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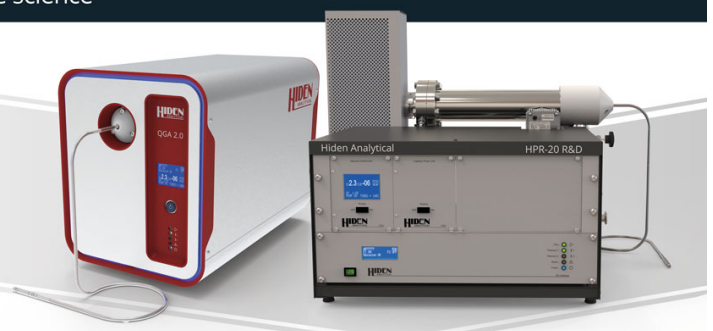
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Citizen's perceived legitimacy of the Dutch natural gas-free heating policy

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Abstract

The Dutch Climate Agreement mandates sustainable heating of buildings by 2050, necessitating a transition away from natural gas towards electrification (heat pumps) and district heating. Dutch municipalities play a key role in this transition policy, as they develop and coordinate neighborhood-specific plans to implement sustainable heating solutions. Understanding how citizens perceive local policy plans can help policymakers to make choices in line with what citizens find important. This study aims to examine the perceived legitimacy of the Dutch heating transition policy as it concerns becoming natural gas-free. The first step in our analysis involved identifying key factors that may affect the perceived legitimacy of the policy in question. Subsequently, we tested the effects of these factors in a questionnaire and vignette study among Dutch citizens ($n = 2,034$). We found that citizens acknowledge and support the importance of addressing climate change (76%) and reducing energy dependence (88%). However, 39% does not feel represented by local council members. Moreover, the vignette experiment showed that collectively sharing transitioning costs, public ownership, price certainty, and communicating uncertainties would make policy more legitimate. Furthermore, participants value the right to opt out of district heating introduced by municipalities, even if this results in higher collective costs. When policy choices in vignettes were aligned with citizen preferences, a majority found presented plans acceptable and expressed no intention to protest. Conversely, vignettes misaligned with citizen preferences resulted in rejection and increased likelihood of protest. Since Dutch citizens are not obliged to comply with municipal plans, securing their acceptance and support is critical. Therefore, it is essential for municipalities to understand and carefully consider citizen preferences when designing local plans.

Introduction

A large part of the European CO₂ emissions is the result of the use of fossil fuels for heating buildings (see e.g., EEA (2024)). The decarbonisation of heating is a transformative challenge for many countries with a significant gas distribution infrastructure like Italy, the United States, Canada, the UK and the Netherlands (Loves and Woodman 2020). The Dutch Climate Agreement (2019) stipulates that seven million Dutch homes and one million other buildings should be heated without natural gas by 2050. In 2023, about 90% of the Dutch households were depending on natural gas for heating, by far the highest share in the European Union (OECD 2023). In 2023, 12% of the Dutch national CO₂ emissions were due to the use of natural gas in the built environment (CBS 2024).

The purpose of switching to natural gas-free heating is to combat climate change, but also to reduce energy dependence on other countries (Ministry of the Interior and Kingdom Relations 2022b). The Dutch national government is responsible for dividing and delineating responsibilities between levels of government and between government and society (RLI 2016). Municipalities particularly have an important role to play in achieving the natural gas-free policy goal. They have to develop Heat Transition Visions (HTVs) and coordinate the local heat transition implementation. These HTVs contain an indication at neighborhood level of how a neighborhood will be heated without the usage of natural gas in the future, for example through renewable

energy-based district heating systems or electrification with individual heat pumps, which are the main natural gas-free heating solutions in the Netherlands. Important principles of the natural gas-free policy overall are to get the lowest national costs and to ensure that the heating plans achieve the national targets for 2050.

Two laws form the basis of the Dutch natural gas-free heating strategy: the ‘Municipal Instruments Heat Transition Act’, the MIHTA (2024) and the ‘Collective Heat Act’ (CHA 2024) which is currently under consultation. With the CHA (2024), the central government aims to regulate heat networks. The actual costs incurred by the heating company can be charged, including a reasonable return for the heating company. Hence, the cost of heat can differ significantly between neighborhoods and heat tariffs can become higher than under the previous ‘not-more-than-other’ principle (Bianchi *et al* 2022). The CHA (2024) stipulates that heating companies, and thus future heat networks, must be at least 51% owned by public entities. The MIHTA (2024) gives municipalities the power to disconnect a neighborhood from natural gas, under the condition that a fully-fledged heating alternative is offered. Currently, that choice lies with individual residents while a forced disconnection from gas is not possible. Alongside a heat alternative, additional conditions are set; for example, municipalities must take into account the affordability of the heat supplied. Furthermore, participation and legal protection must be guaranteed and there must be a reasonable period between the designation of a neighborhood/area and the actual transition to the alternative heat source. The guideline for this is eight years. By law, homeowners are not obliged to cooperate with a collective alternative. Thus, they retain freedom of choice to opt for an alternative (individual) heating technology. This affects the discussion on the tradeoff between lower costs for publicly owned networks and the restriction of personal freedom (see also Zaunbrecher *et al* (2016)).

In addition to the draft legislation mentioned above, natural gas is becoming increasingly expensive. So, it becomes more profitable to insulate or switch to natural gas-free alternatives. In any case, insulation is often prerequisite before switching to heat pumps or low temperature district heating (Wahi *et al* 2022). Subsidies are available for insulating and purchasing heat pumps. Still, municipalities risk not meeting the national intermediate targets for 2030, taking into account the large amount of HTVs which are not yet fully formulated and concrete (van der Molen *et al* 2023). Among other reasons this is due to technical challenges, labor shortages (OECD 2023), and households’ reluctance to switch (Scholte *et al* 2020).

Citizens and the heating transition

When implementing far-reaching policies, social acceptance is an important prerequisite (Wüstenhagen *et al* 2007, Batel 2020). If citizens do not feel involved in the choices made by politicians and they do not support them, it becomes more difficult to shape and implement the policy effectively. The transition to gas-free alternatives for heating houses is a challenge, both technically and socially. It requires citizens to adopt and invest in alternative heating systems and better insulation of their houses, which they might be hesitant to do so because of perceived impact on comfort and convenience (Decker and Menrad (2015), Becker *et al* (2023), Shirani *et al* (2024)). Citizens will have to get used to new appliances in their homes and the activities around the transition will often involve significant inconveniences (de Vries *et al* 2020). The transition also leads to other uncertainties for residents, for example, in cases where they do not trust energy companies (Becker *et al* 2019), professional advice (De Wilde 2019), do not know what exactly is expected of them, or they are concerned about the practical or financial consequences of natural gas-free heating (see e.g.,: Scholte *et al* 2020, Becker *et al* 2023, Howick *et al* 2023). Citizens are also concerned about the technical consequences of heating alternatives, for example whether a heat pump might cause too much noise (Kooger *et al* 2023, de Jong *et al* 2024).

Research questions

The relationship between citizens, public authorities, and other stakeholders is unequitable as there are differences in knowledge, power, and interests. Promoting equitable and sustainable system change requires mechanisms that ensure public benefits (Sareen and Haarstad 2020). Attention to democratic legitimacy is therefore important when designing sustainability transition management (de Geus *et al* 2022, Wesche and Skjølsvold 2025). To date there is limited knowledge about public perceptions of policies for heating decarbonization and key predictors of public acceptance (Becker *et al* 2023). Therefore, we examine the perceived legitimacy of Dutch policy to stimulate the transition to natural gas-free heating of residential buildings. If policymakers understand how citizens perceive this policy, they can make better-informed policy choices which more accurately reflect what citizens find important. Ultimately, implementation can run more smoothly if policies are more acceptable to citizens (Warren 1999, Marien and Hooghe 2011, Bokhorst 2014).

In this study, we map the extent to which policy choices align with what citizens find important and examine to what extent citizens find policy acceptable when thinking about what is in the public interest. In doing so, we also look at how this perceived policy legitimacy is influenced by the choices policymakers have when developing concrete plans for the transition to natural gas-free heating of buildings. This brings us to the following research questions:

- To what extent do citizens accept that the government makes policy to make homes natural gas-free with a view to public interest?
- Which policy choices make natural gas-free policy more legitimate as perceived by citizens?

Conceptualizing policy legitimacy

Ideas about legitimacy of authority have changed and developed over time and different approaches have been applied in the past by different research disciplines, as described in Martens *et al* (2024). Sociologists emphasize the voluntary acceptance of authority and power, lawyers use the concept mainly in the legal sense (i.e., in accordance with the law), while philosophers focus on the moral and ethical foundations of justice (Bakker 2001, Bokhorst 2014). A common approach in psychology (Tyler 2003) for perceived legitimacy stems from ideas by Max Weber (1978), who defined legitimacy as the acceptance of an authority, or as a belief in the appropriateness of an authority. Others, such as Van Noije (2019), McCullough (2015), Bokhorst (2014) and Beetham (1991), prescribe additional conditions for policy legitimacy, including proposing that policy is only legitimate when it acts in accordance with legislation, when it is morally just, and when it serves public interest. We define (perceived) policy legitimacy in this study as: *the voluntary acceptance of policy based on the common good, where the policy is in accordance with the law and citizens recognize the authority of the government as a policymaker* (see also Martens *et al* (2023)).

According to McCullough (2015), there are two main approaches to study policy legitimacy; 1) A normative approach, where the assessment is focused on the level of conformity of certain legitimacy standards aligning with a normative view on what is considered to be legitimate (Rotberg 2004, Lemay-Hébert 2009, Andersen 2012).

2) An empirical approach, based on people's perceptions and the interaction between authority and people (Roos and Lidström 2014).

Our definition for policy legitimacy provided above can be operationalized through either a normative or an empirical approach. In this study we applied the empirical approach, because empirical information about citizens' perceived legitimacy of the natural gas-free policy is not systematically gathered in the existing literature. A systematic overview of relevant legitimacy aspects can contribute to structure the political discussion about the natural gas-free policy.

Based on the literature (Beetham 1991, Bakker 2001, Bokhorst 2014, Vringer and Carabain 2020, Martens *et al* 2023 and in particular Van Noije 2019), we distinguish 13 criteria for policy legitimacy, covering input, throughput and output legitimacy as outlined in figure 1. Input policy legitimacy is about the extent to which individuals and groups have influence over decision-making. Throughput policy legitimacy is the extent to which government acts according to proper procedures, carefully and fairly (procedural justice). Output policy legitimacy is the degree to which policy interventions solve collective problems and thereby increase (broad) welfare (see Martens *et al* 2023).

Methods and approach

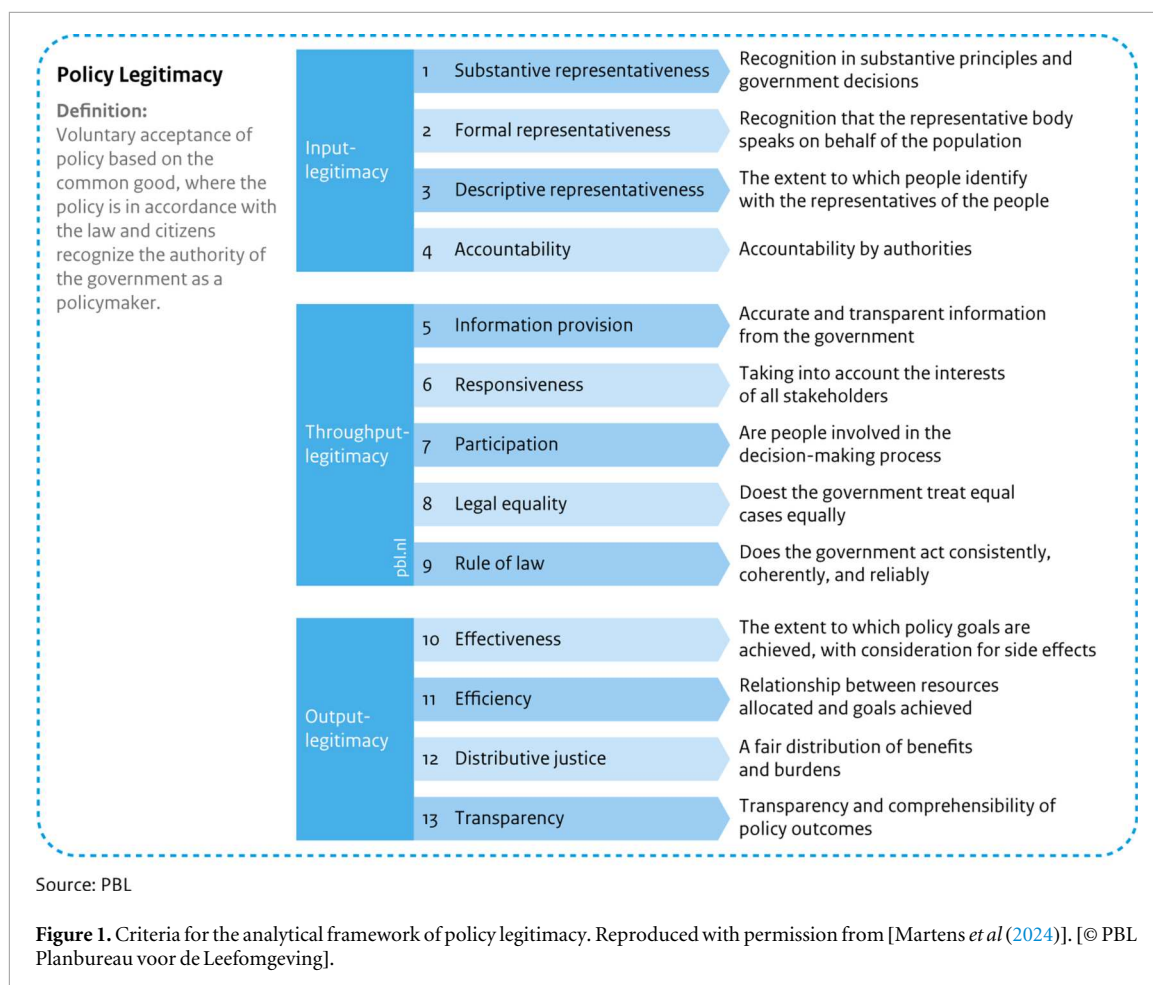
To get a good view on how Dutch citizens perceive the legitimacy of the policy to make homes natural gas-free, we performed an online survey among Dutch citizens. A general question, assessed the overall perceived legitimacy regarding the policy choice for natural gas-free heating policy. We gathered information about the input legitimacy via survey questions. Finally, in a vignette experiment we explored to what extent different policy characteristics affect citizens perceptions of throughput- and output legitimacy.

Population

The fieldwork organisation drew a sample of 4,151 people from their TNS Nipobase panel. This sample is fairly representative for the Dutch population taking into account gender, age, education, regional distribution and household size. Between 13 and 26 April 2023 the questionnaire was fully completed by 2,034 citizens (response rate of 49%). See the results for a description of the respondents' sociodemographic characteristics.

Questionnaire: information and introduction

We showed the respondents the following introduction text as well as the illustrations in figure 2: *'We heat many houses in the Netherlands with natural gas. The Dutch government wants us to heat all houses differently by 2050. Because stopping using natural gas is better for the climate. And it makes us less dependent on other countries for our energy. Municipalities have made plans for all districts to heat houses differently. That is what this questionnaire is about.'* In addition, participants were shown two illustrations with technical information about the most common techniques considered for decarbonized heating at the time: district heating and heating pumps. To explore how citizens generally assess the legitimacy of the policy to make homes natural gas-free, we



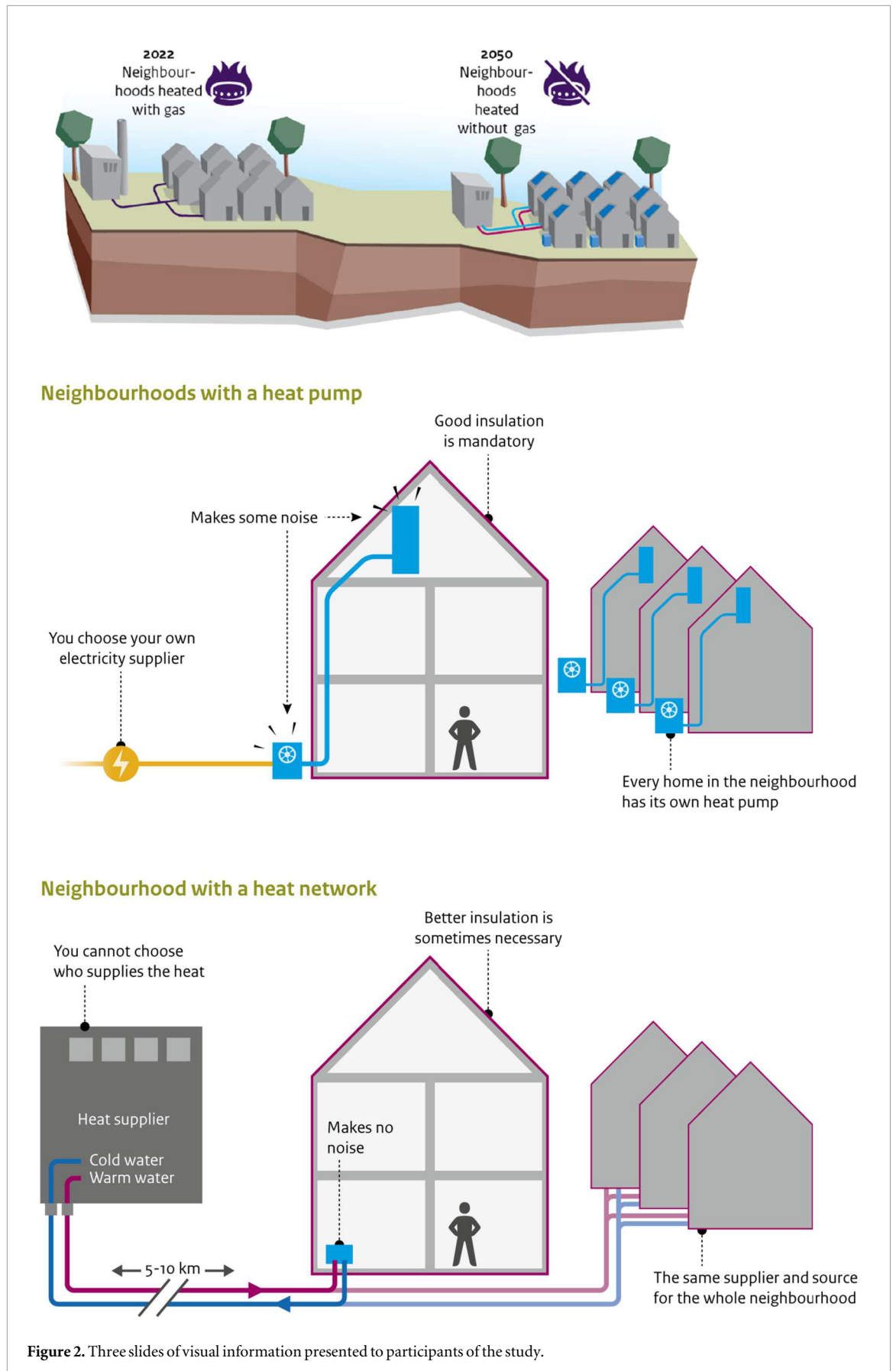
asked: ‘Do you think it is acceptable for municipalities to make plans to heat homes without natural gas? Think about what is best for everyone’, on an 11 point scale ranging from completely unacceptable to completely acceptable. An 11-point scale was chosen to compare with previous work by (Liebe et al 2017) and Addario et al (2020). In this formulation, we tried to approach as closely as possible a simplified version of the definition of policy legitimacy we formulated in the theoretical framework. An 11 point scale was chosen as this can help to lower nonresponse and more positive evaluation by respondents than 5 point scales (Toepoel and Funke 2018).

Questionnaire measuring perceived input legitimacy

We formulated thirteen statements in consultation with policy experts and policy documents that serve as indicators of perceived input legitimacy. In total, there are five statements to measure substantive representation, four for formal representation and four for descriptive representation; see the results for a description of these statements. All statements were presented on a 7-point scale ranging from strongly disagree to strongly agree. In order to examine the relationship with other concepts in our research, such as the overall assessment of the legitimacy of the natural gas-free policy, we calculated average scores for the individual components of input legitimacy. In a pilot the statements were first presented to ten citizens to test their comprehensibility. We did not include items on accountability as citizens felt they did not have sufficient information needed to form an opinion on this. As the survey was undertaken in Spring 2023 and gas prices had increased after the Russian incursion in Ukraine this might have affected participants attitude regarding the use of natural gas to heat homes. Therefore we added an extra statement on the same 7-point scale reading: ‘Because of the war in Ukraine I think differently now regarding the use of natural gas to heat homes’.

Examining the effects of policy characteristics - a vignette experiment

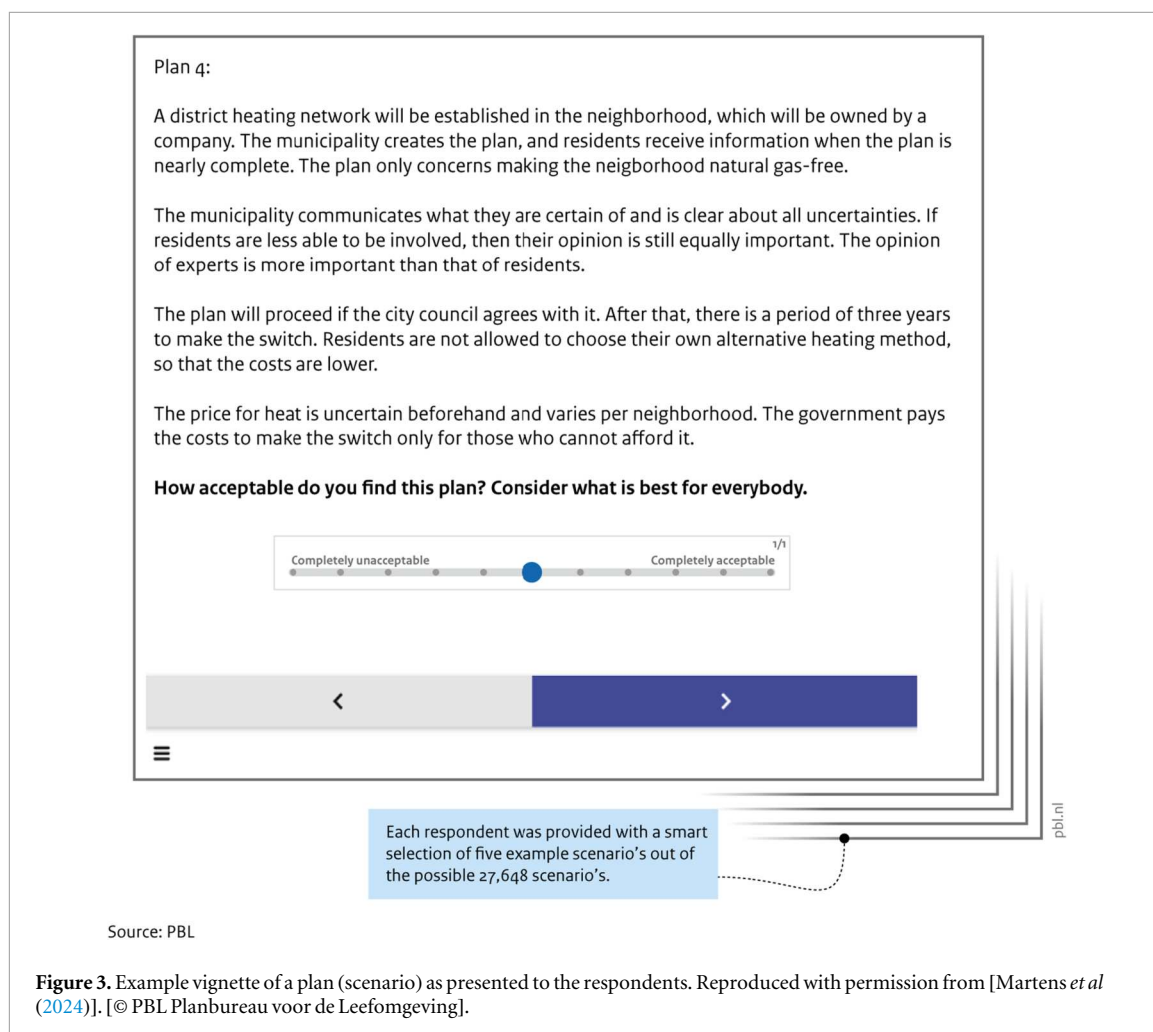
In a vignette experiment, as part of the online questionnaire, respondents read several short descriptions of policy plans (scenarios), which they then judged on perceived policy legitimacy. Using this method, it is possible to assess to what extent different aspects of the scenarios (attributes) affect the overall judgement (Atzmüller and Steiner 2010). The advantage over using standard survey questions predominantly lies in the higher realism that can be achieved by presenting situations instead of separate attributes (Aguinis and Bradley 2014).



To select the attributes and its levels to construct the vignettes, it is important to include the most relevant policy characteristics for perceived legitimacy. We stepwise came to the selection as presented in table 1. First, we studied Dutch policy documents and reports to identify policy characteristics and intentions. We selected

Table 1. Overview of policy characteristics and attribute levels.

Policy characteristic	Various levels			
1) Technical solution and ownership (Distributive justice and effectiveness).	Heat pumps will be installed in the neighborhood, which will be owned by a company.	Heat pumps will be installed in the neighborhood, which will be owned by homeowners.	A district heating network will be established in the neighborhood, which will be owned by a company.	A district heating network will be established in the neighborhood, which will be owned by the municipality.
2) Initiative plans (participation).	Residents create the plan, and the municipality assists them in doing so.	The municipality creates the plan, and asks residents about their opinion regularly.	The municipality creates the plan, and residents receive information when the plan is nearly complete.	
3) Co-opportunities (responsiveness and effectiveness).	The plan also involves improving the neighborhood.	The plan only concerns making the neighborhood natural gas-free.		
4) Information (Information provision).	The municipality communicates what they are certain of and is clear about all uncertainties.	The municipality mainly communicates what they are certain of and says little about uncertainties.		
5) Role residents (Responsiveness and participation).	If residents are less able to be involved, then their opinion is still equally important.	If residents are less able to be involved, their opinion becomes less important.		
6) Role experts (Participation).	The opinion of experts is more important than that of residents.	The opinion of experts is just as important as that of residents.	The opinion of residents is more important as that of experts.	
7) Procedure decision (Participation).	The plan will proceed if more than 70 percent of the residents agree.	The plan will proceed if the city council agrees with it.		
8) Transfer time (effectiveness).	After that, there is a period of eight years to make the switch.	After that, there is a period of three years to make the switch.		
9) Freedom of choice (responsiveness and efficiency).	Residents are not allowed to choose their own alternative heating method, so that the costs are lower	Residents are allowed to choose their own alternative heating method, which results in higher costs.		
10) Certainty about the price of heat (Rule of law).	The price for heat is uncertain beforehand ...	The price for heat is certain in advance ...		
11) Differences in the price of heat (Legal equality).	... and is the same for all neighborhoods	... and varies per neighborhood.		
12) Distribution of the transition costs (Distributive justice).	The government pays the costs to make the switch for everyone.	The government pays the costs to make the switch only for those who cannot afford it.	The government does not cover the costs for anyone to make the switch.	



written texts from the Dutch Climate agreement (2019), the Program to accelerate sustainability in the built environment (Ministry of the Interior and Kingdom Relations 2022b), a draft version of the Municipal Instruments Heat Transition Act (MITHA 2022) and a letter to the parliament from the minister (Kamerbrief 2022) in which he makes important political choices which will become part of the announced ‘Collective Heat Act’ (see CHA 2024). We consulted the website of the National Program Local Heat (NPLW), and we examined the National Insulation Program (Ministry of the Interior and Kingdom Relations 2022a). Finally, we consulted Dignum *et al* (2021) who made an evaluation of the Dutch heat transition policies.

Secondly, based on the document analysis, we constructed a list of relevant policy characteristics that could become part of the vignette design. This list was discussed with policy experts from the PBL, Netherlands Environmental Assessment Agency to construct a draft vignette design. We discussed whether formulated factors and attributes correspond sufficiently with actual policy variations, while also keeping the analytical framework in mind. When the draft questionnaire was complete, ten citizens, selected by the fieldwork agency, were online interviewed by a professional interviewer for about 30 min each to test the vignettes and questionnaire for possible biases and comprehensibility. We anonymously observed the test interviews during the online meeting. Based on these interviews, we made further adjustments, which included a number of simplifications to the formulation of the vignette levels.

This process led to the selection of twelve factors with two to four levels. A 4X3X2X2X2X3X2X2X2X2X3 design (see table 1) led to a population of 27 648 vignettes. Based on the pilot test it was feasible to present each respondent no more than five vignettes (see figure 3). Therefore a so-called mixed design was used where every respondent only judges a subset of vignettes. It is important to carefully construct these subsets to be able to efficiently estimate the effects of attributes on the judgement on a group level (Su and Steiner 2018). We used Sawtooth software with the balanced overlap method to create the subsets. This algorithm constructs sets semi-randomly carefully controlling for level balance and independence of the attributes. Simulations indicated that the selection of subsets was efficient, with standard errors of all main and two-way effects well below the recommended 0.05 cut-off point (Sawtooth).

We introduced the respondents to the vignettes with a brief explanation of the process: ‘Together with others, such as companies and residents, municipalities make plans to heat houses in a different way than with natural gas. A plan is made for each neighbourhood, so that a plan fits a neighbourhood well’. Next, they were

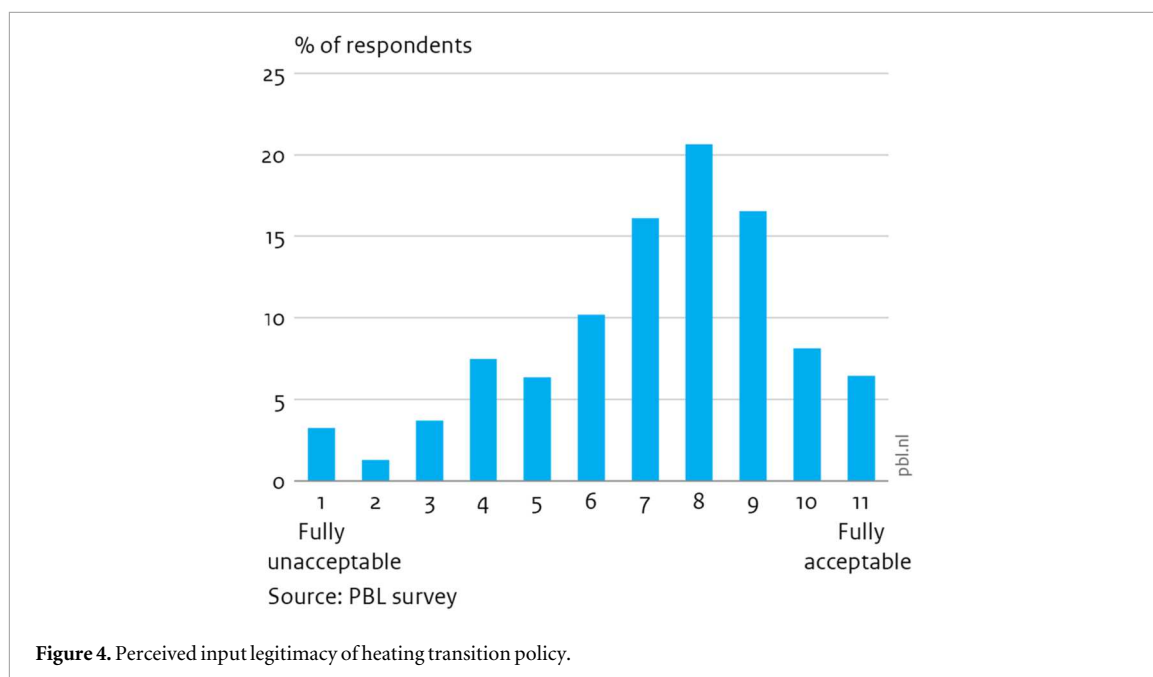


Figure 4. Perceived input legitimacy of heating transition policy.

asked to read the scenarios carefully and to consider what was best for everybody when assessing their acceptability (figure 3). After each description, respondents were asked: ‘How acceptable do you think this plan is?’ on a scale of 11 points from completely unacceptable to completely acceptable. After the last scenario, we asked: ‘If this last (fifth) plan were implemented, would you intend to protest?’

Statistical analysis

We calculated descriptive characteristics for sociodemographic variables and the distribution of responses to legitimacy questions. We calculated Spearman correlations between the variables of interest and Cronbach’s alpha was calculated for the input legitimacy scales to test for internal consistency across the items. To calculate how important each policy attribute was for judging the legitimacy of plans, we used a so-called random intercept multilevel linear model with maximum likelihood estimation. Multilevel models take into account the nested structure of data and are the recommended choice for analyzing vignette data (Baguley *et al* 2022). In our case perceived legitimacy scores of the presented vignettes are nested within respondents, as each respondent judged 5 different vignettes. Attribute levels were entered as predictors and non-standardised beta coefficients were calculated with confidence intervals (CI) of 95%. The beta coefficients therefore represent the estimated effect of each level compared to the reference category. This can be interpreted in terms of the original 11-point legitimacy scale. The reference category was always the least legitimate option chosen post hoc, so the coefficients always indicate the effect relative to the least legitimate level. In a second model, we added the means of the input legitimacy variables (substantive representativeness, formal representativeness, descriptive representativeness) to the random intercept multilevel linear model. With the collected protest intentions, we can calculate for each point on the legitimacy scale what proportion of respondents report the intention to protest. Stata version 18 was used for all analyses.

Results

The characteristics of the respondents can be found in the appendix, table A1. These characteristics correspond reasonably well with the Dutch population (Martens *et al* 2024) although our study includes fewer younger respondents.

General

We present the distribution of responses on the overall legitimacy question in figure 4 (below). The most common response (mode) is a score of 8 on the 11-point scale with a mean of 7.2 ($N = 2,034$, $SD = 2,4$). This indicates that most respondents consider the natural gas-free policy on average reasonably legitimate, although a substantial group perceives the policy as much less legitimate, indicated by lower scores (22% scored 5 or less).

Figures 5(a)–(c) show to what extent the respondents agree with statements regarding the perceived input legitimacy. They agree to a large extent with substantive representativeness (items 1–5), indicating that they largely recognized themselves in the goals of the government and the means to achieve them. Agreement is

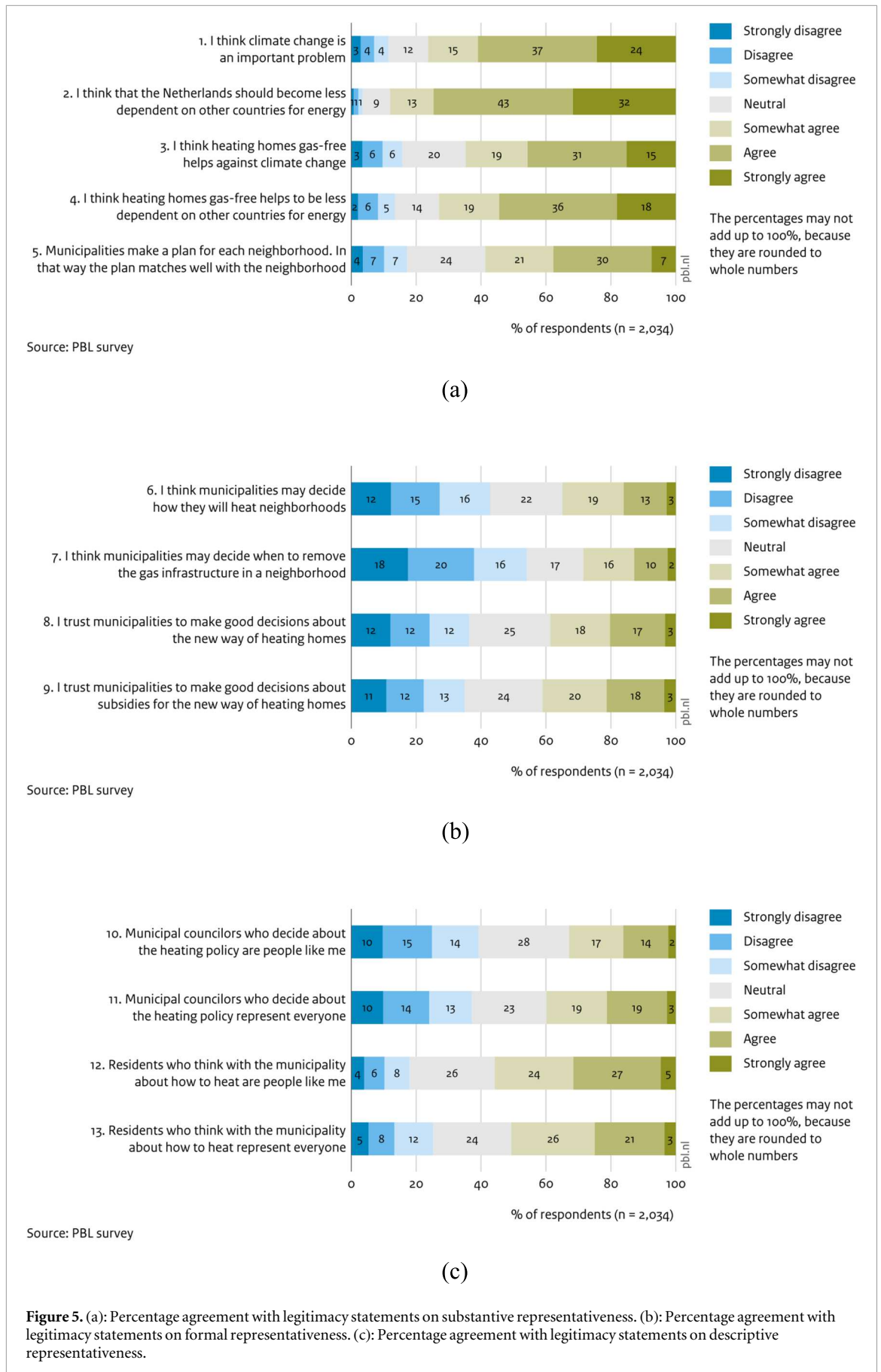


Figure 5. (a): Percentage agreement with legitimacy statements on substantive representativeness. (b): Percentage agreement with legitimacy statements on formal representativeness. (c): Percentage agreement with legitimacy statements on descriptive representativeness.

Table 2. Correlation matrix with Spearman's rho coefficients of overall perceived policy legitimacy and input legitimacy.

	Median (IQR)	Mean (SD)	(1)	(2)	(3)	(4)
(1) Overall perceived policy legitimacy (1–11)	8 (3.00)	7.18 (2.39)	1.00			
(2) Substantive representativeness (1–7)	5.40 (1.40)	5.24 (1.16)	0.65	1.00		
(3) Formal representativeness (1–7)	3.75 (2.00)	3.73 (1.46)	0.62	0.61	1.00	
(4) Descriptive representativeness (1–7)	4.25 (1.50)	4.16 (1.26)	0.50	0.53	0.69	1.00

lower only for item 5, indicating mixed opinions regarding the idea that municipalities making a plan for each neighborhood can help to match plans well with the neighborhood. In addition, 48% of the respondents agreed to at least some extent with the statement that the war in Ukraine caused them to think differently about heating homes with natural gas. For formal representativeness and descriptive representativeness, we see that people more often disagree rather than agree with the idea that municipalities may decide how they will heat neighborhoods and when to remove gas infrastructure in a neighborhood. Regarding the descriptive representativeness, we find that people agree more often with statements 12 and 13 than with statements 10 and 11. So it seems that people feel better represented by other residents than by municipal councilors, if those residents participate with the municipality to think about the transition plan.

We calculated Spearman correlations between variables of interest. We find moderate to strong correlations between input legitimacy and overall judgment of policy legitimacy (0.50–0.65), and between substantive, formal, and descriptive representativeness (0.53–0.69, table 2). The item on the role of the war in Ukraine was associated with overall perceived policy legitimacy to a lesser degree (0.28, not presented in table 2). Cronbach's alpha of the scales were all $> .80$ indicating sufficient internal consistency (substantive representativeness = 0.85, formal representativeness = 0.89, descriptive representativeness = 0.83).

Vignettes

Variation in attitudes towards climate policy is caused in part by differences between vignettes, but also by differences between persons and household characteristics (Mills, Schleich 2012). The intraclass correlation (ICC) is the fraction of the total variation in the data that is accounted for by between-person variation. In our study the ICC is 0.37, calculated with an intercept-only model.

This means that about 37% of the total variation in perceived legitimacy scores can be accounted for by differences between respondents' characteristics. We take this degree of clustering into account by estimating a random intercept model. Model 1 shows the outcome of a model with only variation in throughput and output legitimacy policy choices, while model 2 adds the mean scores of input legitimacy variables to the random intercept multilevel linear model.

Finally, we demonstrate in table 3 how different policy characteristics affect citizens' perceived policy legitimacy. The estimated mean of a vignette with a combination of the lowest legitimacy attribute levels is 3.62 (see intercept of model 1), while the estimated mean of a vignette with the combination of the highest attribute levels is 7.30 [95% CI: 7.14, 7.47]. Except for the factor for co-opportunities, all attribute levels have a significant impact on perceived policy legitimacy. The largest effects are found for the way costs for the transition are distributed (distributive justice). When the government does not cover the costs for anyone to make the switch, respondents rate the policy legitimacy on average $B = 0.89$ [95% CI: 0.81, 0.98] points lower on our 11-point scale as compared to when the government covers the transition costs for everyone, or $B = 0.68$ [95% CI: 0.60, 0.77] when the government covers the costs only for citizens who cannot afford it. Other aspects related to costs and distributive justice are also important for perceived policy legitimacy. Citizens find public ownership more important than the alternative heating technology. Price certainty in advance contributes to perceived policy legitimacy $B = 0.49$ [95% CI: 0.42, 0.56], as well as equality in prices between neighborhoods $B = 0.20$ [95% CI: 0.13, 0.27]. Citizens consider it more legitimate if they retain the right to opt out of district heating, despite higher collective costs $B = 0.31$ [95% CI: 0.24, 0.38].

A number of policy choices regarding participation and communication are important for perceived policy legitimacy. Citizens consider the policy less legitimate if the municipality creates the plan and the residents receive information when the plan is nearly complete, more legitimate if the municipality creates the plan and regularly asks residents about their opinions $B = 0.17$ [95% CI: 0.08, 0.25], or if residents create the plan and the municipality assists them in doing so $B = 0.23$ [95% CI: 0.14, 0.31]. Notably, explicitly communicating about uncertainties $B = 0.37$ [95% CI: 0.30, 0.44] contributes to perceived policy legitimacy. The proceeding of the plan is considered more legitimate in case more than 70% of the residents agree with the plan (versus if the city council agrees) $B = 0.24$ [95% CI: 0.17, 0.31]. Citizens consider plans more legitimate if the municipality makes

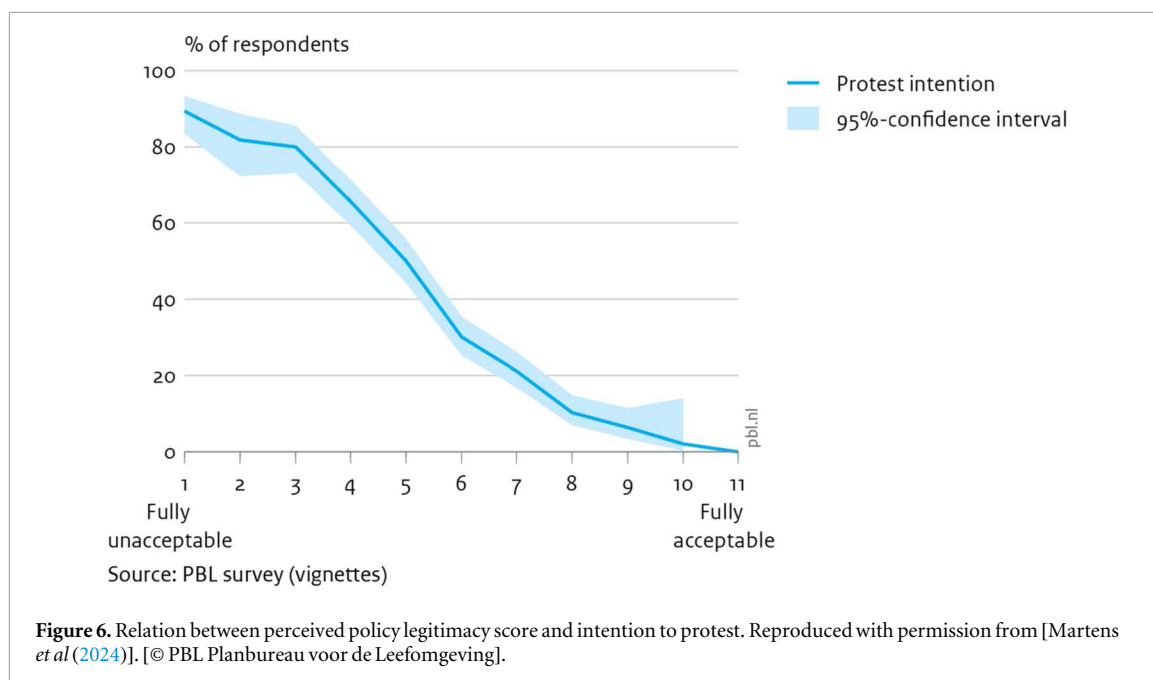
Table 3. Results of random intercept regression models for the effects of vignette attributes on perceived policy legitimacy.

Variables	Model 1		Model 2	
	B	95% CI	B	95% CI
Individual heat pumps will be installed in the neighborhood, which will be owned by a company (versus A district heating network will be established in the neighborhood, which will be owned by a company)	0.07	[−0.03, 0.17]	0.07	[−0.03, 0.17]
Heat pumps will be installed in the neighborhood, which will be owned by homeowners (versus A district heating network will be established in the neighborhood, which will be owned by a company)	0.42	[0.32, 0.52]	0.42	[0.32, 0.52]
A district heating network will be established in the neighborhood, which will be owned by the municipality (versus A district heating network will be established in the neighborhood, which will be owned by a company)	0.39	[0.29, 0.49]	0.38	[0.28, 0.48]
The plan also involves improving the neighborhood (versus The plan only concerns making the neighborhood natural gas-free)	0.06	[−0.01, 0.13]	0.06	[−0.01, 0.13]
Residents create the plan, and the municipality then assists them in doing so (versus The municipality creates the plan, and residents receive information when the plan is nearly complete)	0.23	[0.14, 0.31]	0.22	[0.14, 0.31]
The municipality creates the plan, and asks residents about their opinion regularly (versus The municipality creates the plan, and residents receive information when the plan is nearly complete)	0.17	[0.08, 0.25]	0.17	[0.09, 0.26]
The municipality communicates what they are certain of and is clear about all uncertainties (versus The municipality mainly communicates what they are certain of and says little about uncertainties)	0.37	[0.30, 0.44]	0.37	[0.30, 0.44]
If residents are less able to be involved, then their opinion is still equally important (versus If residents are less able to be involved, their opinion becomes less important)	0.16	[0.09, 0.23]	0.15	[0.08, 0.23]
The opinion of experts is just as important as that of residents (versus The opinion of experts is more important than that of residents)	0.15	[0.07, 0.24]	0.15	[0.06, 0.24]
The opinion of residents is more important as that of experts. (versus The opinion of experts is more important than that of residents)	0.10	[0.01, 0.18]	0.09	[0.01, 0.18]
The plan will proceed if more than 70% of the residents agree (versus The plan will proceed if the city council agrees with it)	0.24	[0.17, 0.31]	0.24	[0.17, 0.32]
After that, there is a period of eight years to make the switch (versus After that, there is a period of three years to make the switch)	0.16	[0.08, 0.23]	0.15	[0.08, 0.22]
Residents are allowed to choose their own alternative heating method, which results in higher costs (versus Residents are not allowed to choose their own alternative heating method, so that the costs are lower)	0.31	[0.24, 0.38]	0.30	[0.23, 0.37]
The price for heat is certain in advance ... (versus The price for heat is uncertain beforehand ...)	0.49	[0.42, 0.56]	0.49	[0.42, 0.56]
... and is the same for all neighborhoods (versus ... and varies per neighborhood)	0.20	[0.13, 0.27]	0.20	[0.13, 0.27]
The government pays the costs to make the switch for everyone (versus The government does not cover the costs for anyone to make the switch)	0.89	[0.81, 0.98]	0.89	[0.81, 0.98]
The government pays the costs to make the switch only for those who cannot afford it (versus The government does not cover the costs for anyone to make the switch)	0.68	[0.60, 0.77]	0.68	[0.60, 0.77]
Substantive representativeness			0.19	[0.12, 0.25]
Formal representativeness			0.42	[0.36, 0.48]
Descriptive representativeness			0.28	[0.22, 0.35]
Intercept	3.62	[3.46, 3.79]	−0.09	[−0.40, 0.22]
Log Likelihood		−21839.06		−21325.66
ICC		0.40		0.25

an effort to take into account the opinion of citizens unable to actively participate $B = 0.16$ [95% CI: 0.09, 0.23]. Citizens consider plans more legitimate when the municipality values the opinion of citizens equally $B = 0.15$ [95% CI: 0.07, 0.24] or more than the opinion of experts $B = 0.10$ [95% CI: 0.01, 0.18].

Model 2 shows that input legitimacy has a large effect on perceived policy legitimacy of the vignettes. For each 1 point increase on the 7 point input legitimacy scales, perceived policy legitimacy (11 point scale) increases by $B = 0.19$ [95% CI: 0.12, 0.25] for substantive representativeness, by $B = 0.42$ [95% CI: 0.36, 0.48] for formal representativeness, and by $B = 0.28$ [95% CI: 0.22, 0.35] for descriptive representativeness.

The more a plan is considered as legitimate, the lower is respondent's intention to protest. There is a clear relationship between protest intention and the overall assessment of the perceived policy legitimacy of the



neighborhood plans (figure 6). This relation shows that the impact of policy choices on acceptance is large. The choices can be made when developing a plan. This helps to interpret the regression coefficients of Models 1 and 2.

Conclusions and discussion

Our findings indicate that Dutch citizens, on average, perceive the natural gas-free policy as moderately legitimate. Nearly all policy options presented—each directly linked to policy legitimacy criteria—were regarded as important for policy acceptability. This underscores that the design of concrete plans for implementing the heating transition at the neighborhood level significantly influences their perceived policy legitimacy. When policy choices in vignettes aligned with citizen preferences, a majority of respondents found plans acceptable and expressed no intention to protest. Conversely, when the vignettes misaligned with citizen preferences on aspects such as costs, cost distribution, communication, and participation, they were rejected, and the likelihood of protest increased. Given that Dutch citizens are not legally obligated to comply with municipal heating transition plans, fostering their acceptance and support is essential. Therefore, it is crucial for municipalities to understand and carefully consider citizen preferences when designing local plans.

There are differences in the degree to which citizens find the natural gas-free policy acceptable, but the group that rejects the policy outright is relatively small. Only 22% rated the policy's legitimacy as 5 or lower on a 11-point scale. Most respondents agreed that combating climate change and reducing energy dependency are important policy goals, and that transitioning to natural gas-free homes contributes to these objectives. This suggests a high level of substantive representativeness, a finding corroborated by other research, although citizens generally have limited knowledge about technologies for decarbonized heating (Jansma *et al* 2020, Scholte *et al* 2020, de Kluizenaar and Flore 2021, Martens *et al* 2023, CBS 2023, de Jong *et al* 2024, Smith *et al* 2025). Levels of formal and descriptive representativeness were found to be lower than substantive representativeness, but important for perceived policy legitimacy. This is in line with Jansma *et al* (2020), who found that trust in the municipality is an important antecedent of residents' attitude towards becoming natural gas-free.

Earlier studies (de Geus *et al* 2022, Vitéz and Lavrijssen 2020) have emphasized the importance of enhancing democratic legitimacy in policies aimed at sustainable transformations in the built environment. Consistent with these findings, our study demonstrates that citizens are more likely to accept and less likely to oppose heating transition plans when these align closely with their perceptions of policy legitimacy. Strengthening democratic legitimacy can be achieved by either designing policies that align better with citizens' preferences or by fostering greater citizen understanding and acceptance of existing policies—or through a combination of both approaches.

Currently, few neighborhoods in the Netherlands have transitioned to being natural gas-free (van der Molen *et al* 2023), and only a small proportion of respondents in our representative sample had personal experience with such policies. A majority indicated that they currently live in homes still heated with natural gas

and that municipal plans for the transition are either unclear or still in the early stages. Consequently, many citizens may be in the initial stages of forming opinions about what constitutes effective and legitimate heating transition policies. It is likely that their ideas about what is legitimate will continue to develop as they learn more about this in interaction with local practice (Hai 2019).

Our findings reveal a gap between citizens' expectations of a fair transition policy and its current implementation. Unburdening individual citizens may foster acceptance (Addario *et al* 2020, Rodhouse *et al* 2021, Amado *et al* 2023). Investment costs and operating costs are important when it comes to acceptance of sustainable heating alternatives (Zaunbrecher *et al* 2016, Troiano *et al* 2019, Jansma *et al* 2020, Chapman *et al* 2021, Becker *et al* 2023, de Jong *et al* 2024). Citizens in our study generally valued collective cost-sharing for the transition, yet existing policies often place a significant financial burden on individual citizens, although subsidies are available. Future Dutch tariffs are likely to differ between neighborhoods, as they will be based on actual costs and a reasonable return for heat suppliers. Similarly, energy costs for residents with heat pumps may differ from those for residents connected to district heating systems. Citizens may be willing to accept some additional costs, but the amount citizens were willing to pay by themselves was not included in the study. A study in the UK (Becker *et al* 2019) showed that citizens were indeed prepared to accept some additional costs because they were in favor of the energy transition, but also expressed distrust and concerns about a profit driven energy system and perceived lack of transparency. In our study we found that when a vignette included ownership of the technical solution by a company, the plan was perceived as less legitimate in comparison to ownership by home owners or municipality, regardless of whether heating pumps or a heating network was chosen as a technical solution.

Heat decarbonization is disruptive, for consumers as well as policymakers, and comes with many uncertainties (Lowe and Woodman 2020, Howick *et al* 2023). Our study found that citizens find policy plans more legitimate when municipalities communicate about what they know for sure, but also about the things they are unsure of. Municipalities often face challenges in communicating uncertainties and involvement early in the planning process (Manktelow *et al* 2023). While citizens desire transparency, municipalities may fear that sharing incomplete or uncertain information can lead to confusion or resistance. The ideal scenario for citizens—where municipalities provide complete transparency about the knowns and unknowns—may only rarely be achieved in practice. If citizens perceive relevant information to be withheld this can drive opposition and decrease acceptance (Becker *et al* 2019, Otto *et al* 2023, Mikhail *et al* 2025).

Discrepancies between citizens' perceptions of policy legitimacy and the realities of policy implementation may narrow through participatory processes, as residents become more informed about the trade-offs associated with various policy choices. Concurrently, policy plans may evolve to align more closely with citizen preferences if certain aspects are deemed highly unacceptable by citizens.

Strengths and limitations

We based our study on an analytical framework that allows for a systematic research design to make a broad evaluation on policy legitimacy. We focused on the perceived legitimacy of the natural gas-free policy in the Netherlands and on hypothetical neighborhood plans, instead of actual plans in practice. By doing so, we were able to focus on policy characteristics which are important for policy acceptance due to the public interest. However, we cannot predict whether policy will actually be accepted in practice. Perceiving heating decarbonization plans as legitimate in general may not directly transfer to acceptance of local plans, as personal and local downsides may then be more salient for citizens (Baur *et al* 2022). Moreover, acceptance or lack of it is difficult to predict in practice, can take many forms and depends on a variety of contextual and institutional factors (Dalton *et al* 2010). A citizen may indicate acceptance of a policy, but then not always follow the rules in practice. Similarly, a citizen may indicate that he does not find a policy acceptable, yet ultimately refrain from opposing it. (Köhler *et al* 2024).

Our large sample size allowed for a fairly precise estimate of the effects. The factorial survey design allowed us in a quantitative manner to present realistic scenarios and assess how respondents value attributes relative to other attributes. An advantage is that the presented scenario's provide more context than single statements. However, certain simplifications were required for comprehensibility in the context of a 10 min questionnaire, and residents based their judgment on limited information. We can therefore not capture the dynamics and effects of the process along the way. Their judgment may be different when given more information and more time to think carefully and deliberately. This research was part of a more extensive study which also included a focus group study (Martens *et al* 2024). Although the results of those focus groups were generally consistent, we found that, throughout the discussion, participants further developed their ideas about legitimacy. For example, with regards to the option to opt out of district heating, initially participants indicated that freedom of choice was very important to them, in line with Schmidt-Scheele *et al* (2022), even if costs for everyone would be higher. But gradually, focus groups emphasized the importance of limiting costs more, which is in line with

Zaunbrecher *et al* (2016), where participants considered the tradeoffs between benefits of community-owned energy supply and restriction of their personal freedom.

In summary, our study shows that citizens are able to make judgements about the perceived legitimacy of different gas-free policy options. If policies take citizens' preferences into account when shaping policies, this can help strengthen its legitimacy. The information from this study can help policymakers to engage with citizens and connect with their perspective. This can contribute to mutual understanding and improve the relationship between government and citizens.

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Data availability statement

The data cannot be made publicly available upon publication because the cost of preparing, depositing and hosting the data would be prohibitive within the terms of this research project. The data that support the findings of this study are available upon reasonable request from the authors.

Ethical statement

At the time the fieldwork of our study was carried out, our institute had no ethical review board. However, the survey data were collected by Kantar Public with at most respect for the respondents' privacy, and with careful consideration of any possibility of adverse consequences. The authors were not able to identify the respondents. Kantar conforms to the ICC/ESOMAR Code of Conduct for Market Research. Kantar holds all ISO certificates relevant for market research (9001, 14002, 20252, 26362 and 27001).

Appendix

Table A1 shows the characteristics of the respondents. These characteristics correspond reasonably well with the Dutch population (Martens *et al* 2024) although our study includes fewer younger respondents.

Table A1. Sociodemographic characteristics of respondents (n = 2,034).

	Frequency	Percent
Sex		
Male	1,052	52
Female	982	48
Age		
18–29	264	13
30–39	237	12
40–49	340	17
50–64	591	29
65+	602	30
Education		
Lower	470	23
Middle	759	37
Higher	805	40
Household size		
1	439	22
2	861	42
3	307	15
4	297	15
5 or more	130	6
Housing		
Tenant	590	29
Homeowner	1,444	71
Living area		
Rural to less rural (<1,000 addresses per km ²)	535	26
moderate to densely urban (>1,000 addresses per km ²)	1,499	74
Nielsen regions		
Large cities (Amsterdam, Rotterdam, The Hague) + surrounding municipalities	328	16
Rest of the West	585	29
North	201	10
East	431	21
South	489	24
Perceived heat transition status own neighborhood		
Neighborhood is natural gas-free	135	7
Execution plan is nearly completed	93	5
Plan in execution	36	1
Plan is still vague	331	16
There is no plan	1439	71

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