes toward  
603 community-based initiatives and promotes institutional trust. Risk perception mediates the  
604 connection between fairness and anti-incinerator sentiment, similarly to its role in *the casual model of*  
605 *trust*. With regard to fairness, we find that procedural fairness plays a more important role in  
606 predicting anti-incinerator sentiment than distributive fairness, indicating that, in contrast to the  
607 benefit-risk allocation, whether the planning and construction process of risk facilities is open, equal,  
608 and transparent has greater weight for people's risk perception and acceptance tendencies. This  
609 result implies the importance of information communication and public engagement in  
610 decision-making processes, and appears to be more in line with previous literature, which argued  
611 that procedural fairness, or participatory justice contributes to the promotion of trust in the  
612 relationship between a company and community, and ultimately facilitated the acceptance of  
613 community (e.g. Hagget [21]; Lacey *et al.* [87]; Liebe *et al.*, [88]). However, this contradicts other  
614 studies; Visschers and Siegrist noted that outcome fairness, along with general attitudes toward  
615 nuclear power, strongly increase decision acceptance, and procedural fairness had only a small  
616 impact [53].

617 Based on an extended psychological-emotional model and systematic empirical study, the  
618 study addresses a gap in the literature on place attachment [12,13,89], institutional trust [47,59], and  
619 fairness perception [53,90] with regard to a community WtE incinerator project in China, and makes  
620 a scholarly contribution to research on the social acceptability of community renewable energy and  
621 the transformation of human-place relationships disturbed by the introduction of energy projects.  
622 The conclusions of this study can be expected to contribute to the improvement of planning and  
623 locating policies that take into account local residents' attachment and identity to dwelling places,  
624 public participation in the early stages of siting processes, and information communication, which  
625 are thought by most scholars to be effective strategies to promote fairness perception and trust in  
626 regulatory authorities and companies [21,27,87]. By enhancing local residents' attachment, or at least  
627 not disturbing it, we hope it will help reduce risk perceptions, discourage people's anti-incinerator  
628 sentiment, and promote social acceptance. To increase people's place dependence to their dwelling  
629 place, for example, authorities can coordinate the appearance of the building with the local natural  
630 landscape, or provide local residents with jobs and necessary financial subsidies.

631 Another important contribution is the confirmation of the importance of fairness perception and  
632 institutional trust, which can reduce anti-incinerator attitudes directly and indirectly via risk  
633 perception, implying the needed prioritization of public engagement and risk communication,  
634 rather than economic compensation, when implementing the renewable energy policy [4,91].  
635 However, as many authors have observed, the lack of participating opportunities was a common  
636 phenomenon in the siting procedures of renewable energy project, including wind farms, nuclear  
637 power stations, unconventional gas development, and WtE incinerators [54,64,92]. At present,  
638 during the process of advancing renewable energy policy in China, deficient public participation  
639 and inefficient risk communication have been widely criticized, especially during environmental  
640 impact assessments. Although a series of regulations and policies have been successively



641 promulgated and implemented, long-term and strenuous efforts are required to ensure genuine  
642 public participation and risk management.

643 We show that trust does play an indispensable role in advancing community renewable energy  
644 projects. Trust is a prerequisite for cooperation and requires strong and continuous communication  
645 efforts. As stated by Fast and Mabee [16] (p. 28), “host communities trust in the siting process is  
646 independent of their trust in wider energy policy.” In the context of China’s WtE incinerators, trust  
647 is more related to opportunities for meaningful engagement in the decision-making process and  
648 more communication with the public about the risks, benefits, and costs associated with  
649 controversial facilities. Furthermore, trust is mutual, and the prerequisite for public trust is trust in  
650 the public first. In fact, developers often express skepticism regarding the capacities and  
651 representativeness of community actors, and community actors view developers as solely motivated  
652 by profit, instrumentally using public engagement to gain planning consent. For trust to be built,  
653 more positive strategies should be undertaken (for instance, partner identification mechanisms and  
654 shared ownership should be adopted within the energy transformation context [22]).

655 The present study has several limitations. First, there are methodology limitations, including  
656 the small sample size used to test the hypotheses, and the short time frame of investigation. As a  
657 result, the change trajectories of people’s risk attitudes and range of perceptions have not been  
658 captured. Second, our conceptual model did not involve other important “higher order” attitudinal  
659 factors, such as value, environmental beliefs, and personal norms. Therefore, further research is  
660 necessary on these subjects using detailed qualitative analysis and systematic quantitative study; in  
661 addition, a longitudinal survey would provide additional insight into respondents’ risk perceptions  
662 and protective behavioral intentions.

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