



**Two Heads are Better than One; The Effects of Social Cohesion and
Knowledge on Willingness to Participate in the Energy Transition in
the Region of Utrecht**

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Abstract

Mitigating the issue of climate change calls for a transition from natural gas towards renewable energy sources in Dutch homes. The present study aimed to explore the social side of the energy transition in the Netherlands, by investigating the effect of social cohesion in the neighbourhood on the willingness to participate in the energy transition, and a potential mediating effect of knowledge about the energy transition. Based on previous findings, social cohesion and knowledge about the energy transition were expected to positively affect the willingness to participate in the energy transition. Additionally, social cohesion was expected to positively affect knowledge about the energy transition. The present study used quantitative data from questionnaires developed by students from Utrecht University, which had been taken in municipalities across the region of Utrecht. Hypotheses were tested using simple linear regression and multiple linear regression models. All predicted relationships were found to be significant, albeit small in effect size. Additionally, knowledge about the energy transition has been found to fully mediate the relationship between social cohesion and willingness to participate in the energy transition. These findings indicate that effect of social cohesion might be explained through knowledge, and thus the direct effect of social cohesion might not be as influential as assumed. The present study provides a modest first insight into the way these concepts interact, and how they operate at the local level. Thus, social cohesion and the shared knowledge it facilitates might be valuable ways for municipalities and policymakers to increase participation in the energy transition in the region of Utrecht, although additional research is needed.

Keywords: Energy Transition, Social Cohesion, Knowledge, Renewable Energy

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Introduction

Climate change can be seen as one of the greatest challenges of our time, and it is a major threat to human existence (Ahima, 2020). Therefore, efforts to mitigate the effects of climate change are of great importance, the most relevant one being reducing the use of fossil fuels by replacing it with renewable energy sources. The urgency to overcome the issue of climate change has been widely recognised by scholars and world leaders alike, which has led to the Paris Climate Agreement that was signed by 195 countries, including the Netherlands, in 2015 (Christoff, 2016). This agreement states that each country must contribute to mitigate global warming by setting targets and reporting about their progress. In the Netherlands, the target envelops to reduce the usage of CO₂ as a county by 95% before 2050 (Climate Agreement, 2019). In order to reach this goal, sustainable renovations have to be made in different sectors. For one of these sectors, described as the built environment, the vision for 2050 asks for the adaptation of seven million homes and one million buildings from using natural gas towards using insulation and renewable and clean energy (van Vuuren et al., 2017). The transition away from natural gas towards renewable energy sources, the energy transition, will be the focus of the present study.

The Dutch approach to the energy transition is characterized by a bottom-up design, in which municipalities are the main responsible actors (Vringer et al., 2021). This means that municipalities are expected to carry the responsibility of implementing climate policies (Vringer et al., 2021). In order to identify possible obstacles and opportunities of the energy transition on the local level, students from Utrecht University, in collaboration with the organisation ‘Academie van de Stad’, have been interviewing residents of municipalities for several years now. This can give valuable insights into what may motivate citizens to participate, and what could be discouraging factors that hinder participation. The present study will utilize the information collected in this collaboration.

In the Dutch Climate Agreement, it is stated that the transition will primarily be a social transition, as it greatly affects the everyday life of citizens (Climate Agreement, 2019). The social challenge is deemed the most significant challenge, as opposed to the technical, financial or administrative challenges that the energy transition brings about. In the report, it is highlighted that citizens need to rely on each other, and the Climate Agreement is referred to as a 'social pact' (Climate Agreement, 2019). This social side to the energy transition has also been recognised by researchers, who state that social and behavioural barriers are abundant and ask for new ways of collaborating, making decisions and mobilizing society (Hoppe & de Vries, 2019). From these findings it is clear that the social aspect of the transition is of great importance. However, it is also very understudied (Sovacool, 2014). The neglect of social and behavioural aspects of the energy transition has negative consequences, as the implementation of technological innovations is met with a lack of social acceptance and adoption from citizens (Hoppe & de Vries, 2019). This emphasizes the relevance of social connectedness and cooperation for an effective energy transition, which is why the focus of the present study will be on social cohesion.

Key characteristics of a cohesive society are close social relations, strong emotional connectedness to the social entity, and strong orientations towards the common good (Schiefer & van der Noll, 2017). According to a review by Schiefer and van der Noll (2017), social cohesion can be defined as 'a descriptive attribute of a collective, indicating the quality of collective togetherness'. Research has shown that individuals from high cohesion communities are more likely to invest in climate change programs, as those can be considered common goods (Akter, 2020). In addition, studies have shown that one characteristic of a network with high social cohesion is the easy flow of knowledge. For example, research has found that information spreads most easily through networks with high density (Haythornthwaite, 1996). In these networks, many actors have relations with many other

actors, which means information can flow easily through the network without being stopped (Haythornthwaite, 1996). Additionally, neighbourhood networks are characterized by an abundance of weak tie relations, which act as a bridge to other networks and therefore encourage the introduction of new information in a network (Granovetter, 1973). While weak ties seem to be efficient at bringing new information into a network, small clusters of strong ties have been found to facilitate the spread of behaviour most effectively (Centola, 2010). It can be argued that, while weak ties are most efficient for the spread of simple contagions and strong ties are most efficient for the spread of complex contagions, both play a part in large scale diffusion processes like the energy transition.

Furthermore, it seems that having more knowledge about the energy transition might increase the likelihood that individuals will participate in it. For example, research has shown that having knowledge on climate change problems generally leads to greater concern about it (Guy et al., 2014). Individuals who are more concerned with climate change have been found to engage in more environmentally conscious consumer behaviour (Kautish & Sharma, 2020) and more conscious energy consumption behaviour (Pothitou et al., 2016). Moreover, studies have shown that individuals who are more knowledgeable on climate change problems and renewable energy evaluate renewable energy sources more positively, and are more willing to financially invest in it (Steg et al., 2015; Bang et al., 2000). Thus, it might be that social cohesion as well as knowledge about the energy transition affect the willingness of citizens to participate. Because social cohesion has also been found to aid the spread of knowledge, there might be a mediating effect of knowledge in the context of the energy transition. Building on the previously mentioned literature, the following research question has been developed:

What is the effect of social cohesion on the willingness to participate in the energy transition in the region of Utrecht, and is this effect mediated by knowledge?

Considering the limited data and small scope of the study, the present study will be of exploratory nature. The main goal is to investigate whether social cohesion and knowledge of citizens regarding the energy transition in Dutch municipalities is worth to be further investigated. The problem in the municipalities is not yet clearly defined. Therefore the present study will add to the literature by creating a better understanding of possible existing obstacles to participation in the energy transition on the level of municipalities, that future research could build on. While this is valuable in itself, it is important to realize that caution is needed when deriving conclusions from the present study, as findings are likely not representative of the general population.

In order to answer the research question, existing literature on the relations between social cohesion, knowledge and participation will be discussed. From the literature, three hypotheses will be derived, which will be tested using the data that has been collected by Bachelor's students from Utrecht University during the course 'Policy and Evaluation Research'. The collection of this data will be further described in the methods section, as well as the statistical approach. Then, the results will be discussed. Finally, a conclusion will be drawn in which the research question will be answered. Lastly, limitations of the present study will be mentioned, as well as directions for future research.

Theoretical Framework

Social Cohesion and the Energy Transition

Due to its complexity, the transition towards renewable energy sources can be regarded as a problem of collective action (Jasanoff, 2018). The problem of collective action is one of Sociology's greatest puzzles, and refers to the way members of groups set aside self-interest and support collective action (Willer, 2009). Investing in renewable energy sources is

often a costly decision for the individual, in terms of both money and time. Yet, it will benefit the group when individuals do so, because transitioning towards renewable energy sources plays part in ensuring a liveable future, which concerns all members of the group. Socially cohesive communities are found to have more capacity for collective action, because social capital is more abundant (Kawachi & Berkman, 2000). Social capital can be defined as those features of social structures, for example trust and reciprocity, which are considered to be resources for individuals and aid collective action (Kawachi & Berkman, 2000). This mechanism has been studied before in the context of individual investments in climate change adaptation, namely investing in cyclone risk reduction (Akter, 2020). Adaptation to issues caused by climate change, such as an increased amount of cyclones, asks for collective action likely in a similar way the energy transition does. Research has shown that communities that are not socially cohesive lack solidarity and trust between members, which impedes collective action as a result of group members not wanting to contribute to public goods (Akter, 2020). In the context of climate change adaptation, individuals who experienced less social cohesion were found to be less willing to invest in cyclone risk reduction compared to individuals who experienced more social cohesion. Based on these findings, the first hypothesis has been derived:

H₁: Individuals who experience a high degree of social cohesion in the neighbourhood are more willing to participate in the energy transition compared to individuals who experience less social cohesion in the neighbourhood.

Knowledge about the Energy Transition as a Potential Mediator

As discussed before, previous studies have shown that social cohesion can increase the willingness of individuals to participate in the energy transition. However, this effect may be

partially explained through the acquirement of knowledge about the energy transition through social contacts. In the following paragraphs, various ways that knowledge is connected to social cohesion and willingness to participate in the energy transition will be highlighted.

Social Cohesion and the Spread of Knowledge

Networks with a higher degree of cohesion are characterized by higher density (Haythornthwaite, 1996). The density of a social network or community is a measure of the degree to which members are connected to all other members of the group (Haythornthwaite, 1996). If density and thus cohesion is high, information is expected to flow more easily as a result of increased opportunities to share the information (Haythornthwaite, 1996). This implies that a higher degree of social cohesion in a neighbourhood should encourage the spread of information, including information about the energy transition. This idea has more recently been supported by Isaac et al. (2007), who found that knowledge about sustainable development and new technologies to a great extent diffuses through informal social ties.

Besides the number of connections, research on knowledge diffusion between different types of connections is abundant. For example, the classic work of Granovetter (1973) has emphasized on the strength of weak ties, characterized by fewer moments of contact and more superficiality, when it comes to the spread of knowledge. Weak ties play an important part in the spread of knowledge through a social network, because they can act like a bridge between two networks that are otherwise separated. This means that new information can reach individuals in the network, that would otherwise have stayed in the same circle. Building on the work of Granovetter, Centola (2010) found small clusters of strong ties to be most efficient in aiding the spread of behaviour, as strong ties have greater capacity to exert social influence. Research has shown that social networks in neighbourhoods consist of a lot of weak ties, for example neighbours (Forrest & Kearns, 2001). While the strength of ties will

not be the focus of the present study, the works of Granovetter and Centola do highlight the importance that social ties, whether weak or strong, hold in the diffusion of information and behaviour.

Additionally, social cohesion has been found to facilitate social learning. Because socially cohesive networks are characterized by high network density, they are remarkably effective in facilitating social learning and copying behaviour (Cherng et al., 2019). Social learning can be described as the process of learning through social interactions between actors within social networks (Bandura & McClelland, 1977). Research by Cherng et al. (2019) has shown that communities with a high degree of social cohesion (defined as the average number of network connections for each household) were more effective in adopting adaptation strategies compared to communities with low social cohesion. Additionally, European case studies have recognized the importance of social learning processes in the transition towards a more sustainable future (Garmendia & Stagl, 2010). Social learning in the context of sustainability does not only generate new cognitive knowledge, it also enhances moral development that enables individuals to judge right and wrong (Garmendia & Stagl, 2010). Learning from the viewpoint of others illustrates the capacity to see climate change issues beyond the individual level and also care about the collective level, which could give rise to a sense of mutual understanding and respect (Garmendia & Stagl, 2010). Based on these findings, the second hypothesis has been derived:

H₂: Individuals who experience more social cohesion in the neighbourhood report to have more knowledge about the energy transition compared to individuals who experience less social cohesion in the neighbourhood.

Knowledge and the Willingness to Participate in the Energy Transition

According to previous research, there are three main factors that influence sustainable energy behaviour; motivation, contextual factors and knowledge (Steg et al., 2015). Research has shown that individuals who are more knowledgeable about the causes and consequences of climate change, are generally also more worried about it (Guy et al., 2014). A recent study has found that having more environmental knowledge significantly increases environmental concern, and that having more environmental concern increases environmentally conscious consumer behaviour (Kautish & Sharma, 2020). Thus, from these findings it seems that having more broad environmental knowledge influences the environmental concern individuals experience, and this leads to an increase in all kinds of pro-environmental behaviour.

These findings also apply to energy consumption behaviour of households. Specifically, research has shown that environmental knowledge plays a strong role in energy consumption behaviour (Pothitou et al., 2016). Having more knowledge on what electricity saving entails or government's initiatives to reduce CO₂ emissions for example, led to respondents engaging in more energy saving behaviours and habits (Pothitou et al., 2016). Furthermore, the knowledge an individual has plays a role in the evaluation of pros and cons of sustainable energy alternatives (Steg et al., 2015). For example, research has shown that the more factual knowledge on hydrogen as a sustainable alternative to fossil fuels individuals had, the more environmentally friendly it was believed to be (Molin, 2005). Therefore, the acceptance of hydrogen was greater for individuals with more factual knowledge about it, and these individuals were also more willing to use hydrogen as a renewable energy source (Molin, 2005). Moreover, it has been found that individuals who are more knowledgeable on renewable energy and the issue of climate change are also more willing to pay more for renewable energy, compared to less knowledgeable individuals (Bang et al., 2000). In

addition, not having adequate knowledge on renewable energy sources has been reported a crucial reason for not installing renewable energy sources (Ntanos et al., 2018). This study has shown that easy access to environmental knowledge is a requirement in order to stimulate citizens willingness to invest and participate in the energy transition (Ntanos et al., 2018).

In conclusion, it seems that individuals who have more knowledge about climate change, sustainable practices and renewable energy are more concerned with it, want to invest more and evaluate renewable energy sources more positively compared to individuals who have less knowledge. Because the energy transition in the Netherlands requires citizens adopting and investing in renewable energy sources, it is valuable to study whether having more knowledge surrounding the energy transition can foster this. Based on these findings, the third hypothesis has been derived:

H₃: Individuals that report to have more knowledge about the energy transition will be more willing to participate compared to individuals who report to have less knowledge about the energy transition.

In conclusion, a high degree of social cohesion has been found to increase knowledge, and a high degree of knowledge has been found to increase willingness to invest in renewable energy. Based on these findings, it could be the case that the effect of social cohesion on willingness to participate can be explained through increased knowledge about the energy transition, obtained through social ties. Therefore, the present study explores whether there could be a mediating effect of knowledge on the relationship between social cohesion and willingness to participate in the energy transition. Seeing as no literature could be found on this potential mediation effect, no hypothesis has been derived. Thus, the analysis is of explorative nature.

Methods

In the present study, the direct effect of social cohesion on the willingness to participate in the energy transition will be investigated first. Second, the effect of social cohesion on knowledge about the energy transition will be tested. Third, the effect of knowledge on the willingness to participate will be analysed. In addition, the present study explored whether knowledge mediates the effect of social cohesion on willingness to participate. All hypotheses are represented in the conceptual model displayed in Figure 1.

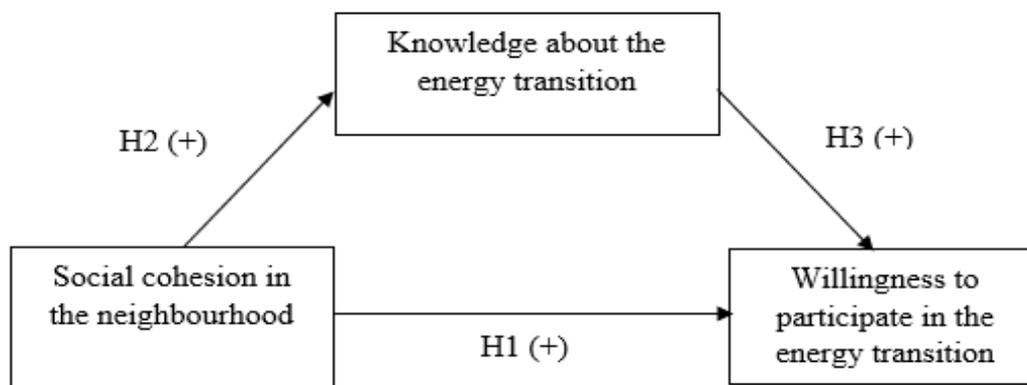


Figure 1: The model used in the present study, in which the hypotheses are visually represented.

Participants

Participants were recruited in the municipalities of Veenendaal, Zeist, Utrecht and Houten in 2019/2020, and in Houten and Amersfoort in 2020/2021. In total, 607 respondents participated in the project in the years 2019/2020 and 2020/2021 combined. However, due to limitations of the dataset, which will be discussed shortly, only participants from the municipalities of Zeist (2019/2020), Houten (2020/2021), and Amersfoort (2020/2021) could be used and were selected for the present study. The data from the municipality of Veenendaal, collected in 2019/2020, has been excluded from the present study because all

questions were either open questions or only had a yes or no option. Therefore, they were not compatible with the other measures of the concepts and could not be combined. Additionally, data from the municipalities of Houten (2019/2020) and Utrecht (2019/2020) had to be left out, due to missing value labels. This flaw in the datasets made it impossible to interpret the scores, which is why data from these municipalities could not be used. After exclusion of the municipalities of Veenendaal (2019/2020), Houten (2019/2020) and Utrecht (2019/2020), 256 participants were left in the dataset. Of these participants, 158 reported to identify as male and 95 as female. Three respondents would rather not specify their gender. The age of the respondents was operationalized using categories. Most respondents, namely 50 percent, were between 46 and 65 years old. Only three and a half percent of respondents were between 18 and 25 years old.

Participants were selected using convenience sampling. All participants of the year 2019/2020 were recruited via door-to-door sampling, in the neighbourhood of focus within the municipality. For the year 2020/2021, participants were recruited online due to social distancing measures that were in effect at that time, in order to prevent the spread of Covid-19. In the online questionnaires, participants had to indicate the neighbourhood they resided in. Participants who did not reside in the neighbourhoods of focus were excluded, and this was the only exclusion criterium. It is important to note that the online recruitment of participants could have caused a selection bias, because respondents with strong opinions on the energy transition might be more likely participate in the online questionnaire. This could have influenced the degree to which the sample is representative of the population of these municipalities, which would pose a threat to external validity (Berk, 1983).

Materials

The data that has been used for the present study has been collected through three different questionnaires. The questionnaires were developed by Bachelors' students following the course 'Policy and Evaluation Research', and were closely monitored and guided by teachers of Utrecht University. All questionnaires were in Dutch. For each municipality a different questionnaire was used, although the four themes of trust in the municipality, attitudes towards the energy transition, knowledge on the energy transition and social cohesion in the neighbourhood were consistent. While other variables were present in the questionnaires, only the questions on knowledge, social cohesion and willingness to participate, as well as demographic variables on age and gender, were used for the present study.

Because questions for the questionnaires were developed by independent groups of students, the questions measuring social cohesion, knowledge and willingness to participate were slightly different between the municipalities, for example in wording. Therefore, for the present study it has been assumed that questions of each concept are similar enough to be considered under one variable. This assumption has been made based on the knowledge that the municipalities were interested in the same concepts, and therefore questions measuring these concepts are likely highly comparable. In addition, the questions were judged subjectively to be very similar. This limitation will be elaborated on in the discussion.

Variables

Social cohesion has been measured with questions such as 'To what extent do you feel connected to your neighbourhood?'. Respondents could answer on a 5-point Likert scale, ranging from 'not at all connected' to 'very much connected'. Another example of a question used for operationalisation of social cohesion is 'I feel connected to other residents from my

neighbourhood'. Respondents could answer on a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. These examples demonstrate the similarity between the questions used.

Knowledge about the energy transition has been measured very broadly, and includes questions about knowledge on plans of the municipality and (benefits of) renewable energy. An example of a question on knowledge about plans of the municipality is 'I am well aware of the plans of the municipality regarding the energy transition'. Respondents could answer on a 5-point Likert scale ranging from 'completely disagree' to 'completely agree'. Another example of a question used to measure knowledge about the plans of the municipality is 'I am aware of the ambitions of the municipality of Houten'. Respondents could answer on a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. An example of a question on knowledge about renewable energy is 'I am aware of the different benefits of renewable energy sources'. Respondents could answer on a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'.

Willingness to participate in the energy transition has been measured using questions like 'I plan on participating in the plans of the municipality of Houten to transition away from natural gas'. Respondents could answer on a 5-point Likert scale ranging from 'completely disagree' to 'completely agree'. An additional example is 'What is the probability at this moment that you will participate in the transition towards renewable energy sources?'. Respondents could answer (1) '0% t/m 20%', (2) '21% t/m 40%', (3) '41% t/m 60%', (4) '61% t/m 80%', (5) '81% t/m 100%'. All original untranslated questions used in the present study can be found in Appendix 1, as well as the internal consistency of the scales.

Procedure

In order to identify possible obstacles and opportunities of the energy transition on the local level, a collaboration between the University of Utrecht and ‘Academie van de Stad’ has been formed. As part of the course ‘Policy and Evaluation Research’ which belongs to the Sociology Bachelors curriculum, students of Utrecht University collected data on different themes surrounding the energy transition. In groups, students carried out questionnaires as well as semi-structured interviews in neighbourhoods of several municipalities within the region of Utrecht. For the present study, only quantitative data from the questionnaires will be used. Data was collected over a period of around three weeks, from December of 2019 to January 2020, and in December of 2020 and January of 2021..

Municipalities in which data was collected in 2020 were Veenendaal, Zeist, Utrecht and Houten. Prior to the data collection, residents of the neighbourhoods in which door-to-door sampling took place were sent a Christmas card including information about the upcoming data collection. Groups of approximately two to three students went from door to door in the neighbourhoods, asking the residents if they were willing to participate in a study on the energy transition in their municipality. If residents were willing to participate, the students would first let the residents sign the informed consent, which stated that the answers would stay confidential and anonymous. Then, the students would let the residents fill out the questionnaire. If there was no response, the house number was noted and there would be another attempt at a later moment. All the data that has been collected was then entered into one dataset per municipality.

In 2021, data was collected in the municipalities of Amersfoort and Houten. Because of national social distancing measures surrounding the Covid-19 pandemic, door-to-door data collection was not feasible. Therefore, data was collected using online questionnaires in 2021.

Respondents were informed of the questionnaires using flyers and an advert in the local newspaper. The respondents who were interested in participating could scan a code which lead to the questionnaire. Questionnaires were developed and carried out using the program Qualtrics. Additionally, interviews were held with some respondents. However, these were not used in the present study.

Data Analysis

All analyses in the present study were carried out using the statistical program SPSS Statistics, version 26. For the purpose of this study, the datasets from the municipalities of Zeist (2019/2020), Houten (2020/2021) and Amersfoort (2020/2021) were combined into one dataset. Then, questions that measured each of the concepts in each municipality were carefully selected and combined into scales when necessary, and the internal consistency of each scale was investigated using Cronbach's alpha. Some items were left out to increase Cronbach's alpha to adequate levels. Thus, a variable for social cohesion, knowledge and willingness to participate was created for each municipality. Then, these new variables were standardized into a z-score. This had to be done in order to combine scores from questions with slightly different answer options into one variable containing all scores from the municipalities combined. After standardizing each score, all scores were combined into one variable for social cohesion, knowledge and willingness to participate respectively. Then, the assumptions of the regression procedure were checked. Using these standardized scores of all municipalities combined, the hypotheses were tested using the four step approach to mediation as proposed by Baron and Kenny (1986). First, the effect of social cohesion on willingness to participate in the energy transition (H_1) was analysed using simple linear regression. Second, the effect of social cohesion on knowledge about the energy transition (H_2) was tested using simple linear regression. Third, the effect of knowledge about the

energy transition on willingness to participate (H_3) was tested using simple linear regression. Fourth, it was explored whether there was a mediating effect of knowledge about the energy transition using multiple linear regression. Using this approach, it can be established whether zero-order relationships exist among the variables, before testing for mediation (Baron & Kenny, 1986). An alpha of .05 was used for all analyses.

Results

Testing the Assumptions of Regression

Before executing the analyses, the assumptions normality, homoscedasticity, linearity and multicollinearity were tested to determine whether multiple linear regression is appropriate. As stated by Williams et al. (2013), only the assumption of normally distributed errors is of importance to multiple regression, as opposed to normally distributed variables. First, the assumption of normality of residuals was tested by looking at the P-P plot of the model. The P-P plot of the residuals shows that the dependent variable of both willingness and knowledge are approximately normally distributed. Slight deviations from the normality line are present, but are likely not problematic providing the other assumptions are met (Williams et al., 2013). Additionally, slight deviations from normality will have little effect on the results of a regression for sufficiently large sample sizes due to the Central Limit Theorem (Williams et al., 2013; Li et al., 2012). Second, the assumption of homoscedasticity was tested by generating a scatterplot of standardized residuals against standardized predicted values. This scatterplot shows that the assumption of homoscedasticity is met, as there is no recognizable pattern present in the scatterplot. Third, the assumption of linearity was checked using a simple scatterplot. The scatterplot showed that there are no indications that nonlinearity is the case. Lastly, the absence of multicollinearity was checked using Variance

Inflation Factors (VIF). This test indicated that multicollinearity was of no concern (social cohesion: VIF = 1.023, knowledge: VIF = 1.023).

Direct Relationships; Social cohesion, Knowledge and Willingness to Participate

Following the four step approach to mediation as described under data analysis, the direct effects as presented in the conceptual model were tested first. Hypothesis 1 was tested using simple linear regression. The simple linear regression shows that social cohesion in the neighbourhood has a significant positive effect on the willingness to participate in the energy transition ($\beta = .139$, $t = 2.246$, $p = .013$). The p-value has been divided by two, as the hypothesis was directional. From these results it can be concluded that there seems to be support for hypothesis 1, and the null hypothesis can be rejected. In order to determine the size of this effect, Cohen's f^2 was calculated. This calculation shows that the effect is of small size ($f^2 = .019$) (Cohen, 1988).

Hypothesis 2 was tested using simple linear regression. The simple linear regression shows that social cohesion in the neighbourhood has a significant positive effect on the amount of knowledge about the energy transition an individual has ($\beta = .150$, $t = 2.410$, $p = .009$). Because of the hypothesis being directional, the p-value has been divided by two. From these results it can be concluded that there seems to be support for hypothesis 2, and the null hypothesis can be rejected. The calculation of Cohen's f^2 shows that the effect is small in size ($f^2 = .022$).

Hypothesis 3 was tested using simple linear regression. The simple linear regression shows that the amount of knowledge about the energy transition has a significant positive effect on the willingness to participate in the energy transition ($\beta = .179$, $t = 2.918$, $p = .002$). The p-value has been divided by two, because the hypothesis was directional. From these results it can be concluded that there seems to be support for hypothesis 3, and the null

hypothesis can be rejected. The calculation of Cohen's f^2 shows that the effect is of small size ($f^2 = .033$).

The Mediating Effect of Knowledge

Considering all expected direct effects were found to be statistically significant, there may be a mediating effect of knowledge. Therefore, multiple linear regression was conducted in order to predict the willingness to participate based on social cohesion and knowledge about the energy transition. It was found that social cohesion and knowledge about the energy transition explain 4.5% of variance in the willingness to participate in the energy transition ($F(2,253) = 6.017, p = .003, R^2 = .045$). The results of the multiple regression indicated that, when knowledge is added, the effect of social cohesion on willingness to transition remains positive, but is not significant anymore ($\beta = .115, t = 1.854, p = .065$). The effect of knowledge on willingness to participate remains positive and significant ($\beta = .162, t = 2.621, p = .009$). The results of both Model 1 and Model 2 can be found in Table 1. Considering the effect of social cohesion is no longer significant after controlling for knowledge, full mediation is the case by reasoning of Baron and Kenny (1986). Therefore, it can be concluded that knowledge about the energy transition may fully mediate the effect of social cohesion in the neighbourhood on the willingness to participate in the energy transition.

Table 1*The Mediating Effect of Knowledge on Willingness to Participate*

Effect	β	SE	95% CI		p
			LL	UL	
Model 1					
Intercept	.006	.062	-.116	.128	.923
Social Cohesion	.139*	.062	.017	.261	.013
Model 2					
Intercept	.006	.061	-.115	.127	.923
Social Cohesion	.115	.062	-.007	.236	.065
Knowledge	.162**	.062	.040	.283	.009

*** $p < .001$, ** $p < .01$, * $p < .05$

Note. LL = Lower Limit; UL = Upper Limit

Conclusion

In order to explore the social side to the energy transition on the local level, the present study aimed to answer the research question: *What is the effect of social cohesion on the willingness to participate in the energy transition in the region of Utrecht, and is this effect mediated by knowledge?* Previous research indicates that a socially cohesive society can be a fruitful base for collective action, as members of the group are more willing to out aside individual interest and invest in common goods (Willer, 2009; Akter, 2020). Furthermore, socially cohesive societies are characterized by many connections between individuals, which could facilitate the spread of information about the energy transition throughout the network (Haythornthwaite, 1996; Isaac et al., 2007). Moreover, plenty of social connections in a network can promote social learning, which has been found an effective method in aiding the

transition towards sustainability (Cherng et al., 2019; Garmendia et al., 2010). Additionally, being knowledgeable on topics surrounding the energy transition is likely a condition to be willing to participate in it, due to increased environmental concern and more positive evaluations of renewable energy sources (Kautish & Sharma, 2020; Steg et al., 2015). Therefore, in the present study it was expected that a higher degree of social cohesion in the neighbourhood would have a positive effect on the willingness to participate in the energy transition, and that this effect would potentially be mediated by knowledge. Using quantitative data collected by students of Utrecht University in three municipalities in the region of Utrecht, simple linear regression and multiple linear regression were executed. In the present study, all of the expected direct relationships were found to be statistically significant. Additionally, knowledge has been found to fully mediate the effect of social cohesion on the willingness to participate in the energy transition.

The results from the present study indicate that social cohesion in the neighbourhood could facilitate the sharing of knowledge about the energy transition, which leads to individuals being more willing to transition away from natural gas. The most noticeable finding of the present study is that, while social cohesion seems to directly influence willingness to participate at first glance, controlling for knowledge shows that the direct effect of social cohesion might be less influential than originally assumed. These results add to the findings from Akter (2020), who found a significant relationship between social cohesion and willingness to participate. The study from Akter (2020) did not control for knowledge, which could hypothetically mean knowledge also mediated this effect. However, there might be an additional explanation. The study by Akter (2020) was conducted in Bangladesh, which gives reason to believe that cultural differences might cause different findings compared to the present study. Bangladesh is regarded as a collectivist society (Devine et al., 2008), while the Netherlands is regarded highly individualist (Triandis et al., 1986). Collectivist countries

generally hold the belief that the welfare of the group is more important than that of the individual (Realo & Allik, 2009). This could explain why social cohesion might have a direct effect on participation in a collectivist country such as Bangladesh, but is merely a function of knowledge diffusion in an individualist country such as the Netherlands.

Furthermore, the present study finds that social cohesion significantly predicts the amount of knowledge about the energy transition. This could mean that in socially cohesive neighbourhoods, social learning and information exchange is taking place, which would be in line with findings of Garmendia and Stagl (2010). However, the process of social learning or the spread of knowledge through the network were not tested in the present study, and thus cannot be fully accepted as the mechanisms at play. Additionally, the present study shows that knowledge about the energy transition significantly predicts the willingness to transition, which is similar to findings from Bang et al. (2000). This might be due to an increase in environmental concern as proposed by Steg et al. (2015), although this was not tested directly in the present study.

Discussion

While there are theoretical explanations for the findings of the present study, the results should be interpreted with caution, due to several limitations. First, the slight differences between questions that were asked in different municipalities, as mentioned in the methods section, could be a threat to the internal validity of the study. Because questions were slightly different between municipalities, construct validity of the concepts that were measured is questionable. The degree of similarity between the different questions could not be tested, which is why similarity has been assumed based on subjective assessment and thus only ensures face validity. Second, the external validity of the present study, specifically the population validity, might be threatened by the method of data collection. Data from two out of three municipalities has been collected using online questionnaires. This could have caused

a selection bias, in which only individuals with strong opinions on the energy transition were more motivated to fill out the questionnaire compared to individuals with more nuanced opinions. Therefore, the sample might not have been representative of the municipalities as a whole, making it more difficult to generalize the findings. However, due to the exploratory nature of the present study, the focus is on defining possible issues and stimulants of energy transition participation rather than generalizing the findings. It is therefore recommended for future research to investigate the relations found in the present study on a greater scale, in order to determine whether the findings are generalizable and hold up for other municipalities in the Netherlands. Additionally, it is recommended that future research investigates the mechanisms proposed in the present study, like social learning and environmental concern, as these were not tested directly.

The present study sheds a precursory light on the way social cohesion and knowledge influence the support for the energy transition on the local level of municipalities. The findings indicate that social cohesion in neighbourhoods, and especially knowledge about the energy transition, could be promising means through which increasing the willingness of residents to transition to renewable energy sources can be realized.

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Appendix 1

Questions that were used in the present study

	Municipality	Question(s)	Cronbach's alpha
Social cohesion in the neighbourhood	Zeist	In hoeverre voelt u zich verbonden met de mensen in uw wijk?	
	Houten	Ik voel me thuis in mijn dorp Ik voel me betrokken in mijn dorp Ik voel me verbonden met mijn mede buurtbewoners (Met verbondenheid wordt een gevoel dat je bij elkaar hoort en van onderling vertrouwen bedoeld)	.868
Knowledge about the energy transition	Amersfoort	Ik voel mij sociaal verbonden met de inwoners van Nieuwland Ik voel dat ik dezelfde sociale regels hanteer als mijn buurtgenoten over wat wel en niet mag in Nieuwland Ik ervaar positieve sociale interactie met mijn buurtgenoten in Nieuwland	.769
	Zeist	Ik heb kennis over: (meerdere antwoorden mogelijk) <input type="checkbox"/> De mate waarin mijn woning geïsoleerd is <input type="checkbox"/> Duurzame energiebronnen <input type="checkbox"/> Energiezuinig gedrag <input type="checkbox"/> Het duurzaam verwarmen van mijn woning	
	Houten	Ik ben op de hoogte van de ambities van de gemeente Houten Ik ben me bewust van de maatschappelijke voordelen van duurzame energiebesparing en -opwekking Ik weet hoe ik mijn woning kan isoleren Ik voel me voldoende geïnformeerd over welke veranderingen er nodig zijn voor mijn huis voor de warmtetransitie en aardgasvrij wonen Ik heb een goed beeld van de kosten die bij deze veranderingen komen kijken Ik voel me voldoende ingelicht over hoe lang deze veranderingen kunnen duren Ik ben op de hoogte van de verschillende voordelen die bij deze veranderingen komen kijken (met betrekking tot geld besparen, klimaat en comfort) Indien ik informatie mis over de warmtetransitie en aardgasvrij wonen, weet ik waar ik die kan vinden	.859

	Amersfoort	Ik ben goed op de hoogte van de plannen van de gemeente met betrekking tot de energietransitie Ik weet goed welke mogelijkheden voor participatie er zijn voor de energietransitie naar aardgasvrij leven	.634
Willingness to participate	Zeist	Ik ben bereid medewerking te verlenen aan de gemeente	
	Houten	Ik ben van plan te participeren in het beleid om van het aardgas af te gaan van de gemeente Houten	
	Amersfoort	Hoe groot schat u op dit moment de kans dat u zal participeren aan de transitie van aardgas naar hernieuwbare (duurzame) energiebronnen?	

Appendix 2 - Informed consent letters

Amersfoort Toestemmingsformulier

Geachte heer/mevrouw,

Voor u ligt een toestemmingsverklaring met betrekking tot uw deelname aan het onderzoek over de energietransitie in de wijk Nieuwland in gemeente Amersfoort. Deze toestemmingsverklaring bestaat uit twee delen. In het eerste deel komt de informatievoorziening aan orde waarin de details van het onderzoek beschreven worden met betrekking tot uw deelname. In het tweede deel komt de toestemmingsverklaring naar voren waarin wordt beschreven waaraan u toestemming geeft als u mee zou doen aan het onderzoek. U kunt na het lezen van deze verklaring de beslissing nemen of u meedoet met het onderzoek. Wij vragen u deze toestemmingsverklaring dus goed door te lezen voordat u akkoord zou gaan.

Informatievoorziening

Dit onderzoek wordt uitgevoerd door sociologie studenten van Universiteit Utrecht in opdracht van de gemeente Amersfoort. Het algemene thema van dit onderzoek is de energietransitie, waarin alle huizen in Nederland voor het jaar 2050 CO₂ neutraal moet zijn wat beschreven staat in het Parijs akkoord. De gemeente Amersfoort heeft interesse in uw mening, houding, ervaring en betrokkenheid omtrent de energietransitie met als doel om burgers meer te laten betrekken in dit onderwerp en zo dus het beleid van energietransitie succesvoller te laten verlopen. Als u besluit deel te nemen aan het onderzoek zorgt u er potentieel voor dat het energietransitie beleid in Nieuwland effectiever en efficiënter wordt uitgevoerd door de gemeente, dit is niet alleen gunstig voor u, maar ook voor iedereen die in Nieuwland woont. Het onderzoek bevat een interviewsessie met een student van de faculteit sociale wetenschappen aan Universiteit Utrecht Daarnaast is uw deelname geheel anoniem. Met anoniem wordt bedoeld dat de gegevens die u overhandigt niet te traceren zijn naar uzelf. Dit zorgt ervoor dat gegevens onherkenbaar zijn en dat bijvoorbeeld de gemeente niet informatie kan linken aan bepaalde inwoners van een wijk. De informatie van het interview wordt opgeslagen in een databestand waar alleen de desbetreffende studenten en docenten toegang tot hebben. Wees er wel van bewust dat niet uitsluitend de interviewer met u gegevens werkt, maar dat alle betrokken studenten tot het onderzoek deze data kunnen gebruiken.

Deelname tot dit onderzoek is altijd vrijwillig. Als u besluit niet mee te willen doen aan het interview is dat uiteraard aan de goede orde. Als u besluit mee te doen aan het onderzoek is het niet verplicht om op elke vraag van de interviewer antwoord te geven. Een ander scenario dat kan voorkomen is dat u akkoord gaat en dat u tijdens het interview voelt dat u de sessie niet wil laten doorzetten. U kunt dit dan aangeven aan de interviewer, het interview wordt dan per direct gestaakt. U hoeft niet een reden te geven voor deze staking.

Toestemmingsverklaring

Als u de intentie heeft om mee te doen aan dit onderzoek, dan geeft u toestemming voor de volgende tien punten:

1. Ik verklaar dat ik volwassen ben en wilsbekwaam.
2. Ik verklaar dat ik geheel vrijwillig aan het onderzoek meedoe.
3. Ik verklaar dat ik voldoende geïnformeerd ben over het onderzoek.
4. Ik verklaar dat ik de gelegenheid had om vragen te stellen aan de interviewer waar hij of zijn informatief op reageerde waardoor mijn vragen beantwoord werden.
5. Ik ga akkoord dat mijn gegevens anoniem zijn en dat deze gebruikt mogen worden voor onderzoeksdoeleinden.
6. Ik ga akkoord dat mijn gegevens voor een langere periode bewaard worden in een databestand, na de afronding van het onderzoek worden deze vernietigd.
7. Ik ga akkoord dat het volledige interview wordt opgenomen voor de wetenschappelijk doeleinden.
8. Ik ga akkoord dat mijn gegevens gepubliceerd kunnen worden in het onderzoeksrapport wat overhandigd wordt aan de gemeente Amersfoort.
9. Ik ga akkoord dat meerdere onderzoekers van de opleiding sociologie aan Universiteit Utrecht toegang hebben om mijn gegevens te gebruiken.
10. Ik verklaar dat ik de volledige toestemmingsverklaring heb gelezen voorafgaand aan het onderzoek.

Als u besluit om niet akkoord te gaan met minimaal één van deze punten, dan wordt het interview niet afgenomen. Mocht u vragen hebben over de toestemmingsverklaring dan kunt u dit stellen aan de desbetreffende interviewer. Wilt u na het interview vragen stellen, dan kunt u deze mailen naar:

Amersfoortnieuwland2020@gmail.com

Wanneer u deelneemt aan het onderzoek, geeft u een mondelinge verklaring dat u akkoord gaat met de algemene voorwaarden en geeft u dus toestemming. Deze verklaring wordt opgenomen als bewijsstuk.

Houten toestemmingsformulier

Beste deelnemer,

In het Klimaatakkoord is afgesproken dat alle woningen, kantoren en andere gebouwen worden verduurzaamd. Dat betekent minder energieverbruik én van het aardgas af. De gemeente Houten heeft de ambitie om in 2040 energieneutraal te zijn. Dat wil zij doen op een voor iedereen haalbare en betaalbare manier.

De gemeente Houten is daarom benieuwd naar uw mening. Hoe kijkt u aan tegen de overgang van aardgas naar andere manieren van koken en verwarmen? Uw medewerking is van groot belang!

De gemeente gaf ons, studenten sociale wetenschappen aan de Universiteit Utrecht opdracht om bewoners van de dorpen Schalwijk, 't Goy en Tull en 't Waal daarover te bevragen. In de volgende vragenlijst worden vragen gesteld over onder andere uw mening en kennis over de zogenaamde 'warmtetransitie', de overgang naar aardgasvrij.

U helpt ons en de gemeente door de vragenlijst in te vullen. Het invullen van deze vragenlijst kost ongeveer 15 minuten en kan tot 6 januari 2020. Daarnaast is er de mogelijkheid om met onderzoekers verder te praten over dit onderwerp. U kan zich daarvoor opgeven aan het einde van de vragenlijst.

Let op: U kunt aan dit onderzoek deelnemen indien u 18 jaar of ouder bent. Deelname is vrijwillig en u kunt op elk moment besluiten om te stoppen. De verkregen onderzoeksgegevens worden altijd vertrouwelijk behandeld. We delen antwoorden en informatie niet met derden. Uw antwoorden worden geanonimiseerd: ze zijn voor de gemeente dus niet terug te leiden naar u persoonlijk.

Mochten er achteraf dingen zijn die u wilt bespreken naar aanleiding van dit onderzoek, dan kunt u contact met ons opnemen via warmewijkenhouten@gmail.com.

Indien u bereid bent om uw medewerking aan dit onderzoek te verlenen, vink dan aan dat u toestemming geeft en klik op volgende om verder te gaan naar de volgende pagina.

Ik geef toestemming voor gebruik van mijn gegevens voor wetenschappelijk onderzoek en ga akkoord met deelname aan dit onderzoek (1)

Zeist toestemmingsformulier

Geachte heer/mevrouw,

In dit onderzoek wordt de houding van de bewoners uit de Pedagogebuurt en Austerlitz (Gemeente Zeist) ten aanzien van de energietransitie onderzocht. Het doel van dit onderzoek is om inzicht te krijgen in de steun en betrokkenheid van de burgers aan de transitie naar gasvrij verwarmen en koken. Dit onderzoek wordt uitgevoerd door tweedejaars studenten van de cursus Beleid- en evaluatieonderzoek (Sociologie) van de Universiteit Utrecht in opdracht van de gemeente Zeist. De uitkomsten van dit onderzoek zullen worden gepresenteerd aan de gemeente Zeist, waarop de gemeente de resultaten zal meenemen in haar beleid. Uw deelname is van grote waarde voor dit onderzoek.

Uw gegevens zullen zorgvuldig worden behandeld. Alle gegevens zullen anoniem worden verwerkt. Alle persoonlijke kenmerken worden verwijderd, waardoor u niet te herleiden bent. Na het verwerken van de data, zullen de vragenlijsten worden vernietigd. De enquête zal maximaal 20 minuten in beslag nemen. Tijdens het beantwoorden van de vragenlijst, heeft u ten alle tijden de mogelijkheid om een vraag niet te beantwoorden, een pauze te nemen of te stoppen met uw deelname. Het invullen van deze vragenlijst is geheel vrijwillig. Indien u naderhand nog vragen heeft over dit onderzoek, kunt u contact opnemen met Remco Spoelstra (R.Spoelstra@odru.nl) van de gemeente Zeist. Ook kunt u via Remco Spoelstra (R.Spoelstra@odru.nl) de resultaten van dit onderzoek aanvragen in februari 2020. Door deze vragenlijst in te vullen verklaard u achttien jaar of ouder te zijn en gaat u akkoord met deelname aan dit onderzoek.

Alvast hartelijk dank voor uw medewerking!