

# Evaluation of a Dutch Wind Farm: Lessons for National Onshore Wind Policies

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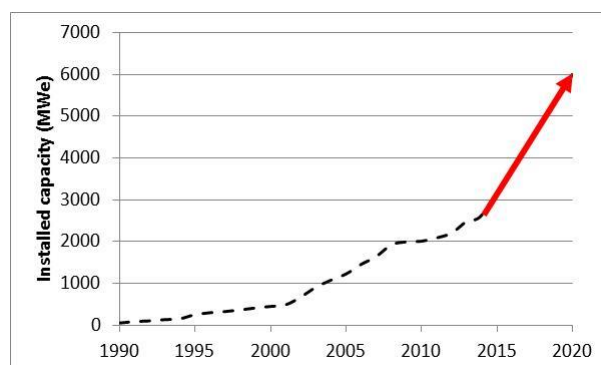
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## Abstract

In this paper we present a rich framework for project evaluation that offers explanatory power for understanding our case study, Wind Farm Houten (WFH), and contributes to the academic knowledge base on social acceptance. In our research, community acceptance, one of the dimensions of social acceptance is central and discussed with the socio-political and market acceptance dimensions. Our data sources and methods included reconstructing, in depth, the planning and development phase of WFH using archived documentation and stakeholder interviews; four surveys to analyze the attitude and motivations of residents; and analyzing the WFH's operational data to determine the impact of and compliance with a tailored noise regulation. Our evaluation shows Houten community acceptance is low. It also shows the turbine operators need to improve their compliance with regulations and that the municipality needs a better system to deal with complaints. These findings resulted in the Town Council directing the responsible Alderman to work with the Board, the wind farm operator, and the residents to “regain the trust of the residents.” At the time of writing this paper, the negotiations to rebuild this trust are ongoing.

## Introduction

Increasing the share of renewable energy is generally considered crucial for meeting long term climate goals, with many governments having ambitious targets and policies to grow renewable energy technologies. Recent energy scenarios for the European Union (EU) show a substantial need to grow onshore wind energy to meet its 2020 renewable energy target (EWEA, 2014). The Netherlands, as an EU member state, has a steep climb to meet its 6 GW goal for onshore wind energy by 2020, as shown in Figure 1.



**Figure 1.** Historical (1990-2014) and projected (2014-2020) development Dutch onshore wind capacity (historical data from Statistics Netherlands)

The Executive Board of Houten, a Dutch municipality with almost 50 thousand inhabitants located 50 km southeast of Amsterdam, is willing to contribute to the national

onshore national wind target and supported the development of Wind Farm Houten (WFH), currently in operation. While the Board would like a second wind farm, the Town Council of Houten will only approve its development after WFH has been evaluated. Therefore, the Board invited us, Utrecht University, to carry out this evaluation.

The five themes we were asked to address in the evaluation were 1) a reconstruction of the development of the wind farm, 2) the functioning of the wind farm regarding environmental aspects (e.g. noise regulation), 3) the local attitude towards / experiences with the wind farm, 4) the role and responsibilities of the main stakeholders, and 5) the contribution of the wind farm to the renewable energy goal of Houten.

Past research suggests that social acceptance may be a powerful barrier to the achievement of wind targets (Wüstenhagen et al., 2007); this appears to be the case in the Netherlands where public resistance to wind energy projects has been growing. Our scan of the LexisNexis Dutch newspaper database revealed<sup>1</sup> that 881 articles on public resistance to wind energy appeared from Jan. 2000 – Dec. 2009 but that 1248 articles appeared in just the next five years, from Jan. 2010 – Dec. 2015.

Although a wealth of academic research on social acceptance of renewable energy technology, and in particular wind, is present (e.g. Wolsink, 2007; Gross, 2007; Petrova, 2016), to our best knowledge our research offers a unique combination of data sources and methods, including an in-depth reconstruction of the planning and development phase, surveys for analyzing the attitude of residents, and an analysis of the operational data of the wind farm, which has not been demonstrated before. We will present a rich framework for project evaluation that offers explanatory power for understanding the current situation in Houten and will contribute to the academic knowledge base. Since this research is based on only one case study, we carefully provide general lessons for national onshore wind energy policies.

## **Research Framework & Methods**

Wüstenhagen et al. (2007) distinguished three dimensions of social acceptance: socio-political acceptance (by the public and policy makers), market acceptance (by investors) and community acceptance.<sup>2</sup> The latter refers to the acceptance of siting decisions by residents and measured by concepts such as procedural justice (is the process perceived as fair?), distributional justice (compensation of nearby residents) and trust (Wüstenhagen et al., 2007). In our research community acceptance is central but, where relevant, discussed in the context of socio-political and market acceptance. The analysis has three building blocks following the three main phases of a wind project: planning, development, operation. Table 1 provides our research questions, data sources and methods.

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<sup>1</sup> Using these search terms (in Dutch): (windmolen or windturbine) and weerstand. Weerstand = resistance.

<sup>2</sup> The three dimensions of social acceptance well connect to the three P's, a term coined by Elkington (1997) where community acceptance deals with People (acknowledging the need for procedural justice, distributional justice and trust), socio-political acceptance with Planet (acknowledging the need for renewable energy to combat climate change) and market acceptance with Profit (acknowledging the existence of a viable business case)

**Table 1.** Overview of research questions, relevant concepts, data sources and methods

	Main research questions	Relevant concepts	Data sources <sup>3</sup>	Methods
Planning phase (1999-2001)	RQ 1.To what extent did the Houten residents support renewable energy? To what extent did the Houten residents support wind energy in Houten?	Socio-political & community acceptance	IVAM, 1999; municipal documents; Survey 1 (see below)	Review of survey outcomes IVAM; analysis of survey data
	RQ 2. How was the wind farm site selected? Were different locations considered? Which selection criteria were used? How were the residents involved in the selection process?	Community acceptance	Ecofys, 2000; municipal documents; stakeholder interviews	Review of documents complemented with interviews
	Synthesis: To what extent did the planning phase offer a healthy balance between socio-political, community and market acceptance?			
Development phase (2001-2013)	RQ 3.Were the residents sufficiently involved in the design of WFH?	Community acceptance	Houten, 2002 & 2003; other municipal documents; stakeholder interviews	Review of documents complemented with interviews
	RQ 4. Were the residents sufficiently involved in the formal procedures?	Community acceptance	(Municipal) documents; stakeholder interviews, Survey 1 (see below)	Review of documents complemented with interviews; analysis of survey data
	RQ 5. What is the degree of trust in the stakeholders involved in WFH?	Community acceptance	Survey 2 (see below)	Analysis of survey data
	Synthesis: To what extent did the development phase offer a healthy balance between socio-political, community and market acceptance?			
Operational phase (2013->)	RQ 6. What is the attitude towards WFH of persons (not) living within 1 km of the wind farm? Are attitudes towards WFH stable over time? What explains the attitude?	Community acceptance	Survey 1; sample = all 820 households within 1 km of WFH; response 31% Survey 2; sample = Survey 1 respondents; response 66% Survey 3; sample = 1332 residents of Houten being member of a (regular) residential panel; response 55%	We analyzed most survey data with descriptive statistics (mean, variance), with a focus on the correlation between indicators; we primarily used 5-point Likert scales (from 1 = totally disagree to 5= totally agree)
	RQ 7. How does the amount of complaints about WFH evolve over time? What is the experience of residents with filing complaints about WFH?	Community acceptance	Municipal database with 135 complaints filed by 49 different households in the period Jul. 2013 – Aug. 2015 Survey 4; sample = 25 residents that had filed a complaint and gave permission to approach them; response 56%	Qualitative categorization of type of complaints; quantitative analysis of development in time Quantitative analysis of open questions
	RQ 8.To what extent is WFH operated according to the regulation in place?	Community acceptance	Operational data WFH	Quantitative analysis wind speeds versus power production
	RQ 9.To what extent does WFH contribute to Houten’s renewable energy goal? What is the impact of the tailor-made noise regulation?	Socio-political acceptance	Operational data windfarm Houten, energy statistics Houten	Quantitative analysis
	Synthesis: To what extent does the operation phase, so far, offer a healthy balance between socio-political, community and market acceptance?			

<sup>3</sup> We conducted Surveys 1-4 in the period May-Jul. 2015; Operational data WFH concern all relevant data of the wind farm for 10 minutes intervals, including the power output, wind speeds, wind direction, light intensity and notification codes (e.g. for noise, shadow cast) for period Jan. 2014-May 2015 (provided by the wind farm operator); in total, we interviewed 17 different stakeholders (civil servants, project developer, project initiator, residents) in the period Apr.-Sept. 2015.

## Results – Planning Phase

In this section we answer research questions 1 and 2 and synthesize the planning phase.

### Research Question 1 (Renewable Energy & Wind Support)

Houten proactively began to explore renewable energy options at the end of 1990s. A wind energy public support survey in Houten in 1999 showed 92% of respondents considered renewable energy important and 58% agreed an appropriate site for developing a wind farm should be looked for (IVAM, 1999). Our review of this survey suggests it did not provide entirely reliable feedback about public support. For one thing, the study did not describe the sampling strategy or give the sample size, making it difficult to understand how reliable and representative the results were. In addition, some questions were indirect or incomplete. For instance, the question “Do you think the municipality should actively look for a suitable wind farm site?” measures public support *to look for* a suitable site but *not support for having* a site. Another question “What would be a suitable site for a wind farm?” lacked an answer category addressing if the site could be “close to houses.” Finally, some survey outcomes were more critical of wind energy development – such as more than half of respondents considered wind turbines a disturbance of the local landscape (IVAM 1999) – got less attention. For the Executive Board of Houten, however, the interpretation of the survey results supported adoption of an ambitious renewable energy goal with wind as an important pillar.

### Research Question 2 (Site Selection)

The Executive Board of Houten evaluated six potential sites against these five criteria: noise, shadow cast, landscape, birds and contribution to the renewable energy goal ambition. They investigated two variants for each site, one with 600 kW turbines (axis height 55 meters tall) and one with 1.5 MW turbines (60 meters), and selected three top sites Options A, B and C (see Table 2), with Option C being their most preferred site. However, whereas Options A and B obtained overall good scores for both the 600 kW and 1.5 MW variant, Table 2 clearly shows that Option C only scores well for the variant with the smaller 600 kW turbines.

**Table 2.** Scores of Top Three Potential Wind Farm Sites (Ecofys, 2000)

Optional locations:	Noise	Shadow Cast	Landscape	Birds	Contribution to RE Goal	Summed scored (added by the authors)
A (600 kW)	0	0	1.75	-1	1.5	2.25
A (1.5 MW)	2	0	1.75	-1	2	3.75
B (600 kW)	0	0	2	1	1.7	4.7
B (1.5 MW)	-1	0	2	1	1.7	3.7
C (600 kW)	2	-1	2	1	0.4	4.4
C (1.5 MW)	-2	-2	1.25	2	1.4	0.65

-2 negative, -1 moderately negative, 0 neutral, 1 moderately positive, 2 positive

In their proposal to the Town Council, the Board justified Option C because of the size of the project (smallest of the three), its closeness to the urban environment, and the anticipated development of an industrial area at the same location. These arguments can primarily be considered “landscape” arguments. The different scores for the two Option C variants remained unaddressed in the Board’s proposal and the Town Council did not question it. We found that three other factors strongly influenced the choice of Option C by

the Town Council: fierce opposition from residents living near Options A and B early 2001, but not from residents living close to Option C (why they did not oppose in this phase of the development remains unanswered); Options A and B not being included in the new local zoning plan (inclusion of the wind farm locations in the plan would cause an undesirable delay that could be prevented by choosing option C); and, finally, the municipality owned the land for option C, but not for Options A and B. The decision-makers did clearly not stick with the original criteria alone but added ad-hoc criteria that seemed to get much weight in the final decision.

### **Synthesis Planning Phase**

Our analysis of the planning phase clearly shows that socio-political acceptance was dominating (and aligned with market acceptance which was in this phase not yet important). Houten had a strong drive to become frontrunner municipality in renewable energy, had formulated an ambitious goal and had set high hopes on the first wind farm to deliver a substantial part of that goal. The municipality considered the survey (IVAM, 1999) as an important means to deal with community acceptance. However, where the outcomes of the survey did not explicitly show a proper site for a wind farm could be found in Houten, the Executive Board saw the outcomes as a justification to start developing the first wind farm. In addition, our finding that both the Town Council and the Executive Board did not question the apparent lack of opposition from residents living near Option C in the period preceding the site selection, suggests that community acceptance was an ad-hoc criterion that was not well investigated. The absence of residents opposing Option C legitimized the choice of Option C, rather than initiating a debate to find out why opposition was absent. Both procedural and distributive justice (fair decision-making) were at stake.

### **Results - Development Phase**

In this section we answer research questions 3-5 (see Table 1), and synthesize the development phase.

#### **Research Question 3 (Involvement in the Wind Farm Design)**

After the Town Council had chosen option C, the Executive Board of Houten initiated a study to work out possible configurations of the wind farm. In February 2003, the Town Council approved a line formation of three turbines, of 1.5 MW each with an axis height of 100 m maximum. In the 2007 environmental permit application the final configuration had crystalized: three turbines of 2 MW each and a height of 105 m. Thus the turbines became taller (from 55/60 to 105 meter) and bigger (from 600 kW to 2 MW) turbines in the course of time. This is notable, given that at the time of selecting option C it was clear from the scores (see Table 2) that tall and big turbines (60 meter axis height, 1.5 MW) would give problems with noise and shadow cast on this location. In the archived documentation we found no justification for the taller and bigger turbines, e.g. proof that the insights of Ecofys (2000) had become outdated. Rather, we found the real justification explicitly mentioned in municipal documents: maximizing the production of the wind farm to make a more substantial contribution to the local renewable energy ambition. Feedback loops in the configuration process were clearly missing. While the proposal of the Board contradicted earlier study outcomes, the Town Council was not able to correct the Board. In addition, the residents living near Option C did not provide feedback (either supportive or disputing) despite being

invited to do so by the municipality. Our interviews with residents did not provide insight as to why they did not use this opportunity.

#### **Research Question 4 (Involvement in the Formal Procedures)**

Although residents near the selected site initially did not object to it, the Board did not manage to have WFH operational before 2005, which was the original plan. One reason was the Province of Utrecht being slower than the municipality of Houten in developing its wind energy policy. Only after the Proving signed the national wind covenant “BLOW” in 2002, did the regional and local policy process become aligned (strengthening the socio-political acceptance). In addition, the energy company involved in the project was subject to a merger in 2003, the project became a lower priority, and the development of the wind farm slowed down. Over time, opposition from the nearby residents also began and rapidly intensified. This alarmed the municipality which, among other reasons, led to a study trip to a wind farm in Germany (Bad Bentheim) in 2004 to experience an operational wind farm and talk with the nearby residents. The study trip revealed that especially noise nuisance was an issue. The municipality therefore decided to implement noise regulation for WFH that was more stringent than the national regulation. Although this tailor made noise regulation can be considered an important mitigation measure implemented by the municipality (having a significant impact on the amount of electricity production, see later), only 61% of the respondents from Survey 1 know about the tailor made regulation and about one-third of them think the regulation is sufficiently stringent.

Finally, a new neighborhood of several hundred homes was developed near the wind farm location prior to the construction of WFH, increasing the number households within 1 km of WFH from several dozen to more than 800. Our review of the archived documentation reveals that the municipality did not sufficiently anticipate this in its communication / participation strategy. The new neighborhood had been planned long before, but no one had expected that its development would be prior to the construction of WFH. If WFH had been constructed first, homebuyers would have made their purchase decisions with the wind farm in operation, rather than imagining what it would be like to live nearby the wind farm. The municipality asked the project developers of the new neighborhood to inform the potential buyers. However, the municipality did not monitor whether the buyers had been informed at all and/or in the right way. Our analysis suggests this is a still ongoing dispute in Houten: the residents claiming that the development of the wind farm was not a certainty at the moment they bought their homes (which decreased in value because of the wind farm); the municipality taking a more formal stance by stressing that the development of the wind farm was a political decision made in 2001, and only reconfirmed in the course of time.

Our general observation is that the municipality did not undertake substantial efforts to involve the new residents in the process in a positive way. Their involvement was restricted to the permitting process. Where the renewable energy goal is typically framed as “something we do together as a community”, the permitting process is more formal and can be considered more “them (municipality as permitting authority) against us (the residents)”.

In Survey 1, when we asked respondents who lived in their houses before WFH was constructed if they knew about plans for its development, 49% said they knew, 45% said they did not know, and 5% said the plans did not exist when they bought their house. Generally, the respondents rated their participation in the decision making process low and this score strongly correlates with their opinion on the wind farm (see Table 3).

**Table 3. Participation In The Development Of The Wind Farm**

Thesis:	Mean	Variance	Correlation with opinion WFH
Sufficient opportunities for participation existed	2.42	1.279	0.501**
I felt involved in the development	2.04	1.116	0.518**
My voice was heard	2.01	1.072	0.677**
Participation in the development (combined three theses)	2.16	1.036	0.626**
Response (N) = 175			

\*\* p<0.01

During the development phase two interest groups became active to oppose the development of WFH: one representing the “original” residents, already founded before 2005, and one representing the new neighborhood, founded in early 2010. In addition, a new local political party was established having an anti-WFH stance. This new party won the 2010 local elections. The efforts of the interest groups severely further delayed the development of WFH in the period 2005-2012. Our review of the archived documentation combined with stakeholder interviews shows an important aspect in the development of WFH in this phase: the conviction of opponents that they had a case to stop the development. Clues were found in the denial of the local zoning plan and the environmental permit by the Council of State, the disunity in the Town Council especially after 2010 when the two biggest parties both had an anti-WFH stance, and the fact that the environmental permit was no longer needed (for details, see Harmsen et al., 2015). The Executive Board of Houten did not manage to convince the residents that the development of WFH would not be stopped, for which they used the following arguments:

- The denial of the local zoning plan and the environmental permit was based on administrative, not fundamental issues.
- In the environmental permit the municipality had proposed an innovative solution to optimally protect the residents against noise (defining a worst-case scenario). This solution was not accepted by the Council of State.
- Despite the fact that the two biggest parties had an anti-WFH stance in 2010 (survey 1 results reveal that 47.1% of the respondents voted in 2010 for these parties), a democratic majority was formed being in (conditional) favor of WFH since the second biggest party had given up their anti-WFH stance to be part of the Executive Board of the municipality.
- The fact that the environmental permit was no longer required was no reason for the new Executive Board to restart the discussion on the wind farm (i.e. it was not considered a potential showstopper).

### Research Question 5 (Trust)

Table 4 provides Survey 2 results regarding the level of trust residents have in authorities (measured in 2015). The average score residents gave to the authorities is more negative than positive, with only the interest group of the residents receiving an almost neutral score. Both the municipality and the wind farm operator get a low score. Please note the Province does not have a direct role in the wind farm. Social trust was also measured with the following question: Do you think that in general most people can be trusted or do you think you should be careful when dealing with others? This question used a 10-point scale and 73% of the respondents scored it 6 or higher.

**Table 4. Trusting Authorities**

To what extent do you trust..... (1 = very little trust; 5 = very much trust)				
Authority:	Mean	Standard Deviation	Correlation with opinion on wind farm	Response (N) <sup>4</sup>
Interest group of residents	2.99	1.091	-0.376**	137
Province of Utrecht	2.76	0.929	0.612**	151
Municipality of Houten	2.65	1.094	0.673**	160
Regional executive office (dealing with complaints)	2.64	0.843	0.566**	118
Wind farm developer/operator	2.45	1.000	0.705**	158

\*\* p<0.01

## Synthesis Development Phase

In the design of WFH socio-political acceptance and market acceptance were most often expressed as the maximization of electricity production on the selected site. To a large extent this may be due to the absence of community involvement in the public consultation of the design plans. Community acceptance became topical after local opposition began and intensified during 2003. This resulted in tailor made noise regulation for WFH that can be considered a significant mitigation measure implemented by the municipality. The residents, however, did not want to listen to the promise of mitigated noise nuisance. They were still convinced that they could stop the construction of WFH. In addition, for the inhabitants of the new neighborhood, a few years later, stopping the development had more priority than aiming for a wind farm with minimum nuisance. A relatively big group of loud opponents did not enable building community acceptance.

During the development phase the impact of the tailor made noise regulation on the future electricity production was looked at but did not raise alarm bells. It was only in the operational phase (see later) that both operator and municipality discovered that the electricity production was severely reduced because of the regulation. This put pressure on both socio-political acceptance (which was kept alive in the Town Council during the development phase) and market acceptance (less production = less turnover).

## Results - Operational Phase

In this section we answer research questions 6-9 (see Table 1) and synthesize the operational phase.

### Research Question 6 (Attitude Towards WFH)

Our analysis of Survey 1, 2 and 3 results shows substantial opposition to WFH from those who live nearby, but much less opposition from Houten residents who do not live near WFH (see Table 5). A neutral opinion would be a score 3 on a 1-5 point scale, with a score of 1 meaning very low agreement and a score of 5 meaning very high agreement. Surveys 1 and 2 both show a combined score of less than 3 among nearby residents, which differs from the combined score of residents not living nearby WFH (3.71). Respondents who gave low scores to theses 1 and 3, gave high scores to theses 2 and 4 (and vice versa). The main WFH nuisance categories we identified in Survey 1 (N=248) are visual disturbance (52%), noise (33%) and shadow cast (34%).

<sup>4</sup> One of the answer categories was “not applicable”. This explains the variation in response.



**Table 5.** Opinion regarding WFH (variance between brackets)

Do you agree with the following theses?	Survey 1 (Live near WFH)	Survey 2 (Live near WHF)	Survey 3 (Do not live near WFH)
1. I welcome WFH	2.74 (1.377)	2.69 (1.384)	3.58 (1.358)
2. WFH should be demolished	3.12 (1.524)	2.80 (1.479)	1.99 (1.313)
3. I'm satisfied with WFH	2.61 (1.316)	2.56 (1.264)	3.38 (1.305)
4. I'm against WFH	3.01 (1.497)	3.04 (1.499)	2.14 (1.349)
Average opinion (combination of 4 theses)	2.86 (1.348)	2.85 (1.298)	3.71 (1.245)
Response (N)	250	167 (thesis 4: 166)	549

### Research Question 7 (Complaints)

In the first half-year, residents filed 63 complaints with the municipality, mainly regarding noise and shadow cast. In 2014 the number of complaints significantly decreased. Representatives of the municipality and the wind farm operator said in interviews that they believed only a small group of persistent wind farm opponents continued to complain. They were strengthened in their opinion by another resident group that increasingly complained about the many downtime hours of WFH, especially in comparison to the operational time of a well-visible wind farm in a neighboring municipality.<sup>5</sup>

Various stakeholders also said both sides considered communication difficult. Our analysis of Survey 1 data shows that 69% of the respondents had complaints about the wind farm, but that only 44% reported these complaints to the municipality, the wind farm operator or the residents' interest group. Respondents who *never* reported their complaints (N=170) were asked why: 74% did not experience nuisance or felt that it was solved; 26% thought their complaints would not be adequately addressed. For residents that *stopped* reporting complaints (N = 58) the majority indicated that their complaints were not resolved. These findings connect to the low level of trust in authorities by the respondents (see Table 5). Importantly, these findings suggest that a decreasing number of complaints over time does not necessarily mean that nuisances became less. Rather, they suggest people give up asking authorities to help resolve the nuisances.

### Research Question 8 (Operation According to Regulation)

Based on noise complaints in May 2014, the municipality filed an administrative warning at the wind farm operator. Based on the response by the operator the warning was withdrawn. We analyzed the same data as the municipality did and found they had used a wrong method to do the checks (which explains why the administrative warning had to be withdrawn). In addition, we analyzed the operational data of WFH farm for the period Jan. 2014-May 2015 to check if WFH had been operated according to the tailor made noise regulation. Our analysis revealed that each turbine for more than 600 hours did not operate according to the operating rules.<sup>6</sup> This resembles a total of 1.1 GWh of surplus electricity production (representing a market value of €40-50,000). From our analysis it became clear that the operator needs greater expertise to operate WFH according to the noise regulation and that the municipality needs greater expertise to check compliance.

<sup>5</sup> This was also confirmed in our Survey 1 showing that 133 respondents (53%) felt that the downtime of the turbines is too much.

<sup>6</sup> These operating rules require the turbines of WFH to stop at given wind speeds.

## Research Question 9 (Contribution to the Renewable Energy Goal / Impact of the Noise Regulation)

The current goal of Houten is to have 16% of its residential energy use provided through renewable energy by 2018. The electricity production of WFH in 2014 was 11.1 GWh. As the total residential energy use in Houten (electricity + fuel for heating) is currently 269 GWh (2013 data from Statistics Netherlands), WFH provides about 4% of the residential energy use overall, and about one-quarter of the 16% renewable energy goal. The annual production of the wind farm (11.1 GWh in 2014) is significantly lower than the wind farm operator (and the municipality) predicted in an official report which projected an annual production of 16.4 GWh just before the start of operation (Ecofys, 2013). Our analysis of the 2014 operational data for the wind farm<sup>7</sup> shows that the tailor made noise regulation greatly affected production (representing a substantial market value), but that other factors also reduced its output, as shown in Table 6.

**Table 6.** Decomposition of impact factors on the 2014 electricity production based on operational data analysis

	GWh
Optimal production in a normal wind year (cf. Circe, 2014)	18.7
Reduced production due to:	
Below average wind year	-2.1
Noise regulation (downtime turbines)	-4.8 (estimated market value €190-240,000)
Shadow cast regulation (downtime turbines)	-0.5
Other notification codes (downtime turbines)	-0.5
2014 Production	11.1
Difference between 2014 and optimal production (unexplained)	+0.3

### Synthesis Operational Phase

Our evaluation of the operational phase of WFH reveals that a stable socio-political, market and community acceptance situation has not yet been reached. The electricity production of WFH is much less than expected (due to the tailor made noise regulation) putting the renewable energy goal of the municipality and the business case of the operator of WFH under pressure. Despite the considerable downtime of the turbines due to the noise regulation, community trust is low. Residents do not feel the municipality or the operator have taken their complaints seriously. After our evaluation showed the turbines are not always operated according to the regulation, the distrust has deepened and led to a situation in which Town Council (November 2015) demanded that the responsible Alderman “regain the trust of the residents living nearby the wind farm” (Houten, 2015) through a mediation process. Such a process between municipality, operator and residents was recently started. The municipality desires a situation in which the residents are better protected (especially against noise nuisance) and where the turbines produce more electricity. One potential solution might be to stop operating the turbines at night but to have fewer daytime operating restrictions.

<sup>7</sup> This has been done by combining the power curve of the 2 MW turbine (power output for given wind speed and air density) with the actual power output/wind speed.

## **Conclusions: Lessons Learned For National Onshore Wind Policies & Guidance For Further Research**

Before the start of our evaluation study WFH was already known as one of the most contested wind farms in the Netherlands. The Executive Board of Houten and the wind farm operator held the opinion (expressed publicly) that the (fierce) opposition that remained after the start of operation in the summer of 2013 came from a small group of residents. As such, WFH would not necessarily differ from other wind farms where it has been statistically proven that local attitudes follow an U-shaped pattern: attitudes are positive before a project, become more critical after announcing a project, and then become more positive again “some reasonable time” after construction (Wolsink, 2007). The reduction, over time, in complaints about noise and shadows cast strengthened the Board’s view, as did the increasing complaints about less electricity being produced compared to a well visible wind farm in a neighboring municipality.

The results of our evaluation study (Harmsen et al., 2015) did not confirm the opinion of the Board: many more residents than expected have a negative attitude towards WFH. In addition, our analysis revealed that the municipality did not always carefully deal with the complaints of residents, and that WFH was not always operated according to the tailor made noise regulation. If the Alderman of Houten will succeed in regaining the trust of the residents is unknown, as the talks between Board, wind farm operator and residents are still ongoing at the time of writing this paper. Consequently, the development of the second wind farm in Houten will be delayed. Stakeholders involved in the development of WFH and in this evaluation have affirmed that the social impact of the evaluation would not have been much less without our thorough multi-method approach. We provide specific conclusions and recommendations for the three analyzed phases below:

### **Planning phase**

- To develop an appropriate communication and participation plan, it is crucial to have insight about public acceptance *near the projected wind farm site*. Although this issue is addressed in literature (e.g. Wolsink, 2007; Petrova, 2016), it often concerns the difference between national and local support. Here, we explicitly stress the difference between general municipal public support and public support for a specific site.
- All the criteria used for site selection, and the weighting of those criteria, should be transparent (in academic literature various multi-criteria approaches are discussed). It can be questioned if a generally applicable list of criteria is sufficient in all cases (our case study e.g. highlighted the decisive role of ad-hoc criteria), so allowing for the addition of relevant context-specific criteria (and analyzing them with the same depth as the other criteria) makes sense. Obviously, a decision based on ad-hoc criteria that are insufficiently analyzed should be avoided.
- Existing “Codes of Conduct” offering guidance to obtain community acceptance (in the Netherlands e.g. NWEA et al. 2014; NLVOW, 2015; Ecofys & Houthoff Bruma, 2015) generally assume that a site has already been selected. Our case study shows that the actual site selection phase needs to be addressed if more than one site is considered, since residents at each site may oppose the project. This opposition may lead to disunity among the residents (issue of distributional justice: “why is the burden shifted to us?”) and have an impact of the actual development process (carrying on the frustration of the selection process). Whether this can be solved by compensating residents is sensitive as compensation might be considered a bribe (Aitken, 2010).

## Development Phase

- Our case study shows the capacity and axis height of the turbines gradually grew, despite earlier research that concluded tall turbines would lead to noise and shadows being cast. This example shows the feedback and public involvement process did not function well. It also shows that early involvement of the residents is essential and cannot be abandoned, since it will affect a project's long-term success. More in-depth case studies could shed a light on the role of feedback in decision chains.
- The communication and participation strategy of a project needs to be flexible in order to adequately respond to big changes in the neighborhoods near a projected wind farm, such as the new homes development that was built close to WFH. As extreme examples such as in Houten are rare, a custom made approach is recommended.
- In the Netherlands, careful participation of residents may be impeded by the Dutch Crisis & Recovery Law which allows a project initiator of a wind farm (between 5-100 MW) to invoke the regional government and bypass the municipality if a local government refuses to cooperate by adjusting or developing a local zoning plan. The great pressure to meet the national 2020 onshore wind goal, as part of a larger renewable energy goal, may increasingly lead to the use of the Crisis and Recovery Law but could anyhow prevent careful participation processes stressed in academic literature and “Codes of conduct”, since a careful participation process should always allow projects to be discontinued.

## Operational Phase

- Our case study suggests that tailor made noise regulations for a wind farm may create an unfortunate precedent (“why are some residents better protected than others?”). Rather, we believe a standard regulation for wind farms close to houses may provide more clarity. Minimizing the amount of households in the direct neighborhood of a wind farm and generously compensating the residents involved (without violating the business case of the wind farm) are generally considered best practices found in “Codes of conduct”.
- Complaint procedures should be transparent for residents (one stop shopping) and stakeholders (e.g. municipality and wind farm operator) should exchange information between each other to ensure that complaints are adequately dealt with. Our evaluation shows that a decrease in the amount of complaints over time may not signal growing acceptance; rather, it may signal that residents over time lose trust in the ability of the proper authorities to adequately deal with their complaints. Our focus on community acceptance also confirms the insights from literature (e.g. Petrova, 2016) that perceived nuisance is often related to the perceived fairness of the process. Although adequate complaint procedures are highly recommended for getting a higher level of community acceptance, a process that is perceived as fair by residents is much more effective.

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