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What makes policy for wind- and solar energy on land acceptable? An assessment of perceived policy legitimacy

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Large-scale changes in society are required to achieve policy goals for a transition to a sustainable energy system. Understanding how citizens perceive regional plans for the placement of wind and solar can help policymakers design their policy. Our aim is to examine the perceived legitimacy of the Dutch Regional Energy Strategies (RES), which are regional policy processes to place wind turbines and solar parks. First, we identified important factors that may affect the perceived legitimacy of RES plans, and we tested the effects of the factors in a vignette study among Dutch citizens ($n = 2733$). We found that Dutch Citizens, on average, perceive the Dutch RES policy to be closer to legitimate than to illegitimate. We also found that the policy design of concrete plans to implement wind farms or large-scale solar PV installations has a large impact on perceived legitimacy. If policymakers find the perceived legitimacy of local sustainable energy generation to be important, they should consider in their policy design a broad set of legitimacy criteria. This study also shows that our approach is feasible for (ex-ante) policy evaluations, taking into account a broad set of evaluation criteria.

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Introduction

The Dutch Climate Act (Climate Act 2019) prescribes a reduction of greenhouse emissions in the year 2030 of 49% (116 Mton CO₂-eq.), compared to 1990. To meet this policy goal, the electricity sector has to reduce its CO₂-equivalent emissions by 20 Mton by using more wind and solar power. In the 1990s, the Dutch government gave municipalities and local communities little say in the siting of wind farm locations. This led to civil resistance and delayed the construction of new wind farms (Akerboom 2018; Hoppe 2021; Wolsink 1996, 2007). In 2019, companies, NGOs and the Dutch government made a climate agreement (Climate agreement 2019). As a part of this agreement, a new governance model emerged for local sustainable energy generation: the Regional Energy Strategies (RES, see Lelieveldt and Schram 2023). For each of the 30 Dutch regions, its local authorities, as municipalities and provinces, draft a plan to generate sustainable energy on land by means of wind farms and large-scale solar PV installations. The contribution of the individual regions is voluntary. But together the plans must lead to an annual generation of 35 TWh (126 PJ), about a quarter of the Dutch electricity consumption in 2030. The 30 regions form no part of the current constitutional-legal decentralised governments, and there is no legal basis for them (Elzinga and Lunsing 2020; Hoppe 2021). Unless the RES regions play an important role in the planning and decision-making process, final decisions about where wind farms or large-scale solar PV installations can be installed, are made by democratically elected councillors of the concerned municipalities. However, the Netherlands is a densely populated country (519 citizens/km²) and wind farms and solar parks will change its landscape and will have an impact on local citizens e.g. nearby wind turbines can reduce the value of properties (Dröes and Koster 2014; Gibbons 2015; Sunak and Madlener 2016), and some citizens are concerned about potential health effects nearby wind farms (Bolin et al. 2011; Crichton and Petrie 2015). The development of wind farms and large-scale solar PV installations often leads to resistance from local residents (Evers et al. 2019).

Citizens and the Dutch RES

Policy makers believe that more participation could contribute to less resistance. That is why the Dutch Climate agreement emphasises the importance of citizen participation in the RES (Climate agreement 2019). In practice, more participation does not automatically translate to increased acceptance and perceived legitimacy (Roth et al. 2017). Sometimes participation processes lead to adjustments in the plans, like a reduction of the turbine height or additional financial benefits for residents (Hemelaar 2021). While such adjustments may reduce opposition against new wind farms, they may also reduce the amount of generated energy and the likelihood that the national climate policy goals will be achieved. To achieve policy goals timely manner and tailor these plans to the needs of citizens, it is important that policy-makers have a thorough understanding of how citizens perceive the policy plans to generate sustainable energy. Earlier studies (Ellis and Gianluca 2016; Liebe et al. 2017; Walter 2014) have mostly focused on acceptance by citizens as an outcome, in particular acceptance of a specific initiative, such as acceptance by local residents of a new local wind farm. Several factors have been shown to affect acceptance of sustainable energy policy in different countries, and in particular, specific initiatives for new wind farms. The factors found are: characteristics of the plans (e.g. turbine height), citizen participation, perceived costs and benefits, trust in authorities, distributional justice and knowledge (e.g. Hall et al. 2013; Huijts et al. 2012; Jobert et al. 2007; Langer et al. 2016; Strazzeria et al. 2012; Walter 2014; Wolsink 1996, 2007).

In this study, we examine citizen motives for policy acceptance or rejection regarding the RES plans, which are based on perceived public interest. That makes our approach somewhat abstract, and citizens may perceive a psychological distance towards RES plans than towards a specific initiative for a local wind farm. But with a more distant perspective, citizens are more likely to consider their own ideological values for decision-making rather than circumstantial contextual information, which can impact evaluative consistency (Ledgerwood et al. 2010). That brings us to the aim of this study, which is *to examine the perceived legitimacy of renewable energy policy in the Netherlands*. To examine this, we (1) assess the overall perceived legitimacy of the Dutch RES policy and differences across subgroups of citizens. And (2) we examine to what extent different policies and citizen characteristics affect citizens' perceived legitimacy of the RES policy. Therefore, in the next paragraph, we conceptualise perceived policy legitimacy and its dimensions, and in the "Methods" section, we show how these dimensions were operationalised with respect to the RES.

Conceptualising perceived policy legitimacy

In this study, we focus on the perception of policy legitimacy by citizens. Ideas about legitimacy have developed over time, and different approaches have been applied in the past by different research disciplines. Sociologists emphasise 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 (Tyler 2006) in psychology for perceived legitimacy stems from ideas by Weber, who defined legitimacy as the acceptance of an authority, as belief in the appropriateness of an authority. Aside from appropriateness, there are additional conditions for policy legitimacy as described by Van Noije (2019), McCullough (2015), Bokhorst (2014) and Beetham (1991). Policy is legitimate when it is accepted, but also in accordance with law and rules, morally just, and serving the public interest.

A literature review by Schoon (2022) described different definitions of legitimacy. In his search to operationalise legitimacy, he describes legitimacy as a dyad, consisting of an object of legitimacy, an audience and a relationship that connects those two. In this study, we focus on the legitimacy of policy, although we recognise the importance of the relationship with the government responsible for it. Then the dyad of Schoon consists of the policy (the object of legitimacy), citizens (the audience) and the relationship between citizens and policy makers responsible for climate policy. So, we define (perceived) policy legitimacy as: *The voluntary acceptance of government authority based on considerations of public interest, while the policy is in accordance with the law, and citizens recognise the authority of the government*. In our view, this definition adequately credits different views on legitimacy, and fits our purpose of examining the perceived legitimacy of policy.

Criteria for (perceived) policy legitimacy. In this paper, we examine whether legitimacy for RES plans is granted by citizens on grounds of perceived public interest and how this perceived legitimacy is affected by potential policy features of the policy that are presumed to be criteria for potential sources of legitimacy. Based on literature (Bakker 2001; Beetham 1991; Bokhorst 2014; Vringer and Carabain 2020 and in particular Noije 2019), we distinguish 13 criteria, covering input-, process- and output legitimacy, see below. Many of these criteria are also addressed as good governance criteria by the UN (see UNESCAP XXXX),

which is an indication that there is some consensus about which criteria are important. And the differences in the criteria set are due to the exact goals.

The 13 criteria can be divided over input, throughput and output legitimacy:

Input legitimacy is about the extent to which individuals and groups have influence over decision-making. It contains:

1. Substantive representativeness arises if one recognises oneself in the substantive principles and choices of authorities and policy.
2. Formal representation occurs when people recognise their representatives as having the authority to speak or decide on their behalf.
3. Descriptive representation occurs when people can identify themselves (similar personal characteristics, especially socio-economic and demographic) with the people who speak on their behalf or make decisions about them.
4. Accountability requires that authorities account for their actions.

Throughput legitimacy is the extent to which the government acts according to proper procedures, carefully and fairly (procedural justice). It contains:

1. Accurate and transparent information, actively given by the authorities.
2. Responsiveness means that the interests of all those involved are carefully taken into account.
3. Citizen participation is when people are actively involved in decision-making.
4. Equality of law means that the government treats everyone equally.
5. Legal certainty means that the authorities act consistently.

Output legitimacy is the degree to which policy interventions solve collective problems and thereby increase (broad) welfare (Scharpf 1999). It contains:

1. Effectiveness is the extent to which the government achieves its policy goal(s) with the policy pursued. In addition to the target effects, other effects on welfare and well-being are also considered.
2. Efficiency, expressed in the degree to which the government reaches the policy goals relatively better (faster, cheaper, etc.) than other groups could do themselves.
3. Distributional justice concerns the question of what is an equitable distribution of scarce resources (benefits and expenses), both financially and otherwise.
4. Transparency of the policy outcomes are monitored, communicated openly and honestly and are accessible, explainable, insightful, comprehensible/understandable for informed citizens.

Methods and approach

We assess the overall perceived legitimacy by Dutch citizens of the Dutch RES policy with survey questions and with a vignette experiment, and we examined to what extent different policy characteristics affect citizens' perceived legitimacy of the RES policy.

Assessing the overall RES legitimacy. We assessed the overall perceived legitimacy of the RES policy directly after the introduction video at the beginning of the questionnaire, with the following text and question: *"We would like to know whether you consider the existence of Regional Energy strategies legitimate. By that, we mean whether you consider it acceptable that such a policy exists, when you think about everyone's interests. When you think*

about everyone's interests, do you find it acceptable that there are regional Energy Strategies?" (11-point scale, fully unacceptable—fully acceptable).

Examining effects of policy characteristics—a vignette experiment. To explore which different policy characteristics of RES policy affect citizens' perceived legitimacy, we carried out a vignette experiment. In a vignette study, respondents read several short descriptions of policy plans (scenarios) to elicit judgements about these (Atzmüller and Steiner 2010). Using this method, it is possible to assess to what extent different aspects of the scenarios (attributes) affect the overall judgement. The advantage over using a standard survey lies mainly in the higher realism that can be achieved by presenting situations instead of separate attributes (Aguinis and Bradley 2014).

A policy plan can be described with several attributes with varying levels. Therefore, many potential policy plan scenarios (vignettes) are possible. It is not feasible to let respondents judge all these vignettes, therefore, it is common to use a so-called mixed design where every respondent only judges a subset of vignettes. Careful construction of subsets is necessary to be able to efficiently estimate the effects of attributes on the judgment on the group level. In our experiment, we had 7 attributes with 2 or 3 levels. A $2 \times 2 \times 3 \times 3 \times 3 \times 3 \times 2$ design (see Table 1), led to 648 vignettes. Based on a pilot test, it was feasible to present each respondent with no more than 4 vignettes. So, we used Sawtooth software to select a maximally efficient design (Su and Steiner 2020). The balanced overlap method led to an optimally efficient design where simulations indicated that standard errors of all main and 2-way effects were well below the recommended 0.05 cut-off point.

It is important to include the most relevant policy characteristics for perceived legitimacy in the construction of the vignettes. We followed the next steps to come to our selection as presented in Table 1. First, we interviewed an expert regarding the RES plan to identify planned policy variations that existed in practice and related societal issues that might be relevant for perceived legitimacy. During the interview, we connected these policy variations to our analytical framework (see the 13 criteria above). We also compared this with approaches in empirical studies on the acceptance of wind energy. To ensure completeness, we asked this expert near the end of the interview whether concepts that are included in the analytical framework, but not spontaneously mentioned by the expert, whether any of those concepts could be relevant to include. Then, we designed a concept version of factors and attributes.

Only aspects of throughput and output legitimacy were included in the vignette design because it did not seem possible to link input legitimacy to actual variations in policy and to keep the number of factors limited to ensure comprehensibility for respondents. Therefore, we assessed input legitimacy with a questionnaire preceding the vignette experiment. Statements on accountability were excluded in the final questionnaire, as respondents who participated in the video interviews indicated that they considered piloted items on accountability confusing and perceived to have insufficient information to judge whether responsible authorities could be held accountable for their policy choices.

Next, the draft vignette design was discussed with four experts studying the RES, including the earlier interviewed expert, to verify whether the formulated factors and attributes corresponded sufficiently with actual policy variations, taking also our analytical framework in mind. Based on this consultation, we revised the vignette concept, and an additional level was added to the distribution of financial profits ('Profit of wind turbines and solar panels is distributed across people who live nearby'), as we assumed this level might be considered most legitimate by some citizens.

Table 1 Attributes with levels for the vignette experiment with preferences of respondents as expressed in familiarisation tasks^a.

Attribute	Levels	Legitimacy framework
Efficiency preference	Impact on landscape must be as small as possible, even if the costs will be higher (67.8% ^a) The costs must be as low as possible, even if the impact on the landscape will be larger (14.0%)	Output legitimacy: efficiency
Placement turbines and solarparcs	Wind turbines and solar parks are more often placed in municipalities with more space (34.7%) Wind turbines and solar parks are more often placed in municipalities where more energy is used (38.8%)	Output legitimacy: distributive justice (burden)
Distribution of profits	Profits of wind turbines and solar parcs are distributed across people who live nearby (11.7%) Profits of wind turbines and solar parcs are evenly distributed across people in the municipality (56.1%) Only people who invest in wind turbines and solar parcs get the profits (16.9%)	Output legitimacy: distributive justice (profits)
Ownership	Wind turbines and solar parks are owned by people nearby (17.0%) Wind turbines and solar parks are owned by investors (10.7%) Wind turbines and solar parks are owned by the government (52.7%)	Output legitimacy: distributive justice (influence)
Information	All people in the municipality were informed personally and completely about the RES plan (67.1%) People nearby were informed personally about the RES plan. Other people were informed later. (14.1%) All people in the municipality were informed through the local newspaper after the RES plan was final (10.3%)	Throughput legitimacy: transparency
Participation/influence	The opinion of citizens played an important part in making the RES plans (61.9%) The opinion of citizens played a limited part in making the RES plans (29.5%) The opinion of citizens played no part in making the RES plan (2.5%)	Throughput legitimacy: participation and responsiveness
Procedures	When following all procedures, conscientiousness is more important than speed (84.2%) When following all procedures, speed is more important than conscientiousness (5.9%)	Throughput legitimacy: policy in line with rules and laws.

^aPreferences as expressed in the familiarisation task between brackets. The 'no preference' level is not shown, therefore, percentages do not add up to 100.

Ten citizens, selected by a fieldwork agency, were online interviewed by a professional interviewer for about 35 min each to test the vignettes and questionnaire for possible biases and comprehensibility. We observed the interviews anonymously in the online meeting. Based on these interviews, we made adjustments. As a number of simplifications to the formulation of the vignette levels and the addition of an extra level to the attribute 'ownership' were made, respondents indicated that the option for wind farms and solar parks to be owned by the government would be considered most legitimate, but not present in the draft version of the vignettes. This level was initially not included because it does not exist in actual RES plans, according to the interviewed experts. We did not include a factor on policy effectiveness, as preferences regarding effectiveness may be strongly correlated with perceived input legitimacy. See Fig. 1 for an example of the presentation of the vignettes.

Study population. On 19 November 2021, an invitation to respond to the online questionnaire and vignettes was sent by e-mail to a representative sample of 5844 Dutch citizens aged 18 and over, proportionally stratified according to gender, age, education level, household size and region. The sample was selected by Kantar from the NIPObase, a panel of more than 100,000 people who are regularly invited to respond to online surveys. In the event of non-response, Kantar sent a reminder by email. Kantar conforms to the ICC/ESOMAR Code of Conduct for Market Research.

Survey procedure and variables. The survey was set up as follows:

- We expected the respondents to be unfamiliar with the policy in their region. Therefore we presented them contextual information about the national goals and general processes of the RES at the start of the survey, both through text (ca ten lines and a number of pictures: of a solar park, a set of wind turbines, and a picture of the RES regions in the Netherlands) and through a video with a duration of 1 min and 17 s.
- We assessed the overall perceived legitimacy of the RES policy directly after the introduction video at the beginning of the questionnaire. See above for the exact question.
- In addition, we asked respondents a number of questions regarding their awareness and perceived level of understanding of the RES. This information was considered relevant background information as an indication of whether respondents had a sufficient comprehension of the RES policy to understand the questionnaire items and vignettes.
- To assess input legitimacy, a number of statements were constructed to assess criteria for perceived input legitimacy, applying a 7-point scale (strongly disagree-strongly agree). For use in the correlational analyses, we calculated average scores for every input legitimacy domain, and Cronbach's alpha was >0.70 (substantive representativeness = 0.76, formal representativeness = 0.72, descriptive representativeness = 0.83). All statements are presented in Table 5 in the "Results" section.

When you think about everyone’s interest, to what extent do you consider this RES plan acceptable?

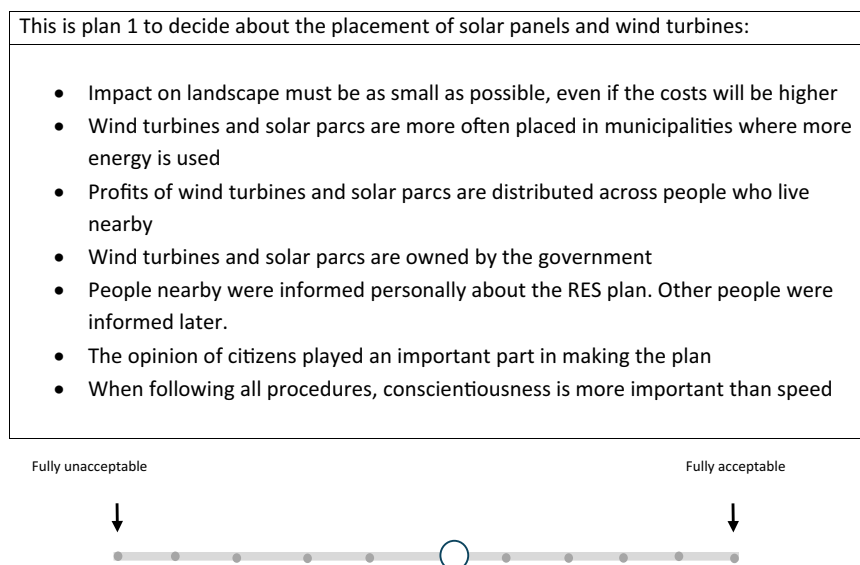


Fig. 1 Vignette example. Presentation of the vignettes, an example.

- We considered that the vignette task might be relatively complex for respondents, and to familiarise them with the attributes, we introduced the attributes one by one and asked respondents about their preferences for different policy features (familiarisation task).
- Next, we presented the respondents with four vignettes about policy variants and asked them to what extent they find these variants acceptable from a public interest point of view, in a similar way as the overall perceived legitimacy, with an 11-point scale and verbal descriptions only on both ends of the scale (see Fig. 1).
- Then we asked about the respondent’s perceived proximity of wind turbines and solar parks on a 5-point scale (1 = very close, 5 = very far) and how they would find it to live close to wind turbines or a solar park (1 = not a problem at all, 5 = a very big problem). For the analyses, the latter variable was recoded in the opposite direction such that a higher score indicated a more positive attitude toward living close to wind turbines or solar parks.
- Finally, we asked respondents and their trust in the government when it comes to climate policy. This can give information about the relation between policy (the object of legitimacy) and citizens (the audience). We measured this trust with eight statements:

1. How much trust do you have in the government when it comes to climate policy? The government ...

- informs openly, without withholding information
- is honest
- is sincere
- has the same values as me
- takes into account the interests of people like me
- is knowledgeable
- is competent
- will do the right thing.

The responses to these statements (5-point scale: totally disagree – totally agree) were combined into a total score by calculating an average (Cronbach’s alpha of the scale was 0.94).

Information on the background variables sex, age, education level, and urban density of the residence municipality was available through the panel. Kantar coupled the actual proximity of wind turbines based on a public database of built wind turbines and the addresses of the respondents.

The statistical analysis. For analysing differences between sub-groups on the overall perceived legitimacy scale means and 95% confidence intervals were calculated, and for continuous characteristics, Spearman’s Rho correlation coefficients were calculated. To test the effects of the attribute levels in the vignette experiment on perceived legitimacy, a multilevel linear model was used. Multilevel models take into account the nested structure of data. In our case, perceived legitimacy scores of the presented policy scenarios (vignettes) are nested within respondents, as each respondent judged four different scenarios. We used a random intercept model (using SPSS, version 28) to take the varying levels of perceived legitimacy between respondents into account, and maximum likelihood estimation was used to estimate effects. Attribute levels were entered as predictors, and unstandardized beta coefficients were calculated with 95% confidence intervals. Beta coefficients represent the estimated effect of each level compared to the reference category. This can be interpreted on the original 11-point legitimacy scale. To enhance interpretation for each attribute, the least legitimate level as perceived by respondents (based on the model outcome) was chosen as the reference category, which renders all coefficients positive. To assess the effects of participant characteristics on legitimacy judgements in the vignettes, we ran a random intercept model for each characteristic separately alongside the attribute-level predictors. As continuous predictors (e.g. trust in the government) were measured on different scales, we first standardised these predictors to enhance the comparison. For these variables, the beta coefficients represent the effect of a standard deviation increase in the predictor on the 11-point legitimacy scale.

Results

In this section, we first present the characteristics of the respondents. Next, we present the overall perceived legitimacy of

the Dutch RES policy and its relation with socio-demographics and trust in the government. And finally, we present how different policy characteristics affect citizens' perceived legitimacy. We split this up into the effects of input legitimacy and throughput/output legitimacy.

Respondent characteristics. The questionnaire was fully completed by 2733 (47% response) of the invited citizens between

November 19th and December 7th 2021. Our sample characteristics and the representativeness for the five population characteristics are described in Table 2. Respondents lived mostly in urban municipalities (72% > 1000 addresses per km²) as opposed to rural municipalities (28% < 1000 addresses per km²), and the majority were homeowners (73%).

The large majority of respondents (87%) were not aware of the existence of a RES plan for their own region. After watching the RES video and reading the general information provided, the majority of respondents indicated that they understood what the RES are (66%), but they found it less clear who makes decisions regarding the placement of wind turbines and solar parks (44%) or how decisions are being made (42%).

Table 2 Sample characteristics and population reference.

	Respondents (n = 2733)	Dutch population 2021^a
<i>Sex</i>		
Female	49%	51%
Male	51%	50%
<i>Age</i>		
18-29	13%	19%
30-39	14%	15%
40-49	18%	16%
50-64	33%	26%
65+	23%	23%
<i>Education level</i>		
Lower	26%	27%
Middle	42%	38%
Higher	32%	35%
<i>Household size</i>		
1	21%	20%
2	40%	34%
3	15%	16%
4	17%	20%
5+	7%	11%
<i>Nielsen regions</i>		
Large cities (Amsterdam, Rotterdam, The Hague) + surrounding municipalities	15%	16%
Rest of the West	29%	30%
North	11%	10%
East	21%	21%
South	24%	24%

^aStatistics Netherlands (CBS) Gold Standard (<https://www.cbs.nl/nl-nl/maatwerk/2021/44/gouden-standaard-2020>).

Overall RES legitimacy and relation with socio-demographics and trust. Figure 2 shows the frequency distribution of overall legitimacy scores for the RES. Higher scores indicate higher perceived legitimacy. With an average RES legitimacy score of 7.5 (SD = 2.2) respondents perceived the existence of the RES on average as more legitimate than not.

There are limited differences across socio-demographic groups in perceived overall RES legitimacy (Table 3). Respondents with a lower education level consider RES policies slightly less legitimate.

The perceived overall legitimacy is also related to the perception of the local environment of the respondents. People perceive the overall legitimacy of RES policy more negative when they perceive the distance between their dwelling and existing wind farms or solar parks to be smaller and when they find living close to them more problematic (Table 4). However, we did not find a relation between the overall legitimacy and the actual distance to existing wind farms.

Trust can also be seen as part of the dyad as described by Schoon (2022), being the relation between the object of legitimacy and the audience. If people have little knowledge about a policy, they will probably base their perceived legitimacy mainly on the extent they trust the government. So, it can be expected that when people have faith in a policy, they do perceive it to be more legitimate. We found such a relation between trust in the government and the perceived legitimacy of the RES policy (Spearman's rho = 0.307, see Table 4).

Perceived input legitimacy of RES policy. Table 5 shows to which the respondents agree with statements regarding the

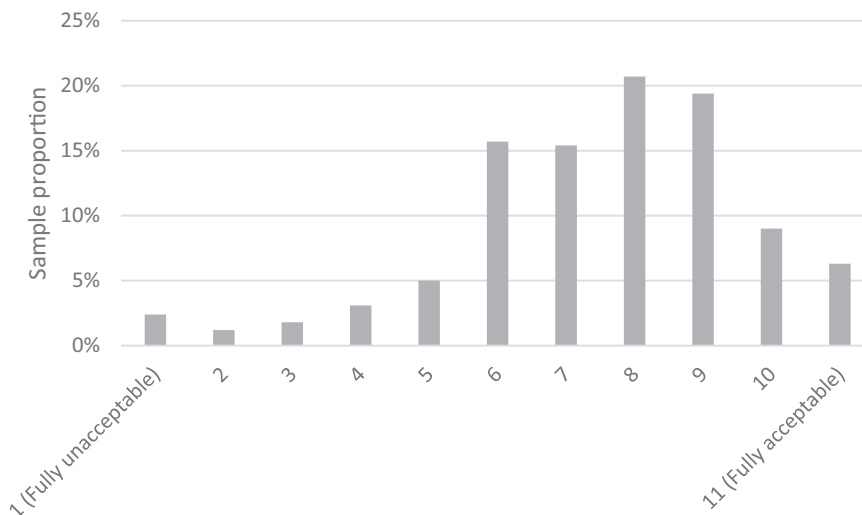


Fig. 2 Perceived RES legitimacy. Frequency distribution of perceived overall RES legitimacy (n = 2733).

Table 3 Perceived overall RES legitimacy scores across sociodemographic groups.

Socio-demographic characteristics		Mean overall perceived RES legitimacy score	95% CI
Sex	Male	7.39	7.27-7.52
	Female	7.59	7.48-7.69
Age	18-29	7.72	7.51-7.93
	30-39	7.57	7.36-7.78
	40-49	7.62	7.43-7.82
	50-64	7.27	7.12-7.42
	65+	7.52	7.35-7.69
Education level	Lower	7.22	7.07-7.37
	Middle	7.41	7.29-7.53
	Higher	7.81	7.66-7.97
Housing	Tenant	7.48	7.33-7.63
	Homeowner	7.49	7.40-7.59
Living area	Less urban (<1000 addresses per km ²)	7.41	7.26-7.56
	More urban (>1000 addresses per km ²)	7.52	7.42-7.62

perceived input legitimacy of the RES. They agreed to a large extent with substantive representativeness (items 1–5), indicating that they largely recognised themselves in the goals of the government and the means to achieve them. Only for item 5 agreement was lower, indicating mixed opinions regarding the amount of attention in society for the advantages and disadvantages of solar and wind energy. There was less agreement about formal and descriptive representative items (items 6–10) compared to the substantial representativeness items. In particular, there was less agreement with the descriptive representativeness items (items 9 and 10), indicating that most respondents did not think that their municipal counsellors were a good representation of themselves or others. All input legitimacy domains were significantly correlated with overall perceived legitimacy of the RES (see Table 4).

Perceived throughput and output legitimacy of concrete hypothetical RES plans (vignettes). The perceived legitimacy data for throughput and output legitimacy that we gathered in our vignette study have a hierarchical nature. Scores vary not only across the vignettes (the lowest level, commonly referred to as Level 1), but also across the different respondents in our study (Level 2, see Hox et al. 1991). 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 was 0.25, calculated with an intercept-only model. This means that about 25% of the total variation in perceived legitimacy scores can be accounted for by differences between respondents. So, 75% of the total variation can be accounted for by differences between the vignettes. We take this degree of clustering into account by estimating a random intercept model.

Table 6 shows the estimated effects of the various attribute levels on perceived legitimacy of the RES vignettes in our random intercept model¹. The model is used to calculate the expected average perceived legitimacy score of a vignette with a specific combination of attribute levels. The overall size of the effects for a vignette with a combination of the highest legitimacy attribute levels was 7.6 [95% CI: 7.4–7.7]. The estimated mean of a vignette with a combination of the lowest legitimacy attribute levels was

Table 4 Correlation matrix with Spearman's rho coefficients of perceived RES legitimacy and other variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Overall perceived RES legitimacy (1-11)	-									
(2) Distance to nearest wind turbine in km	-0.001	-								
(3) Perceived distance to wind turbine (1-5)	0.135**	0.380**	-							
(4) Perceived distance to solar parc (1-5)	0.138**	-0.016	0.414**	-						
(5) Attitude living close to wind turbines (1-5)	0.273**	-0.045*	0.005	0.087**	-					
(6) Attitude living close to a solar park (1-5)	0.329**	-0.008	0.145**	0.103**	0.468**	-				
(7) Substantive representativeness (1-7)	0.508**	0.031	0.171**	0.123**	0.259**	0.338**	-			
(8) Formal representativeness (1-7)	0.398**	-0.015	0.102**	0.101**	0.312**	0.273**	0.496**	-		
(9) Descriptive representativeness (1-7)	0.388**	0.007	0.090**	0.048*	0.267**	0.224**	0.397**	0.598**	-	
(10) Trust in government (1-5)	0.307**	-0.001	0.088**	0.094**	0.248**	0.182**	0.278**	0.342**	0.410**	-

*p < 0.05
**p < 0.01

Table 5 Percentage agreement with input legitimacy statements (n = 2733).

	Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
1. I think climate change is an important problem.	2.3%	2.4%	3.3%	9.3%	13.2%	38.5%	31.1%
2. I think it is important that the Netherlands does not need to depend on other countries for energy	1.2%	3.3%	3.5%	10.6%	16.8%	41.2%	23.4%
3. I think more solar and wind energy helps against climate change	2.9%	3.8%	3.3%	12.9%	18.5%	37.9%	20.7%
4. I think more solar and wind energy helps to be less dependent on other countries for energy	2.2%	3.4%	2.9%	11.0%	20.8%	40.2%	19.5%
5. I think there is enough attention in society for all the advantages and disadvantages of solar and wind energy	4.1%	12.5%	16.9%	23.2%	22.1%	17.7%	3.5%
6. I think the government is responsible for decisions about solar and wind energy	3.0%	6.0%	8.3%	23.1%	25.3%	27.1%	7.2%
7. I think municipalities may decide where to locate solar parks and wind turbines in the region	4.1%	7.8%	9.2%	15.7%	24.7%	31.4%	7.1%
8. I trust municipalities to make good decisions about solar parks and wind turbines in the region	6.0%	10.3%	11.8%	20.3%	22.9%	24.2%	4.4%
9. Municipal councillors who decide on solar and wind energy in the region are people like me	5.9%	11.2%	13.0%	24.8%	19.6%	21.8%	3.6%
10. Municipal councillors who decide on solar and wind energy in the region represent everyone	7.1%	13.3%	14.5%	22.6%	21.3%	18.3%	2.9%

Table 6 Results of random intercept regression model for the effects of vignette attributes on perceived legitimacy.

Variables	Regression coefficient (B)	95% Confidence interval
Low impact on landscape (vs low impact on costs)	0.87	[0.80, 0.94]
Spatial distribution based on availability of land (vs based on energy use)	0.01	[-0.06, 0.08]
Profits are distributed equally amongst residents in the municipality (vs amongst investors)	0.54	[0.45, 0.63]
Profits are distributed amongst residents who live nearby (vs amongst investors)	0.22	[0.13, 0.31]
Ownership by local residents (vs ownership by investors)	0.25	[0.16, 0.34]
Ownership by government (vs ownership by investors)	0.53	[0.45, 0.62]
Medium information provision (vs minimal information provision)	0.11	[0.03, 0.20]
Full information provision (vs minimal information provision)	0.41	[0.32, 0.49]
Medium citizen influence (vs no citizen influence)	0.52	[0.43, 0.61]
Maximum citizen influence (vs no citizen influence)	0.88	[0.79, 0.97]
Following procedures: conscientiousness over speed (vs speed over conscientiousness)	0.58	[0.51, 0.65]

3.7 [95% CI: 3.6–3.9]. Except for the spatial distribution factor, all attribute levels had a significant impact on perceived legitimacy. The largest effects were found for ‘influence’ and ‘efficiency’. When the opinions of citizens play no role in the RES, respondents rated the legitimacy on average 0.88 points lower as compared to full participation of residents. For the efficiency attribute, the rated legitimacy was on average .87 points lower when the aim was to keep the costs as low as possible, compared to the level with an aim to keep the impact on the landscape as small as possible.

Effects of respondent characteristics on perceived legitimacy of RES plans (vignettes). Table 7 presents the outcomes of 14 random intercept models where we added each respondent characteristic (e.g. age) separately as a predictor alongside the vignette attributes. Therefore, beta coefficients represent the association between a specific characteristic (e.g. age) and perceived legitimacy of RES plans when adjusted for the vignette attributes, but not adjusted for the other respondent characteristics. Regarding socio-demographic characteristics, younger and less educated respondents judged RES plans in general as more legitimate. In addition, trust in the government, perceived input legitimacy of RES policy and environmental perceptions (i.e. perceived distance and environmental attitudes) all played a substantial role. We did not observe a statistically significant effect of distance to the nearest wind turbine, however, this could

be due to the limited number of respondents living close to one (24 living < 1 km).

As we suspected that the absence of a significant effect of the spatial distribution attribute in the vignettes might be due to a dependence on whether respondents lived in a more or less urban area, we tested this interaction term, which was significant ($B = -0.32, p < 0.001$). Respondents living in a more urban municipality considered a RES plan more legitimate when wind turbines and solar parks are built in areas where there is more availability of land (vs distribution based on energy use, $B = 0.10; p = 0.035$), while the opposite was true for respondents living in less urban municipalities ($B = -0.22; p < 0.001$).

Discussion

We found that Dutch Citizens, on average, perceive the Dutch RES policy to be closer to legitimate than to illegitimate. However, there are differences between groups of citizens. We also found that nearly all RES policy options we presented to Dutch citizens and which directly relate to policy legitimacy criteria, were perceived to be important for the acceptance of RES policy. That means that the policy design of concrete plans to implement wind farms or large-scale solar PV installations has a large impact on the perceived legitimacy.

Taking into account that the Dutch RES policy has already been applied for a longer period, we consider it striking that most citizens (87%) were not aware of the existence of the RES

Table 7 Results of 14 random intercept regression models for the effects of individual respondent characteristics on perceived legitimacy adjusted for vignette attributes.

Variables	Regression coefficient (B)	95% confidence interval
Female sex (vs male)	0.02	[-0.10, 0.13]
18-29 years (vs 50-64)	0.57	[0.38, 0.76]
30-39 years (vs 50-64)	0.35	[0.17, 0.54]
40-49 (vs 50-64)	0.30	[0.13, 0.47]
65+ (vs 50-64)	0.17	[0.01, 0.32]
Lower education (vs higher)	0.21	[0.06, 0.36]
Middle education (vs higher)	0.16	[0.02, 0.29]
Tenant (vs homeowner)	0.11	[-0.02, 0.24]
More urban living area (vs less urban)	0.06	[-0.07, 0.19]
Substantive representativeness ^a	0.46	[0.40, 0.51]
Formal representativeness ^a	0.58	[0.53, 0.64]
Descriptive representativeness ^a	0.51	[0.46, 0.57]
Trust in the government ^a	0.51	[0.46, 0.57]
Distance to nearest wind turbine ^a	0.01	[-0.05, 0.07]
Perceived distance to wind turbine ^{a,b}	0.14	[0.08, 0.20]
Perceived distance to solar park ^{a,b}	0.15	[0.09, 0.20]
Attitude living close to wind turbines ^{a,c}	0.45	[0.40, 0.51]
Attitude living close to a solar park ^{a,c}	0.38	[0.32, 0.43]

^aPredictor variable is standardised. The beta coefficient represents the effect of a one-standard-deviation increase in the predictor on the 11-point perceived legitimacy scale.

^bThe higher the score on this predictor, the farther away one perceives living from the object.

^cThe higher the score on this predictor, the more positive the attitude.

policy. When they got more information about the RES policy, as we gave in our study, they assessed the overall legitimacy closer to fully acceptable than to unacceptable, a score of 7.5 on a scale from 1 to 11. This, despite they still did not understand completely by whom, or how exactly these policy decisions are being made. This score is probably partly due to trust in the government because citizens who have more trust in the government assess the policy legitimacy as higher. Education level and age are, to a lesser degree, related to the perceived legitimacy. Younger and less educated citizens judge RES plans in general as more legitimate. However, perceived distance to existing wind farms and solar parks, as well as the attitude towards living close to them, seems to be more important; the perceived legitimacy of RES policy is lower when people perceive the distance between their dwelling and existing wind farms or solar parks to be smaller and when they have a less positive attitude about living close to them. The actual distance to existing wind farms seems not to affect the perceived legitimacy.

About the input legitimacy, most people support the goal of the policy (preventing climate change and a more independent energy system) and the energy sources (solar and wind energy). However, citizens acknowledge to a lesser degree, and they feel less represented by the responsible authorities.

For the throughput and output legitimacy, we found that the design of RES plans can affect the perceived legitimacy largely. Different RES plans gave a maximum difference of nearly 4 points on the legitimacy scale from 1 to 11. Here, the impact of the landscape as opposed to costs (efficiency) was of important influence (0.9 points). This is also valid for a complete absence of citizen influence as opposed to maximum influence (0.9 points). Our findings of citizens' preference for limiting impact on landscapes are reflected in the actual RES plans in the field. They predominantly opt for a relatively high share of solar parks rather than wind turbines. The importance of citizen influence for perceived legitimacy is consistent with many other studies (see e.g. Ek and Persson 2014; Liebe et al. 2017; Lienhoop 2018). Other policy characteristics we analysed also had an impact on legitimacy, but to a lesser degree.

Initially, we found no evidence for a preference for the policy option to place wind turbines and solar parks in municipalities with more space or to place them where more energy is used. A closer look at the data showed there was a preference, but it depended on whether people lived in a more or less urban municipality. Citizens living in a more urban municipality consider a RES plan more legitimate when wind turbines and solar parks are built in areas where there is more availability of land, while citizens living in less urban municipalities find it more legitimate to place the wind turbines and solar parks in an area where the energy is used. The difference is relatively small, but in line with other studies documenting a perceived injustice when it comes to this spatial distributive aspect (Christidis et al. 2017; Langer et al. 2016)

The perceived legitimacy was higher when profits were distributed amongst all citizens in the municipality instead of a distribution among citizens who live nearby or investors. This is notable and can indicate that citizens have less trust in the fairness of alternative options to divide the financial benefits, which is in line with Lienhoop (2018): Investing is not accessible and affordable for all citizens. Added to that, citizens may feel that investors should not be entitled to the full share of the profits, as they do not always share in the burdens of living nearby.

Ownership and distribution of profits are closely related but not the same. Ownership is about influence during realisation and management, while the distribution of profits is purely focused on the gains. We found that ownership by citizens is perceived as more legitimate than by investors, which is in line with (Liebe et al. 2017). However, contrary to common expectations and the current policy (to ensure distributional justice and local public support, the Dutch climate agreement (2019) strives for a 50% local ownership), we found lower perceived legitimacy when wind farms and solar parks are owned by citizens, compared to ownership by the municipality. This is in line with Ek and Persson (2014), who showed that citizens negatively value private ownership, and prefer wind farms to be owned by municipalities or cooperatives.

The important role that citizens attribute to the Dutch government is striking in the light of a sharp decline in citizens' trust

in government (Engbersen et al., 2021). Low trust in authorities may have also contributed to our findings that the importance that citizens attach to conscientiousness over speed and full information over limited information.

Strengths and limitations. We based our study on an analytical framework that allowed for a broad and systematic research design. In our opinion, the most important strength is that this study focuses on the perceived legitimacy of more general renewable energy plans instead of local support of wind farms and solar parks, as most studies do. We presented the respondents in this study with fairly abstract RES policy characteristics. By doing so, instead of looking at the support of a local initiative, we were able to focus on motives for policy acceptance due to public interest. The low intraclass correlation of 0.25 in our experiment underlines this, which is much lower than for other vignette studies (0.70–0.79 in Liebe et al. (2017) and 0.63 in Parkins et al. (2021), investigating effects of policy attributes on local acceptance of wind farms. This suggests that in our study, the evaluation of respondents was influenced by the policy characteristics presented, more than in the other studies mentioned. It is possible that when citizens evaluate the local acceptance of wind farms, they are more influenced by person-related factors like whether they already have a wind turbine in the vicinity (Liebe et al. 2017) or their political orientation (Parkins et al. 2021). The second strength is that our large sample size allowed for a fairly precise estimate of the effects. The factorial survey design allowed us to present realistic scenarios and assess how respondents value attributes relative to other attributes.

A limitation of our study was that we were able to consider a limited number of factors in our analysis, due to constraints of the vignette tasks for the respondents. However, we tried to limit the consequences of this limitation to select carefully selecting the most important factors. The 2nd limitation of our study that we want to mention is that it can be that the presentation of some factor levels are not clear to all respondents, which can limit the value of our conclusions. However, we tried to minimise this by the execution of a pilot in which ten citizens were interviewed on these aspects of the vignette task.

Finally, we want to mention that based on our approach, conclusions about when a policy is acceptable or not cannot be made. We have no indication at which level on the 11-point scale between fully acceptable and fully unacceptable, used in our study, citizens will finally, in the majority, accept the policy. But our study does give indications of which policy characteristics matter and which are more important, and which are less important.

Conclusions and policy implications

On average, Dutch citizens perceive the Dutch RES policy to be closer to legitimate than to not illegitimate. The policy design of concrete plans to implement wind farms or large-scale solar PV installations has a large impact on the perceived legitimacy. Limiting the impact on the landscape was found to be important, as well as citizen influence. Despite a quite low trust in the authorities, they perceive higher legitimacy when wind farms and solar parks are owned by the municipality, compared to ownership by citizens or companies.

If policymakers find the perceived legitimacy of local sustainable energy generation to be important, they should consider, in designing their policy, a set of legitimacy criteria, e.g. the set we have studied. This study also shows that our approach and the analytical framework we use are feasible for (ex-ante) policy evaluation on its perceived legitimacy, taking into account a broad set of evaluation criteria.

Data availability

The datasets generated and analysed during the current study will be available at the time of publication from the corresponding author on reasonable request.

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Note

1 The average score was close to the midpoint of the 1–11 scale ($M = 5.6$, $SD = 2.3$).

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Author contributions

The authors contributed equally to this work.

Competing interests

The authors declare no competing interests

Ethical approval

At the moment of the data collection in November to December 2021, our research institute (PBL Netherlands Environmental Assessment Agency) did not yet have an ethical committee. However, we did get approval retrospectively from the ethical board of PBL on the 2nd of October 2025 (approval number 003-2025). All research was performed in accordance with the Netherlands Code of Conduct for Research Integrity of 2018 (<https://doi.org/10.17026/DANS-2CJ-NVWU>). This study is based on primary data and was collected by KANTAR Public on behalf of PBL Netherlands Environmental Assessment Agency. KANTAR collected this data at most respect for the respondents' privacy, and with careful consideration of any possibility of adverse consequences. The authors received anonymised data from KANTAR Public, and they were not able to identify respondents. We approached only adults.

Informed consent

Kantar Public invited members of the NIPObase panel to participate in the survey. NIPObase is a panel consisting of over 100,000 people who are regularly invited to respond to online surveys. When signing in as a panel member, the members received information about the purpose, privacy, data storage, right of withdrawal and use of the collected data, and signed a repeated informed consent form. All participants have been fully informed that their anonymity is assured. In the invitation to the survey, KANTAR again points out the rights, approval and consent of the respondents. KANTAR Public conforms to the ICC/ESOMAR Code of Conduct for Market Research and holds all ISO certificates relevant for market research (9001, 14002, 20252, 26362 and 27001).

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-025-06140-9>.

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