A Heated and Contested Relationship: Examining Pro-Environmental Attitudes and Gas Use in Municipalities in The Netherlands

Abstract

This paper builds on research relating to the attitude-behaviour gap within sustainability to examine whether the level of strong-pro environmental attitudes within Dutch municipalities are associated with gas use. It hypothesizes that higher levels of strong pro-environmental attitudes are associated with significantly lower levels of gas use. To examine this, the paper first devises a cross-sectional dataset of all municipalities in the Netherlands (N = 379) from several databases and employs multivariate linear regressions on the devised dataset. The data includes six (potential) predictors as well as the average gas use across households in a municipality in 2018. In the data, the level of strong pro-environmental attitudes in municipality is operationalised as the share of votes ecological parties received in the 2018 municipal election. The results of the regressions suggest that strong pro-environmental attitudes are associated with significantly lower levels of gas use. This further instils confidence in the ability of strong general pro-environmental attitudes to predict pro-environmental behaviours. The results further highlight that strong pro-environmental behaviour deserves a role in the academic literature that aims to predict gas use in municipalities. Nevertheless, the findings should be treated with caution as the results also indicate that the observed significant effect is contingent upon the inclusion of two observations in the data. Therefore, more research is recommended.

Keywords: attitude-behaviour gap, pro-environmental behaviour, gas use

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Introduction: Gas use as an opportunity to take responsibility

In 2022, the IPCC released its latest climate science report on climate change mitigation. The report highlighted that in order to stay below 1.5 degrees Celsius of global warming, which is the aim of the Paris agreement, "rapid transformations across all sectors and systems are necessary to avoid the worst climate impacts" (IPPC 2022; World Resource Institute, 2022, p. 1). Recent academic work on sustainability management has highlighted that in order to facilitate such a transition towards a low-carbon economy, the private, public, and civil (individuals) sectors all need to take responsibility and aim to limit carbon emissions (Kolk et al., 2008; Tulder & Mil, 2022) .

Across the sectors, often, one of the bottlenecks of effective decarbonisation is the attitude-behaviour gap, which is the difference between one's sustainable attitudes (or intentions) and the actual behaviour that is undertaken. For example, a seminal study highlighted that five Australian Multinationals, who are considered frontrunners in terms of sustainability, were often not able to maintain their sustainable behaviour over time, especially in times of economic downturns (Wright & Nyberg, 2017). As such, there was often a gap between the attitudes (and intentions) of the organisation and its actual behaviour.

Like the example, in the beginning most academic work related to the attitude behaviour gap within sustainability has been conducted in relation to the attitude-behaviour gap within businesses (Boulstridge & Carrigan, 2000; Tulder & Mil, 2022). However, current literature has started to focus on the attitude behaviour gap within individuals (Casaló & Escario, 2018; Shaw et al., 2016; Wiederhold & Martinez, 2018).

Recently, Casaló & Escario (2018) as well as other studies started to explore how the strength of one's general (pro-)environmental attitudes (i.e., does one indicate to generally care for the environment, regardless of any specific issues), affects pro-environmental behaviour (Biasini et al., 2021; Ghose & Chandra, 2020). More specifically, Biasini et al. (2021) highlighted how strong (general) pro-environmental attitudes precede pro-environmental dietary behaviour; Ghose & Chandra (2020) found that strong pro-environmental attitudes predict the purchase of more sustainable products and, lastly, Escario (2018) found evidence that support the strong pro-environmental attitudes predicts recycling behaviour. However, although a strong positive association between general pro-environmental attitudes and several pro-environmental behaviours has been found, whether this relationship also holds for other pro-environmental behaviours still has to be examined.

A particularly interesting pro-environmental behaviour that has not been examined yet is gas use. Households in some developed countries, such as the Netherlands and Germany, still rely mainly on gas for the heating of their homes, cooking and showering. Currently, in the Netherlands, the number of households that still rely on gas for all these three things is more than 95% (Centraal Bureau voor de Statistiek, 2021a)[2]. As such, currently in the Netherlands, reducing gas use either by consuming less or switching to alternative ways of heating, cooking, and showering has tremendous potential for reducing CO_2 emissions. An average household of two people in the Netherlands can save circa can save around four tonnes of CO_2 each year by fully switching away from gas (WISE The Netherlands, 2021). To put this in perspective, a person that is vegetarian for a whole year saves one tonne of CO_2 each year compared to

[2] The Dutch Central Bureau of Statistics

someone who eats meat all day (Plumer, 2016). Therefore, the research chooses to examine gas use and focuses on the following question:

What is the association between the level of strong pro-environmental attitudes in municipalities and average gas use across households in municipalities in the Netherlands?

As becomes clear from the question, this research has chosen to focus on the association between pro-environmental attitudes and gas use at the level of municipalities rather than, for example, the level of households. This decision was made for two reasons. First, extensive individual level data detailing gas use but also strong-pro environmental beliefs was not available in the Netherlands or Germany. This paper was able, however, to retrieve and construct this data the municipality level in the Netherlands in 2018. Second, an extensive literature has highlighted how variables such as average household size, average house size and average income in a municipality are related to the average gas use in a municipality (Druckman & Jackson, 2008; Mashhoodi & van Timmeren, 2018; Yun & Steemers, 2011). However, all these models are not focused on the inclusion of behavioural variables, such as strong pro-environmental behaviour, and consider only data related to the houses themselves. Therefore, choosing the level of municipalities provided an opportunity to add to this literature by highlighting whether data on strong pro-environmental behaviour could be included in these models to more accurately predict gas use across households in municipality.

Following the emerging research on the relationship between strong pro-environmental attitudes and pro-environmental behaviour as discussed in the preceding paragraphs, this research hypothesizes that municipalities which exhibit a higher level of strong pro-environmental attitudes will exhibit on average lower average gas use of its inhabitants.

In order to examine whether this is the case, the following method section will outline the dataset that was created for this study, the empirical strategy of this paper and the operationalisation of the variables. Subsequently, the results section will outline the selection of variables, the employed regression models, and the assumptions of the models. Lastly, before concluding, the fourth part will reflect on the limitations of the paper and discuss the implications of the observed results for the literature relating to the attitude-behaviour gap as well as models aiming to predict gas use across households at the municipality level.

Method

Data

To examine the association between the level of strong pro-environmental attitudes in a municipality and average gas use in the Netherlands, this paper devised a cross-sectional dataset consisting of the average gas use across households as well as seven (potential) predictors of average gas use in a municipality. All the data in the dataset was recorded in 2018. Figure 1 highlights for each variable in the dataset the number of observations as well as its mean and standard deviation.

Important to mention is that the Netherlands consisted of 379 municipalities in 2018 and therefore for most variables there is an observation for each municipality. However, the predictor *share of votes for ecological parties* is based on municipal election data, and therefore counts 335 observations, as there were only 335 municipal elections in the Netherlands in 2018. No elections were held in the remaining 44 municipalities as these would stop to exist in their current form. 35 of those municipalities would join 11 already existing municipalities in 2019. Consequently, elections for these municipalities would only be held at the end of 2019.

The median spendable income in a municipality was, therefore, not recorded anymore in 2018 for these 35 municipalities but was still recorded for the 11 that would expand. This explains why the median spendable income has 344 observations instead of 379.

The following sections will outline for each of the variables where the data for each variable has been collected and why these variables were collected. If relevant, it is also discussed why a certain concept has been operationalised in the dataset a certain way.

Dataset Gas Use and Pro-Environmental Attitudes in Dutch Municipalities (2018)

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
Average gas use (m^3) *	379	1451.24	252.24	370	1290	1630	2390
Average household size *	379	2.27	0.18	1.64	2.19	2.37	3.32
Average house size. (m^2) *	379	132.59	21.52	76	118	145	237
Share of houses built after 2015 (%)	379	2.15	1.41	0.04	1.147	2.806	12.97
Median spendable income (1,000 euros)	344	38.50	4.75	24.30	35.30	41.74	57.40
Share of votes for ecological parties (%)	335	7.31	7.37	0	0	12	33.33
District heating (%)	379	1.86	7.47	0	0	0	68.60

*Table 1: Table highlighting descriptive statistics for the collected dataset. * Indicates that a variable is the average of all the households in a municipality.*

Pro-environmental attitudes

This paper operationalised the level of strong pro-environmental attitudes within a municipality by calculating for each municipality the share of votes of that *ecological parties* received in the last municipal elections of 2018. Ecological parties are defined as parties for whom the protection of the environment is the most prominent driver of policy preferences. As such, for people that chose to vote for ecological parties, the general protection of the environment is the most important policy-issue that needs addressing, trumping other concerns. As such, voting for an ecological party can be seen as an expression of *strong* pro-environmental attitudes, because it takes precedence over other concerns such as for example, security or economic growth.

To create this variable, this research drew upon two different data-sources. First, it relied on the (Comparative) Manifesto Project to retrieve for each party in the 2018 election whether they were considered an 'ecological party'.[3] Second, it relied on a dataset from the Kiesraad, which is an organisation that works with the Dutch Central Bureau of Statistics and the University of Amsterdam, to gather the total number of votes as well as the votes per party for each municipal election in 2018 (Kiesraad, 2018). These two data sources allowed the share of votes for ecological parties to be calculated in each municipality.

Average gas use per household (M^3)

The dependent variable in the model of this paper is the average household gas use (M^3) per municipality. The data for this variable are taken from private housing database from the Dutch Central Bureau of Statistics (Centraal Bureau voor de Statistiek, 2022). The aggregated data per municipality has been collected by the CBS in cooperation with public utility companies in the Netherlands, who have specific data on how much electricity and gas each household used. The methods to measure gas use are standardised across all seven Dutch public utility companies and are also used by energy providers to bill individual households. Therefore, the data on the average household gas use per municipality can be considered reliable.

Furthermore, given that the data for gas use as well as some of the upcoming control variables are at the level of municipalities, it is important to highlight that the smallest municipality in the dataset (Schiermonnikoog) consisted of 516 households. This further instils a confidence in the reliability of the data, as this implies that the calculated averages are more robust to individual variation in the household level data. If some municipalities would have very few households (below 30), as was the case before 2010, the averages would have been mere severely dependent upon each individual observation.

House size and share of newly built houses.

Data on several potential control variables were collected from two other databases from the Dutch Central Bureau of Statistics (CBS). First, from the housing inventory database, the average house size (m^2) as well as the share of houses built after 2015 per municipality was collected (Centraal Bureau voor de Statistiek, 2020).

The data on the share of houses built after 2015 was collected because the Dutch government passed a newly law that prohibits the use of gas boilers and stoves in houses built after 2015. This suggests that, ceteris paribus, municipalities with a higher share of houses built after 2015 will have a lower average gas consumption. It is important to highlight that previous studies have not yet taken this into account in their models (Mashhoodi & van Timmeren, 2018).

[3] The (Comparative) Manifesto Project been an ongoing project that qualitatively analyses political parties' election manifestos during elections to better understand the policy preferences of political parties. It does this by coding quasi-sentences in each party manifesto into a set of defined categories, such as whether a quasi-sentence displays pro-environmental attitudes. This allows the research team to express the prominence of each category as the percentage of quasi-sentences in each manifesto. The project currently analyses all the manifestos during (national) elections in more than 50 countries.

Relatedly, when the average house size is larger in a municipality, the average gas use will also theoretically be larger when all other things are held constant, because larger houses require more gas to get and stay warm.

Both the average house size and the share of buildings built after 2015 are compiled by the CBS from the basis registration addresses and buildings (BAG). When houses are built, the contractor is obliged to report both the date by which the house was finished and its size to the BAG. Consequently, the CBS averages are compiled based on comprehensive data.

Median spendable income and household size
The second set of control variables collected were the median spendable income in a municipality and average household size in a municipality. The decision to collect these variables was based on the fact the previous literature has indicated that both variables are significant predictors of average gas use across municipalities (Druckman & Jackson, 2008; Yun & Steemers, 2011). The underlying logic explaining the relationship between income and gas use is that people with less income are more likely to reduce gas or electricity use to spare costs and do so more severely. For household size, the logic is that bigger households shower and cook more leading to increased gas use. Moreover, the likelihood that someone is home who would like to turn up or on the heating is also greater.

Furthermore, this research made the choice to collect data related to the median spendable income rather than the average spendable income in municipalities. As the average income measures are, in some municipalities, heavily right skewed, median spendable income measures are more reflective of the capabilities of most households to use more gas.

The data for both variables were taken from the household characteristic database from the CBS (Centraal Bureau voor de Statistiek, 2021b). The data was originally created in cooperation with the Dutch tax authorities who have individual level income data on all the residents working and living in the Netherlands. Moreover, the aggregated data on household size was created in collaboration with the Ministry of Ministry of the Interior and Kingdom Relations, who maintains a database with basic information relating to everyone working or living in the Netherlands. This includes the address at which people are registered. These methods of collection, again, instil a confidence in the reliability of the data.[4]

District heating (%)
The last variable that was collected for the dataset was the percentage of households in a municipality that were connected to district heating in 2018. Like gas use, the data for this variable was taken from the private housing database (Centraal Bureau voor de Statistiek, 2022). District heating is a system for distributing heat generated by a power plant (or other industrial plants) through a system of insulated pipes. In the Netherlands, in places close to powerplants or industry, district heating is used to help heat homes. Given that the number of houses that are connected to district heating systems are proportional to the amount of heat generated by the system, it can, therefore be expected that a higher percentage of houses are connected to district heating, ceteris paribus, is associated with lower levels of average gas consumptions across households in municipalities (Centraal Bureau voor de Statistiek, 2022).

[4] Obviously, there are some concerns. For example, some people register at an address and do not life there. Moreover, income generated in other countries or illegally is not taken into in the median spendable income. However, for the purpose of this study, it is not necessary to explore reliability and validity concerns.

Empirical Strategy
As the dependent variable, average gas use across households in a municipality, is continuous and all other variables are also at the level of a municipality, this paper relies on multivariate ordinary least squares regression in order to analyse the association between strong pro-environmental attitudes and gas use in municipalities.

Following the recommendations by Fidell & Tabachnik (2003), before the analysis, the correlations of the predictors will be analysed. Predictors that have correlations with each other that are above the threshold of 0.7 will not be both included in the regression models, as (severe) collinearity will cause unreliable estimates for their associations with gas use.

Results

Correlation Matrix
Figure 1 displays the correlation matrix for the six theoretical predictors as well as gas use. From the figure it becomes clear that the average house size is severely correlated with median spendable income in municipalities ($r = 0.75$, $p < 0.001$). Therefore, in consequent analyses median spendable household income and average household size (per municipality) will not be included in the same model. Rather, at each step, two models will be created, one that includes median spendable income and one that contains average house size.

Secondly, the figure also highlights that all other correlation coefficients between the predictors fall between -0.33 and 0.36 ($-0.33 < r < 0.36$). Therefore, given that these correlation coefficients are rather low, the models produced by a combination of these predictors will not suffer from (severe) collinearity. This suggests that the effects of these predictors on gas use can be interpreted more confidently.

Correlation Matrix for the Gas Use and Pro-Environmental Attitudes Dataset

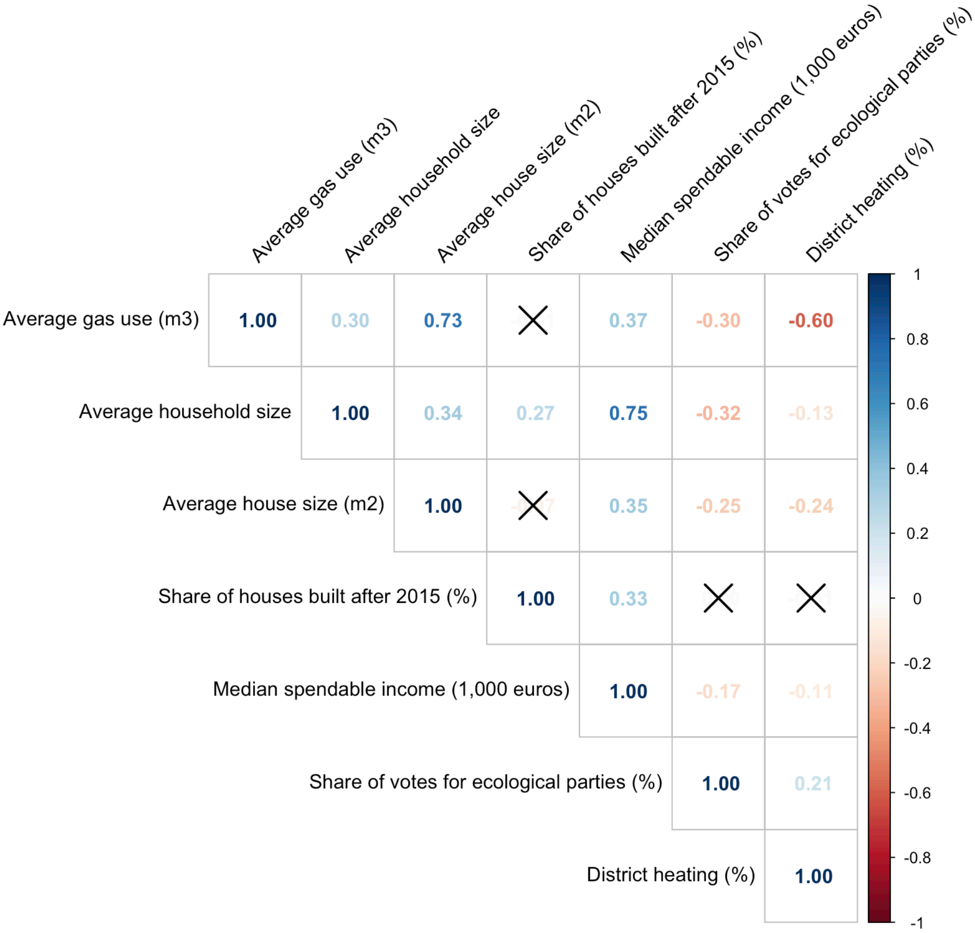

Figure 1: Correlation matrix for the collected dataset. In the first row, the dependent variable is displayed. Crosses indicate that the observed correlation was not significantly different from 0 (at alpha = 0.05)

Multivariate Linear regression models

The results of the linear regression models are presented in Table 2 (p. 11). The first two models highlight the results based on all observations in the dataset. However, before discussing the results, Figure 2 highlights four plots that help to assess the assumptions of first multivariate regression model. This is discussed before diving into the results of the models, as this sheds light on why this paper presents four rather than two models.

Inspecting Potential Multivariate OLS Violations in Model 1

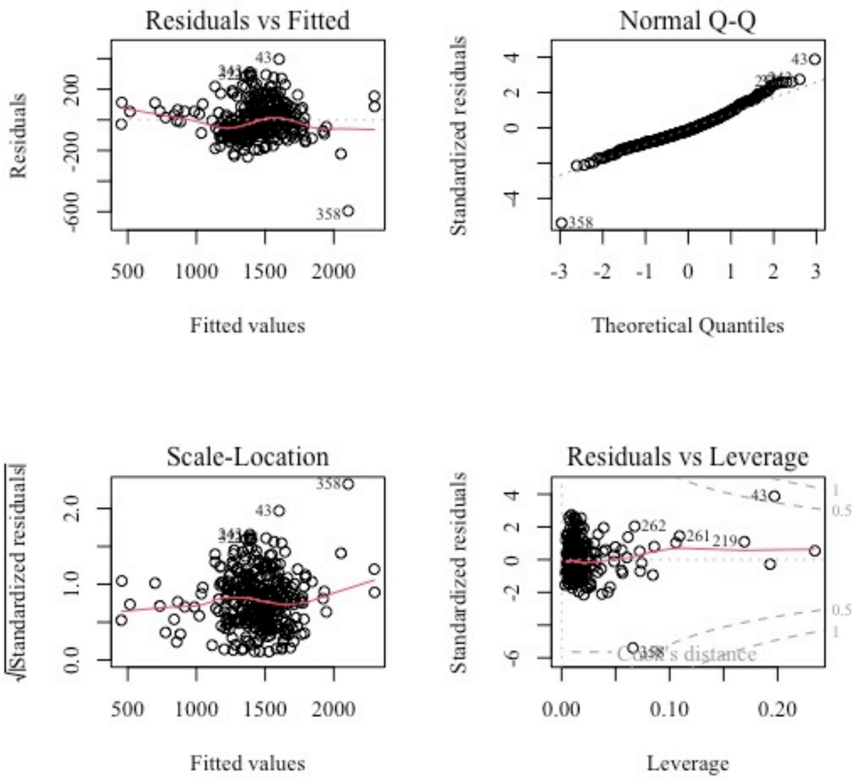

Figure 2: Four plots examining the validity of model 1

<u>*Assumptions of the model 1 (median spendable household income; all data)*</u>
From the residuals versus fitted plot in Figure 2 it can be observed that the data fall randomly above and below the dotted line where residuals are 0. This suggest that the relationship between the independent variables and the average gas use is linear, which is one of the first assumptions of multivariate OLS regression. This linearity of the relationship is further supported by red line (highlighting the average value of the residuals at each fitted point) which is roughly linear and perpendicular to the dotted line.

Moreover, Scale-Location plot in Figure 2 highlights some changes in the variance of the residuals over the range in fitted values indicating the model, but a consequent Breusch-Pagan test suggested that change in the variance is not enough to be seen as significant (BP = 10.923, p = 0.072). One can therefore still view the data as satisfying the assumption of homoskedasticity.

Despite, meeting the assumptions of linearity and homoskedasticity, The Q-Q plot in Figure 2 as well as a Shapiro-test (W = 0.956, $p < 0.001$) suggest that the residuals are not normally distributed. However, the models were not changed as a result, as research has indicated that the regression models are robust to violations of this assumptions when the sample size exceeds 100 observations (Alexopoulos, 2010; Draper & Smith, 1998).

Lastly, as can be observed in the Q-Q plot as well as the Residual vs Leverage plot, the model seems to have two outliers. One of these outliers can even be identified an influential outlier (See residual vs leverage plot, Figure 2), suggesting that coefficients and significance of the model might drastically change upon exclusion of this observation. Similar observations relating to the violation of the normality assumptions, the identified outliers as well as the adherence to linearity and homoskedasticity can be made for the second model (See appendix B).

In order to determine whether the data related to these observations was the result of faulty data collection, the values for all variables (except share of votes received) were manually compared to data from 2017. The manual comparison indicated that the values in 2018 did not deviate substantively from values in 2017. This instils a higher confidence in the validity of the data. Consequently, the data were not excluded completely in the models. However, in order to assess the robustness of the controls, and especially the variable of interest, share of votes for green parties, two additional models were run (Model 3 and 4, Figure 2).

Results of the regression models

As highlighted in the Table 2, the first model, which included median spendable income and the outliers, has an adjusted R^2 of 0.729, suggesting that the model can explain 72.9% of the variation in the data. Furthermore, the F-statistic is statistically significant suggesting that at least one of the model predictors is significant. Interestingly, the second model, which included the average household size per municipality and the outliers, also has a significant F-statistic, but a slightly lower adjusted R^2 ($adj.\ R^2 = 0.719$). The observed reduction in the variation that can explained can be attributed to the swapping of median standardised income with average household size. Relatedly, perhaps unsurprisingly, the exclusion of the outliers improved to adjusted R^2 of both the third and fourth model to 0.814. Therefore, these models are able to explain 81.4% of the variance found in the data used to estimate the model.

Next, in the first and all other models, it can be observed that the average house size in a municipality has a statistically significant positive association with the average gas use in a municipality. Based on the first model, an increase of the average house size of 1 square meter, leads to an increase in average gas in a municipality of 6.56 cubes of gas. Based on appendix A, an increase of one standard deviation (21.5 m^2) in the average house size within a municipality is associated with an increase in of 142 cubic meters of gas.

The median spendable income of a municipality is significantly associated with average gas use in a municipality in the first model, but not in the third model, which does not include the outliers. In the first model, an increase of median spendable income by 1000 euros is associated with an additional 6.70 cubes of gas when all other variables are held constant. An increase of one standard deviation (4.70) in median spendable income in a municipality is, ceteris paribus, associated with an increase in average gas use in a municipality of 31.5 cubic meters of gas.

None of the models that included the average household size in a municipality, highlighted a significant association with average gas use in a municipality. This suggest that average household size is not related to the average gas use in municipality.

Similar to median spendable income, district heating was significantly associated with average gas use across all of the models. However, unlike median spendable income, the direction of the significant association for district heating was negative. Consequently, the first model suggests that an increase of 1% in the use of district heating in a municipality relates to a decrease of 15.0 cubic meters of gas when all other predictors are held constant.

More importantly, the share of votes for ecological parties as a proxy for the level of strong pro-environmental attitudes in a municipality exhibited a significant negative association across the first two models. In the first model, an increase of one percentage point in the votes received for ecological parties in a municipality, ceteris paribus, is associated with a decrease in the 2.33 cubic meters of average gas use. Furthermore, an increase of one standard deviation in the share of votes is associated with a reduction in average gas use of 17.0 cubic meters. Unlike the first two models, however, no significant association was found between the share of votes received and the average gas use in municipalities.

Lastly, the share of houses built after 2015 only exhibit a *significant* negative association in the models in which the outliers have been removed. In the third model, for example, an increase in the houses built after 2015 by one percentage point, all other things equal, reduces average gas use in municipalities by 11.9 cubic meters of gas. Moreover, an increase in the percentage of houses built after 2015 by one standard deviation (1.31), ceteris paribus, is associated with a decrease gas use by 15.6 cubic meters of gas.

Results of the Regression Explaining Average Gas Use Across Households in Municipalities

	Dependent variable:			
	Average gas use (m^3).			
	Model 1	Model 2	Model 3	Model 4
Average house size (m^2)	6.563^{***}	7.083^{***}	8.225^{***}	8.339^{***}
	(0.386)	(0.386)	(0.362)	(0.357)
Median spendable income (1,000s of euros)	6.708^{***}		1.426	
	(1.828)		(1.536)	
Average household size		3.357		4.628
		(49.194)		(39.782)
Share of votes for ecological parties (%)	-2.331^{**}	-2.631^{**}	0.174	0.139
	(1.056)	(1.205)	(0.857)	(0.877)
Share of houses built after 2015 (%)	-3.622	3.811	-11.985^{**}	-10.442^{**}
	(5.564)	(5.527)	(4.924)	(4.882)
District heating (%)	-14.972^{***}	-15.046^{***}	-14.808^{***}	-14.811^{***}
	(0.971)	(0.988)	(0.774)	(0.773)
Constant	365.195^{***}	534.297^{***}	356.872^{***}	383.235^{***}
	(71.256)	(107.531)	(60.526)	(84.910)
Observations	335	335	333	333
R^2	0.733	0.723	0.817	0.817
Adjusted R^2	0.729	0.719	0.814	0.814
Residual Std. Error	134.56 (df = 329)	136.95 (df = 329)	106.57 (df = 327)	106.39 (df = 327)
F Statistic	179.56^{***} (df = 5; 329)	172.07^{***} (df = 5; 329)	283.04^{***} (df = 5; 327)	286.33^{***} (df = 5; 327)
				$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 2: Results of the multivariate regressions explaining average gas use across households in a municipality. In each cell, a regression coefficient is shown. The value in between brackets represents the standard error of the coefficient.

Discussion

Relations to the literature

The results from models one and two highlight that municipalities that a higher share of votes for ecological parties, ceteris paribus, have a lower average gas consumption across households. As such, these models confirm the hypothesis that there is a significant (negative) association between higher levels of pro-environmental attitudes and average gas use across households in municipalities. This finding adds to the literature on the mechanisms between strong attitudes and behaviours within sustainability. By identifying yet another behaviour (even if it is 'municipal' behaviour) next to recycling, food choice and consumption of clothing in which strong pro-environmental attitudes are associated with pro-environmental behaviours, the importance of the mechanisms is stressed.

As such, this provides a relevant policy insight. Governments who are trying to make promote sustainability of its citizens can focus on influencing their attitudes towards sustainability. This can complement other approaches such as nudging or aligning economic and environmental incentives (Thaler & Sunstein, 2008; Tulder & Mil, 2022). Research on the formation of strong pro-environmental attitudes, has indicated that environmental knowledge and education is central to the formation of these strong attitudes (Casaló & Escario, 2018). Consequently, governments could also put additional focus on sustainability education to promote sustainable behaviours among its citizens. In the case of gas use, for example, the government focus on explaining how much CO_2 is reduced by switching to green energy and the societal benefits of this CO_2 reduction if it is done systematically.

- break with average household size.
- addition for models without behavioural variables

Nevertheless, the results should also be interpreted with caution. As highlighted in model three and four, the exclusion of two outliers, which *do* seem valid observations (making it hard to justify theoretical reason for the exclusion other than the modelling itself), suggest that the association between pro-environmental attitudes and gas use is insignificant. Therefore, the results do not seem robust. This highlights the need for future research into this topic.

Limitations

First of all, one of the main limitations of this paper is related to operationalisation of strong pro-environmental attitudes within a municipality. Pro-environmental attitudes within a municipality were measured through the number of seats won by ecological parties in municipal elections. However, the average turnout in the Dutch municipal elections was only a mere 54.97% (Kiesraad, 2018). Therefore, the attitudes of a significant portion of the population in most municipalities was missed.

This is especially problematic because the propensity to vote might not be the same among people with strong pro-environmental attitudes and those without strong pro-environmental attitudes. Research has highlighted that the likelihood of green voting increases among individuals with more education and a higher income (Schumacher, 2014). Furthermore, people who do not vote in the Netherlands, have on average a lower income and less education (Klundert, 2021). Consequently, the level of strong pro-environmental attitudes measured in municipalities might have been inflated. As a result, it seems likely that the size of the association between strong pro-environmental attitudes and gas use was underestimated.

A second point of attention in this paper relates to the limited scope of the data. Despite introducing municipal pro-environmental attitudes as a predictor for average gas use across households in a municipality, the model also left several variables that have been shown to affects gas use out of the model. For example, the proportion of retired people in a municipality has been shown to affect gas use, as retired people spend more time at home (Schumacher, 2014). Similarly, the different types of houses in a municipality (e.g., detached house, terraced house, apartment) and the age of houses in a municipality were also not included in the model, whereas research has shown that municipalities with older houses as well as more detached houses have, ceteris paribus, a higher average household gas consumption (Druckman & Jackson, 2008; Yun & Steemers, 2011). Further research is therefore needed to determine whether the observed significant association in the first two models between strong pro-environmental attitudes in a municipality and the average gas use in a municipality is robust to the inclusion of these missing variables and continues to exhibit a reasonable effect size.

Lastly,

Conclusion

Research relating to what induces or is associated with sustainable human behaviours has only just begun to understand some of the dynamics that underly it. This paper examined the relationship between the level of strong pro-environmental attitudes in municipalities and average gas use across households. The dynamic that it uncovered, albeit a very fragile one, is that a higher level of strong pro-environmental attitudes in a municipality is associated with significantly less average gas use. Next to fact that more research is needed to determine whether this association will hold, other research might already start exploring new dynamics related to pro-environmental attitudes and gas use. For example, do people with strong pro-environmental attitudes reduce their gas consumption more quickly compared to those with weak pro-environmental attitudes when gas prices go up? Do people start using more gas again as the price goes down? Do the potential increases in use differ between people with strong or weak pro-environmental attitudes? Apart from the fact that these questions provide an understanding of human behaviour, which is interesting in and of itself, these questions can also highlight when interventions are needed. If, in certain situations, even those with strong pro-environmental beliefs fail to act sustainably, it might be necessary for businesses or governments to step in to try to accelerate sustainability. As mentioned in the beginning, the key to limit global warming to 1.5 degrees Celsius, is if the public, private and civil sector work together.

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Appendix A: Descriptive Statistics of Data on which Regression Models 1 and 2 are based

Descriptive Statistics of Data on which Regression Models 1 and 2 are based

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
Average gas use (m^3)	335	1440.657	258.438	370	1275	1625	2390
Average household size	335	2.273	0.178	1.71	2.185	2.37	3.32
Average house size. (m^2)	335	131.854	21.664	76	118	143.5	237
Share of houses built after 2015 (%)	335	2.172	1.431	0.042	1.157	2.766	12.973
Median spendable income (1,000 euros)	333	38.583	4.699	25.2	35.5	41.8	57.4
Share of votes for ecological parties (%)	335	7.311	7.365	0	0	12	33.333
District heating (%)	335	2.094	7.92	0	0	0	68.6

Appendix B: Plots used to examine the assumptions of model 2 (all data; based on average household size)