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Government versus the people – The mismatch in value use to assess solar farms in the Netherlands

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ABSTRACT

In energy projects, especially in controversial ones, two trajectories of assessment can be distinguished: a formal trajectory, embedded in the legal system, and an informal trajectory, residing in the public discourse. Often, there is a fundamental mismatch between these two trajectories. The informal trajectory arises because local residents perceive certain shortcomings in values used to assess the project in the formal trajectory. In this paper, we investigate the role values play in the assessments of eight utility-scale solar farms in two municipalities in the Netherlands. Based on policy documents, transcripts of city council meetings and newspaper articles, we identify seven values that play an important role in the assessment of solar farms. In order of their occurrence: *Prudent land use*, *Procedural justice*, *Minimized observable impact on surroundings*, *Legality*, *Sustainability*, *Financial distributive justice* and *Innovation*. Of these, *Legality* and *Sustainability* are most used as arguments in favor of solar farms (mostly in the formal trajectory), whereas *Procedural justice*, *Prudent land use* and *Minimized impact on surroundings* are most used in arguments against solar farms (in both trajectories). Our empirical results indicate that a solar farm is more likely to be controversial when only a minimal formal evaluation framework is in place. Based on our results, we recommend policymakers to develop comprehensive evaluation frameworks for energy projects, as well as to organize a multitude of interaction opportunities between the formal and informal trajectory. In this way, the interaction between the two trajectories can lead to better-quality and better-supported decisions on energy projects.

1. Introduction

Societal acceptance is widely recognized as a crucial prerequisite for accelerated transitions in general, and the low-carbon transition specifically [1]. Numerous energy projects have been halted due to social resistance, and scientific literature offers various explanations for this. A lack of participation within the decision-making process is often explored [2]. Also, absence of compensation and other perceived injustices relating to the project are important factors [3,4]. In many cases, the lack of acceptance can be attributed to a mismatch between the assessment of a project or technology by a government versus the perceptions of local residents who are recipients of this technology [5–7]. This mismatch highlights the existence of two trajectories of assessment: a formal trajectory, and an informal one.

Pesch et al. [8] discussed the discrepancies between the trajectories by introducing the concept of 'overflowing' and 'backflowing'. In the formal trajectory, a government designs policies according to pre-set rules and procedures. These rules and procedures serve as a frame that inevitably includes some values, but excludes other values [8,9]. The absence of certain values that are deemed important by the public can lead to the formation of an informal trajectory of assessment; this process is called overflowing. Within this informal trajectory the public deliberates among themselves about the proposed project. In some cases, the informal trajectory may cause adaptations to the policies in the formal trajectory – a process called backflowing. Within these processes, values play a central role: it is the perceived mismatch of important values between the trajectories that leads to controversy [8,10]. This mismatch, for instance, becomes evident when values are perceived to be missing, or when differing interpretations of values exists.

Some research has been conducted to identify important values in energy projects. In a general sense, the concept of energy justice has

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received much attention in the scientific literature. The tripartite model of energy justice, consisting of distributive justice, procedural justice and justice as recognition, has been proposed as a framework that provides the opportunity to explore where injustices occur [11]. Sovacool and Dworkin propose eight values that aid energy decision-making, namely availability, affordability, due process, good governance, sustainability, intergenerational equity, intragenerational equity, and responsibility [12]. Additionally, Mouter et al. [13] focus on value-sensitive design of energy projects, identifying a list of 29 values that played a role in a controversy on natural gas drilling in the Netherlands. Furthermore, Dugstad et al. [14] take a value-based approach in the evaluation of wind energy projects, stressing that not only market values should be incorporated in management and appraisal of renewable energy projects, but for the meaning of places also emotional, symbolic and spiritual values are important.

Yet, the concept of values has not been structurally connected to the process of overflowing and backflowing, nor has the role of values in overflowing and backflowing empirically been established. It is our hypothesis that overflowing is triggered when a qualitative mismatch occurs between values that are emphasized in formal trajectory and those present in the informal arena. Specifically, this may mean certain values deemed important by residents are missing in the evaluation framework used by a government to decide on an energy project; it could also mean the same values are assessed differently by governments and residents. Depending on the potential re-assessment in the formal process caused by the values forwarded in the informal trajectory, backflowing may occur. To test this hypothesis, in this study, we will combine a value-based approach with the theory of Pesch et al. on overflowing and backflowing and apply this on solar farms.

Solar farms, which are utility-scale landbound photovoltaic electricity generation, play an increasingly important role in the energy transition [15]. However, solar farms are becoming more controversial in recent years [16–19]. Important factors in the acceptance of solar farms are the size of the solar farm [17–19], the impact on agricultural production and tourism [17], impact on landscape character and existing wildlife [17], and benefits to the local community [16,19].

Solar farms are a suitable technology to study overflowing and backflowing given the controversy around it as well as the large scale at which this technology is deployed. However, solar farms have been studied much less extensively from a governance perspective than other renewable energy technologies such as wind energy [20]. Various studies on decision-making around solar farms take a technical approach tailored for use in Geographic Information System (GIS)-based studies [21]. Such studies focus on exclusion criteria such as protected sites (world heritage sites, national parks), important sites (religious or tourist sites, airport) and permanent sites (water bodies, major settlement areas) [22]. Furthermore, evaluation criteria are important, namely climatological factors (solar radiation, air temperature, humidity), topographical factors (elevation, slope, possible orientation) and the location (proximity to road and grid network) [22]. A limited number of GIS-based studies focus on the social acceptance factors. In these studies, quantitative factors that are associated with public acceptance are included. Examples are the proximity to residential, agricultural, recreational areas, and to areas that are culturally important or important for wildlife [21]. Sward et al. [21] add two social factors that are not easily translated into GIS-models, namely "Government policy" and "Public Opinion/Acceptance" [21]. We conclude that most literature on solar farms is centered around either technical factors in decision-making or around ex-post social acceptance. In this paper we explicitly focus on the social factors within the decision-making process and the interaction between decision makers and citizens throughout the process.

The contribution of our paper is twofold. First, our contribution to theory is the novel conceptual combination of the value-based approach to the theory of overflowing and backflowing. Hereby we aim to advance the understanding of the mismatch between the governments and residents in their assessments of energy projects. Second, our practical contribution lies in identifying the myriad of values that play a role in the decisions regarding the installation of solar farms and their optimal locations. This knowledge can be utilized by practitioners, including project developers and policy makers to inform and guide their actions on solar farms. In the following sections we explain the theoretical background of over- and backflowing, (in)formal trajectories, the role of values and the resulting combination in our conceptual model (Section 2), the methodology for analyzing the case-studies (Section 3), the results and discussion (Section 4) and the conclusions, encompassing certain policy implications as well (Section 5).

2. Theoretical background: overflowing, backflowing and values

In this research, we combine the overflowing and backflowing approach to energy controversies with a value-sensitive-design approach.

The term overflowing was coined by Callon to describe the formation of "emergent concerned groups" when reflecting on how economic markets can manufacture "the social" [9, p. 145]. Pesch et al. [8] applied this concept to energy projects and added the term backflowing. The definitions of overflowing and backflowing, as put forward by [8, p. 825], are as follows:

> […] two interacting trajectories of assessment: a formal trajectory that is embedded in the legal system and an informal trajectory that is mainly embedded in public discourse. The emergence of an informal assessment trajectory can be seen as a response to a (perceived) lack of attention to particular concerns or values in the formal trajectory, i.e., 'overflowing'. The emerging informal assessment may subsequently lead to adaptations in the formal trajectory, which we refer to as 'backflowing'.

We can see that the definitions of overflowing and backflowing depend on the definitions of the formal and informal trajectory. In a formal trajectory "a repertoire of (legal) procedures, standards, tools, and policy arrangements is used to establish a collective value appraisal of the new technology or a project" [8, p. 826]. The informal trajectory, resulting from overflowing, is characterized by "advocacy for public values that some actors consider to be underrepresented (or sometimes even missing) in the formal assessment trajectory".

A formal trajectory generally starts when first plans to permit solar farms arise. This can occur when (local) governments draft evaluative frameworks, or in the absence of this, when a project developer requests a new permit or zoning plan adjustment (see also Section 3.1.1 for a brief description of the formal decision-making process). Once the formal trajectory starts, interested parties form their opinions, wishes and or concerns. Depending on the exact procedural rules, these interested parties can either participate in the formal procedures (being heard or consulted) or will want to influence the outcomes of the process in other ways. The latter can take many forms: people may form action groups, organize protests, raise their voice within (local) media, etcetera. The informal trajectory may enter the formal arena again at various instances, for example by attending city council meetings or by staging a legal protest. All processes may occur simultaneously and publicly, and therefore influence each other. Precisely how the over- and backflowing between the formal and informal trajectories arise, depends on the case-specific circumstances. Diving deeper into these trajectories, we see they differ in a number of attributes, as detailed in Table 1.

In this paper we adopt a somewhat different approach than Pesch et al. We denote that Pesch et al. state that the informal trajectory that leads to controversy is caused by the underrepresentation or absence of certain public values in the formal trajectory. However, Pesch et al. do not treat values as inherent normative qualities of energy projects; rather, they focus on the general process of value appraisal. In this paper, we put more emphasis on values and aim to elaborate on the

Table 1
Attributes of formal and informal trajectory of assessment.

	Formal trajectory of assessment	Informal trajectory of assessment
Logic of value expression	Judicial rationality (Embedded in predetermined procedures, recurring practices/routines)	Narrative rationality (continuity, based on shared origin and common future + emotional attachment)
Justice tenet starting point	Procedural justice (Universal and general principles. Assumes equality.)	Justice as recognition (adding attention for specific practices and circumstances. Requires explicit recognition local sphere)
Democratic principle	Delegative authority	Community-based authority
Main actors	Institutionalized actors (e.g., governmental authorities, firms, expert organizations)	Residents, citizens, NGOs, sometimes ad hoc civil society organizations
Opinions about other	Self-interest, opportunism, nimbyism, emotional	Technocratic, elitist, ignoring rights, impose suffering
Group identity	Detached disposition	Common identity of a(n emerging) societal collective

Source: adapted from Pesch et al. [8].

nature of values by investigating which values play which role in utility-scale solar energy projects in general, and potentially in controversies specifically. Therefore, we propose to expand the overflowing and backflowing model by a value-based approach. We draw upon the notion of a value-sensitive design of policy processes [13,23]. This approach has been popularized by Friedman and it entails accounting for human values throughout the design process of a technology [24]. Van de Poel [25] observed that translating values to design requirements was a relatively neglected aspect of value-sensitive design, and therefore proposed the value hierarchy, depicted in Fig. 1. It consists of three elements: values, norms and design requirements. For example, in case of solar farms this could entail *Aesthetics* (as value), *Landscape integration* (as norm) and *A 10-meter-wide green lane should be added to the solar farm* (as design requirement). The value hierarchy can be used in two ways; for designing e.g. a product in a way that is sensitive to overarching values (i.e. top-down), or to pursuit underlying values based on observed norms or design requirements (i.e. bottom-up). The latter is defined by Van de Poel as: "one starts with more specific design requirements and looks for more general norms and values on which these requirements may be based or to which they may contribute" [25, p. 259]. We use the value hierarchy in the bottom-up manner; in general, not the abstract values are referred to in discussions, but more specific characteristics like norms or design requirements [23]. For comprehensive applications of the value hierarchy to an energy controversy, we refer to Mouter et al. [13] and Dignum et al. [23].

2.1. Conceptual model

The combination of Pesch's overflowing and backflowing model and Van de Poel's value hierarchy serves as our conceptual model, illustrated in Fig. 2. It is depicted in stylized form; it should be noted that generally there is not one distinct overflowing process, followed (or not) by one distinct backflowing process. Rather, the process is dynamic with many small instances of overflowing and backflowing.

Starting from the formal trajectory, we identify three probable causes of overflowing. First, a value that is absent in the formal trajectory is put forward in the informal trajectory (in Fig. 2: Value Y). An example would be that in the formal trajectory a solar farm is translated to the value *Aesthetics* whereas in the informal trajectory it is also translated to the value *Welfare*. Second, the same values are used, but translated to different norms (in Fig. 2: Value X is translated to Norm X.1, X.2 and X.3 in the formal trajectory, whereas it is translated to Norm X.1 and X.4 in the informal trajectory). An example would be that in the formal trajectory the *Aesthetics* value is translated to norms of landscape integration, moderate size of the solar farm and that there should not be too much glare from the solar farm, whereas in the informal trajectory a norm that the color of the solar farm should be similar to its surroundings is also brought up. Third, the same values and norms are used, but

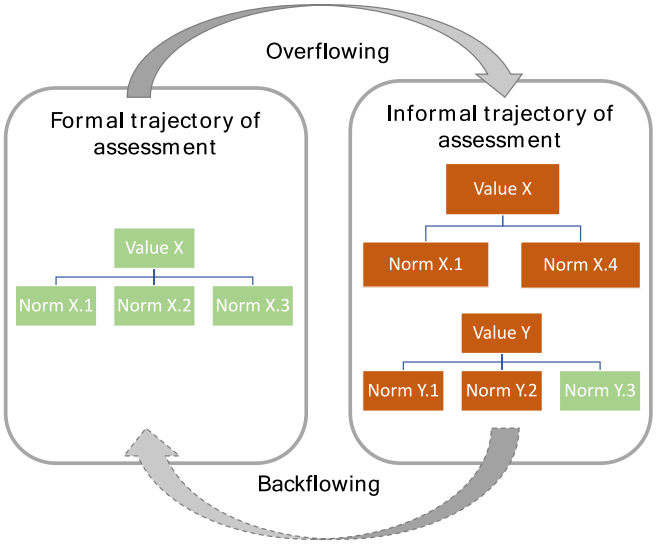

Fig. 2. Conceptual model. A combination of Pesch et al. [8] and Van de Poel [25]. Light green boxes represent norms and values that are used as arguments in favor of an energy project, dark orange boxes arguments that are used against an energy project. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

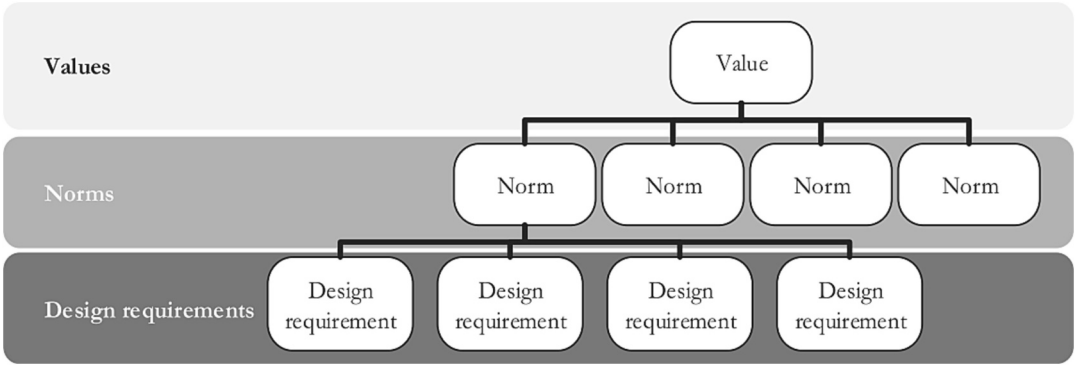

Fig. 1. Value hierarchy based on van de Poel [25].
Source: Mouter et al. [13].

the appraisal is different (in Fig. 2 seen by the difference in color shading of Norm X.1). For example, a size of 10 ha of a solar farm can be considered as sufficiently moderate in the formal trajectory, but too large in the informal trajectory.

Backflowing then entails that a certain value appraisal of the informal trajectory leads to adaptations in the formal trajectory. This can be on a micro-level; an example would be that the project developer changes the height of the trees planted around a specific solar farm. But also on a macro-level, for example if the government includes *Welfare* as a value in their updated evaluation framework that guides decision-making on solar farms.

Note, for visual purposes the design requirements are left out of the figure, but the same logics apply for these.

This model helps us to assess the qualitative difference between the formal and the informal trajectory. We argue that the more difference between the formal and informal trajectory (different values, norms and design requirements used, as well as different appraisal of the same values, norms and design requirements), the more incomplete the informal trajectory apparently perceives the value assessment of the formal trajectory.

Missing values in the formal assessment could potentially increase the probability of a controversy, and as such, we investigate whether minimal formal evaluation frameworks are associated with more controversy. However, it should also be noted that in contrast to Pesch et al. [8] (and also to Mouter et al. [13] and Dignum et al. [23]), we do not focus on controversies per se. Our model can also be used in analyzing non-controversial policies, for example comparing the value use between two separate formal trajectories and/or informal trajectories: not every missing value will lead to a controversy.

3. Case studies and methodology

3.1. Case studies

For the empirical part of this study, we focus on the Netherlands, specifically the regional energy transition of the province Zeeland. Zeeland is an interesting study area, because it combines several characteristics that can make it potentially challenging to install solar farms. It has medium-high population density with 215 inhabitants/km^2. This results in having considerable land space that could be used for utility-scale solar farms, while at the same time having residential areas within the proximity of every option for such a solar farm. Moreover, large parts have historically been used as agricultural lands, and literature suggests that these areas are challenging to transition to energy purposes [21]. We selected two case studies within Zeeland: the municipalities of Tholen and Terneuzen. We selected these as our case-studies because the municipalities had different approaches to the decision-making processes. Tholen was the first municipality to permit a solar farm, in 2015. This solar farm was permitted as a pilot project, based on a minimal formal framework to evaluate solar farms. On the other hand, Terneuzen introduced an elaborate formal framework to evaluate solar farms, established in 2019. To date, six solar farms have been permitted based on the policy framework. Both municipalities now have several solar farms, at least one in open land, in the proximity of local residents, and on agricultural land.

As such, the research design could be seen as a most-different case study design comparing a municipality that started with permitting a solar farm with a municipality that started with an elaborate process on policy development around solar farms before permitting one. Or to put it differently, we compare a minimal formal evaluation framework with an elaborate formal evaluation framework. At the same time, the case studies could be read in isolation; the minimal versus elaborate formal framework is not the only difference between the municipalities and not all observed differences in the outcome can be attributed to this.

3.1.1. Formal decision-making procedures for solar farms in the Netherlands

In the Netherlands, formal decision-making procedures for projects like the solar farms in Tholen and Terneuzen are strictly regulated. We do not aim to provide a complete description of this formal process, but will describe a summary of the different regulations in place below. The decision-making regulation concerns the type of spatial decisions that need to be made, the type and number of permits required as well as the opportunities for public participation throughout this formal process. First, the Dutch Spatial Planning Act determines specific rules for spatial decisions and permits relating to building projects. Environmental Impact Assessments need to be drafted to determine the impact of projects on nature, biodiversity and human beings under the Environmental Management Act.

These are minimum requirements that (local) governments must follow when permitting a new solar farm. Before considering a specific permit request, (local) governments have the opportunity to draft evaluative frameworks, in which rules regarding distance or land use are specified additionally to the formal rules stemming from for instance the Environmental Management Act. When such a framework is in place, those who request permits must meet these requirements for the request to be considered. These evaluative frameworks often reflect values specific to the local circumstances and can, among others, exclude areas from solar farm developments.

Second, the process is regulated by the Dutch General Administrative Law Act, which determines generally applicable rules about decision-making procedures, public participation opportunities and access to justice. For instance, when a municipality issues a draft building permit, the public concerned can submit a view (in Dutch: "*zienswijze*") on this draft decision. "The public concerned" can be defined as the public affected or likely to be affected by, or having an interest in, the environmental decision-making [26]. In the case of solar farms, this means for example a local resident who lives in the proximity of the intended solar farm. Submitting a view is the first step in a possible legal process; once the decision is final, the public concerned who submitted a view can exercise their access to justice and submit formal objections, and if necessary, appeal to a court (firstly to the district administrative court, subsequently to Judicial Division of the Council of State) [26].

3.1.2. Solar farm policy development in Tholen

The municipality of Tholen (26.425 inhabitants) consists of the peninsulas Tholen and Sint Philipsland. In its solar farm policy, we distinguish three phases. Phase I started in 2013 when the executive government presented a vision on sustainability, proposing the possibility of "pilots" for solar farms on agricultural lands. This vision was unanimously established by the city council. As a result of this vision, one solar farm was permitted, with a capacity of 17 MW. Two views submitted by local residents were declared "unfounded" by the executive government. One of the residents appealed, but the administrative court denied the objection, thereby giving the green light to the solar farm. Phase I ended with the establishment of a new policy for potential new solar farms, accepted by a large majority of the city council in 2017, marking the commencement of Phase II. During Phase II, the municipality communicated plans for four new potential solar farms. Several city council meetings were held about permitting the first of these solar farms, meetings that were attended by many local residents. The outcome was that the 2017 policy was withdrawn in 2019; all city council members agreed no more solar farms would be permitted until a new policy was developed. This started Phase III, the development of a new solar farm policy, which is ongoing at the moment of writing.

3.1.3. Solar farm policy development in Terneuzen

The municipality of Terneuzen (54.589 inhabitants) started a public process for solar farms in 2018, when the municipality communicated that they received applications for new solar farms spanning hundreds of acres, from various project developers. In 2019, a policy framework was

established to evaluate these initiatives. Based on this framework, five solar farms were permitted in 2019, and one in 2020. The public, consisting of interested citizens, submitted two views on the draft version of the 2020 permit but these views did not lead to changes in permitting the solar farm. In total six solar farms were thus permitted in Terneuzen, with a combined capacity of 196 MW, of which 180 MW is operational at the moment of writing.

3.2. Values in energy projects

To determine the values that are deemed important in deciding whether and where to install a solar farm, we used the value hierarchy approach of Van de Poel [25]. We took a bottom-up approach for value determination [13]. This is an inductive approach, investigating various sources to obtain a complete overview of the relevant values. In line with Dignum et al. [23]., it should be noted that values are often not discussed in an explicit manner. Rather, arguments in favor or against solar farms were given, mostly addressing norms (and to a lesser extent values and design requirements), and we attributed these to overarching values.

We investigated all newspaper articles, political debates and vies submitted by local residents in the context of solar farms. For newspaper articles, we searched in Nexis Uni using the following terms:

> **ALL FIELDS:** (Zonnepark *OR* Zonneakker *OR* Zonneweide) *AND* (Tholen *OR* Terneuzen) *AND* **SOURCE:** (Provinciale Zeeuwse Courant),

Zonnepark, *Zonneakker* and *Zonneweide* are Dutch words for solar farms (literally translated: solar park, solar field and solar meadow, respectively). The *Provinciale Zeeuwse Courant* is the regional newspaper, which is likely to report most about regional developments rather than national outlets. This search resulted in 45 newspaper articles for Tholen and also 45 newspaper articles for Terneuzen.

Furthermore, we analyzed two types of official documentations of the formal trajectory: recordings and minutes of city council meetings and views submitted by the public concerned. Between 2014 and 2020 eight city council meetings were held in Tholen and seven in Terneuzen, in which solar farms were discussed. We used recordings of these meetings, and automatically transcribed these using Kaldi and Amberscript software. Transcriptions were manually adapted for the parts relevant to this research. Both for Tholen and Terneuzen two views were submitted to the decisions for one solar farm. These views were also included in the empirical research.

Summarizing, the following data were assessed:

- Transcripts of eight city council meetings in Tholen.
- Transcripts of seven city council meetings in Terneuzen.
- 45 newspaper articles about solar farms in Tholen.
- 45 newspaper articles about solar farms in Terneuzen.
- Two views submitted by local residents in Tholen on the concept decision of a solar farm, plus response by municipality.
- Two views submitted by local residents in Terneuzen on the concept decision of a solar farm, plus response by municipality.

Following generally accepted principles of inductive coding [27], we performed inductive coding on all of the above-mentioned texts. As mentioned before, all arguments in favor and against solar farms were coded, overarching themes could be distinguished, serving as the values that are important when assessing a solar farm. Then, all text was again coded, and all arguments were attributed to the values, to enable the possibility for quantitative analysis, e.g. to compare the value use in the formal and informal trajectory.

3.3. Overflowing and backflowing

In addition to the inductive coding described above, we also employed deductive coding to explore overflowing and backflowing processes. This approach involved coding specific sections of all documents into either the formal or informal trajectory based on the characteristics outlined in Table 1. Hereby, we mostly focused on the actors, as this can be determined most objectively. Hereby the role of the person that expresses the argument was assessed: i.e., an argument provided by an alderman speaking in a newspaper about a solar farm (s)he approved, would be categorized as part of the formal trajectory even though this person is simultaneously also a citizen, and even though the argument was not expressed within the city council. By utilizing the value-based approach, we examined the presence of overflowing and backflowing at different stages of the policy process by comparing the occurrences of values in both trajectories. We denoted overflowing when we observed values or norms in the informal trajectory that could not be found in the formal trajectory, or when certain values receive much more attention in the informal trajectory than in the formal trajectory. This could also be one or two levels lower in the value hierarchy, i.e., if both the formal and the informal trajectory refer to the same value but have a different elaboration of the value (see Fig. 2). Hence, overflowing could be observed via statements from the informal trajectory in newspaper articles, in the transcriptions of city council meeting where they spoke, or in the views they submitted to concept decisions on solar farms. Once we identified instances of overflowing, we examined an updated version of the policy framework, if available. In cases where new values, norms or design requirements proposed in the informal trajectory were later integrated into the updated policy framework, we labeled this as backflowing.

Our mix of deductive and inductive coding resulted in a list of 767 statements (or arguments for) assessing solar farms, attributed to either the formal or the informal trajectory. The NVivo file of our research is available, however it should be noted that all texts are in Dutch.

3.4. Degree of controversy

Throughout this paper we will use the term “degree of controversy” to characterize the process resulting in the solar farm. We follow the definition of “controversy” of Mouter et al.: ‘an existing socio-technical energy system is controversial when the case is subject of public and political debate and suffers from significant social opposition’ [13]. I.e., this definition contains three elements: political debate, public debate and social opposition. The assessment of political debate involves evaluating the quantity of arguments both in favor of and against a particular solar farm during city council discussions, as well as considering the number of votes opposing the establishment of the solar farm in the city council. On the other hand, public debate and social opposition are determined by analyzing the number of arguments against the solar farm found in the informal trajectory and the number of views and/or objections submitted expressing opposition to the solar farm.

4. Results and discussion

We start our analysis in a general form, by providing a taxonomy of values based on the entire dataset in Section 4.1. We then proceed to analyze the case studies individually in Sections 4.2.1 and 4.2.2, comparing the two in Section 4.2.3 and critically reflect on our results in Section 4.3.

4.1. Prominent values in assessing solar farms

Table 2 gives an overview of the values that have played a role in the assessment of solar farms in the municipalities of Tholen and Terneuzen in the period 2013–2022. In Tables 4–10 in Appendix A the value hierarchies are included, with per value also sub-values or norms, and

Table 2
Values of importance in assessing solar farms.

Value	Description
Financial distributive justice	Distribution of financial benefits and ills (including spillover effects)
Innovation	Uniqueness of the project or to technological improvement
Legality	Agreement with the law (municipal, provincial, national or European)
Minimized observable impact on surroundings	Minimizing the visual- or sound impact of solar farms
Procedural justice	Information provision and due process participation
Prudent land use	Comparison of solar farms to alternative land use possibilities
Sustainability	The future livability of the area of flora and fauna (including humans)

examples. In total, 767 statements assessing solar farms were attributed to one of the values. Fig. 3 shows the occurrence in the newspaper articles and debates per value, as well as to what extent the values are used as an argument in favor of solar farms versus against solar farms. It is apparent that *Prudent land use* was the most used value for assessing solar farms, followed by *Procedural justice*, *Minimized observable impact on surroundings*, *Legality*, *Sustainability* and *Financial distributive justice*. The value *Innovation* was only scarcely used. Most values were in majority used for arguments against solar farms. Not surprisingly, *Sustainability* is an exception to this, and is used slightly more as an argument in favor of solar farms than against solar farms. *Legality* is almost as often used as argument in favor of solar farms as argument against solar farms. We will proceed by discussing all values in more detail, in the order of their occurrence in our empirical dataset. Note, the order in which we discuss the values is thus specific to our studied cases and does not necessarily reflect the importance of a value to assess a solar farm in general one on one.

4.1.1. *Prudent land use*

The Netherlands combines high population density with high agricultural production; as a result, land in the Netherlands is scarce. Therefore, land use is heavily debated, and thus there have to be good reasons to change the destination of a piece of land from e.g., agricultural to energy park. In the value *Prudent land use*, we draw upon the interpretation of prudence as energy justice value, where the importance of choosing the 'appropriate technology' and taking into account 'the complete array of potential socio-technical consequences' [28, p. 363] – the same thinking can be applied to using scarce land, given notion to the idea that prudent planning does not necessarily imply sustainable development [29]. Arguments against solar farms in this value category for example refer to that fertile land should not be sacrificed for energy purposes or that alternative locations such as roofs are preferred. Arguments in favor of solar farms include that certain land is not very usable for other applications, or a location has a well-placed with respect to (energy) infrastructure.

4.1.2. *Procedural justice*

Procedural justice is well-documented concept within the energy justice field. It entails the notion that processes should be equitable and should engage all stakeholders in a non-discriminatory way [30]. Core elements of this are meaningful participation and information sharing [11,31,32]. From all values, this value had the highest ratio arguments against solar farms versus arguments in favor of solar farms, namely 3:1. Arguments against solar farm mainly focused on the late involvement of local residents, the impossibility for local residents to change the outcome, and the scarce information provision to local residents. The responsibility towards future generations was used as an argument in favor of solar farms.

4.1.3. *Minimized observable impact on surroundings*

This category entails the observable impact on surroundings. It includes the value of *Aesthetics*, as proposed by Mouter et al. [13], but extends it to sound impact of the solar farm and also the (altering) appraisal of the area. Arguments in favor of a solar farm would be that it

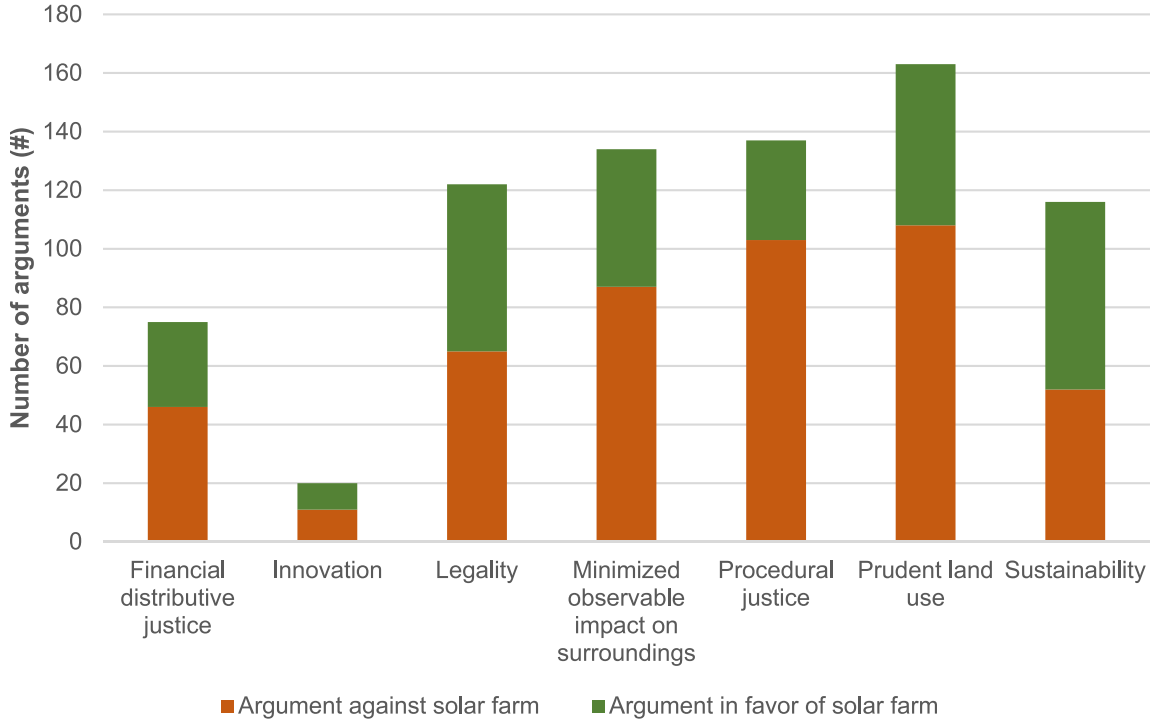

Fig. 3. Number of arguments, categorized per value it could be attributed to. Based on all newspaper articles and city council debates in assessing solar farms in Tholen and Terneuzen in the period 2013–2022.

is well integrated into the landscape, whereas arguments against solar farm argue the opposite. This value is especially context-specific; in the Tholen case the cultural-historic value of the land was often stressed, stating that the solar farms would change the land to semi-industrial area, whereas in Terneuzen (which is already a more industrial area), the further increase of sound nuisance and thus decrease of livability of the area was stressed.

4.1.4. Legality

Related to the value *Legal justice* found by Mouter et al., arguments attributed to *Legality* entail statements on whether the solar farm (policy) is consistent with the existing law. Examples of arguments in favor of solar farms for this value are referring to renewable energy targets that have to be met or earlier agreements with project developers that should be honored. On the other hand, often it is emphasized that targets are already met (for example if the municipality already outperforms the national target) or that a solar farm is not in line with other policies of the municipality or the province.

4.1.5. Sustainability

Sustainability is often stipulated as energy justice value [13,33] Almost all parties, in both trajectories, agreed upon the importance of sustainability. As mentioned before, this was the most-used argument in favor of solar farms. However, it was also used against solar farms, e.g., by arguing solar farms negatively impact biodiversity or generate waste.

4.1.6. Financial distributive justice

Distributive justice is also one of the often-used pillar of energy justice. It entails the distribution of benefits and ills on all members of society in equitable manner [30]. Here we specifically focus on the financial aspects of distributive justice. This mainly focuses on the local residents have economic disadvantage of the solar farm (e.g., a decrease in house value), and whether profits also flow into the local community or stay with a multinational.

4.1.7. Innovation

This value was used only scarcely. When arguing in favor of the solar farm, it was mentioned a solar farm was a unique project, the largest in the country, or that it would contribute to the technological development of the area. At the same time, it was used against solar farms, most notably arguing that the municipality should wait with investing in solar farms as future technologies would be more attractive.

4.2. Occurrences of overflowing and backflowing

4.2.1. Tholen

Our analysis focuses on Phase I and II of solar farm policy development (see Section 3.1.2) as it were these phases where the overflowing and backflowing processed could be observed.

Phase I (2013–2017) starts with the executive government of Tholen proposing a policy note on sustainability: “Dare to act sustainably” [34]. All city council members voted in favor of the policy note. In the policy note, the municipality allows solar farms on agricultural land to some extent: “The municipality wants to study every situation, but in principle holds a positive attitude against a few pilots within the municipality. ‘A few’ meaning for example three pilots translating to several tens of hectares” [33, p. 13]. However, ‘criteria will be elaborated in a later stage’ and ‘Criteria like visibility from public road, taking away glare have to be studied further’. The municipality wants land to be used that is less usable for other purposes or which have obtained a new function. In those situations, ‘we advise to search for useful applications for the space below the panels.’ These are the criteria that were used by the developer in requesting the permit, and thus evaluated by the municipality. The criteria can be categorized as *Minimized observable impact on surroundings* (visibility from public road and glare) and *Prudent land use* (less-usable land and use area below panels). It was decided to not discuss the permit request in the city council, as four years earlier the city council had given mandate to the executive government to make decisions on permitting licenses that depart from the destination plan of the area, if not politically sensitive. The executive government argued the decision was not politically sensitive, an assessment that was not overturned by a sub-committee of the city council. Two local residents submitted views to the draft decision, but these views did not lead to changes. One resident subsequently appealed at the administrative court, which denied the objection.

The arguments forwarded in this phase, attributed to the overarching values, are illustrated in Fig. 4. All described causes of overflowing could be observed in Tholen in this phase (i.e. missing values, different norms within the same value, different appraisal; see Section 2.1). As described in the previous paragraph, many values were missing in the formal evaluation framework. In Fig. 4 all values could also be found in the formal trajectory, however the reason for this is that upon in the discussions with the local residents described above, all values were also treated within the formal trajectory. Still, when looking at the high-level values for this Phase in Fig. 4, one can already observe the overflowing to the informal trajectory: there is large discordance between the formal and the informal trajectory. The opposition of the informal trajectory focused on two different values, namely *Financial distributive justice* and *Legality*. Especially *Financial distributive justice* is remarkable, with 35.7% of the arguments that could be attributed to this value, whereas in the whole data set only 9.8% could be attributed to this value. One of the local residents who submitted a view against the draft decision, a neighboring farmer, stressed the negative spillover effect of the solar farm to his farm, as he expected geese normally foraging at the land eyed for solar farms would now to come to his land. The other local resident who submitted a view would become a central figure in the opposition in Phase II. Both local residents stressed the decrease of house value as argument against the solar farm. Both views were declared “unfounded” by the municipality. The farmer appealed the decision at the administrative court, which also ruled the view unfounded.

Also apparent from Fig. 4, is the difference in appraisal between the formal and informal trajectory. The informal trajectory overwhelmingly appraises the solar farm in a negative sense, whereas in the formal trajectory positive and negative appraisal are balanced. Not visible in Fig. 4, but also observable in the underlying data, are different specification of norms within the same value. For example regarding procedural justice, local residents argued an information evening should have been organized by the municipality. In response, the municipality stated that their decisions are made publicly available and local residents can participate by submitting a view on these decisions.

In 2017, a new formal framework was established [35], marking the start of Phase II. The executive government presented several options for areas to allow solar farms: not permitting solar farms, permitting solar farms when not established on agricultural lands, or permitting solar farms also on agricultural land with the requirement of landscape integration. The executive government opted for this last option, adding a few conditions:

- Only one additional solar farm would be permitted, and it should be in the searching area around the existing solar farm (*Prudent land use*);
- At least 25% of the profits should be used for investments in the context of sustainability and livability (*Financial distributive justice*);
- The solar farm does not lead to “disproportional” impact on the use and development opportunities of neighboring parcels (*Financial distributive justice*);
- A 10-meter-wide green lane should be added to the solar farm, with regional vegetation (*Minimized observable impact on surroundings*);
- Permits should be granted before 1/1/2020 (*Legality*).

Here we can observe backflowing, both from the value categories and from how it is specified. In the first policy framework there was no

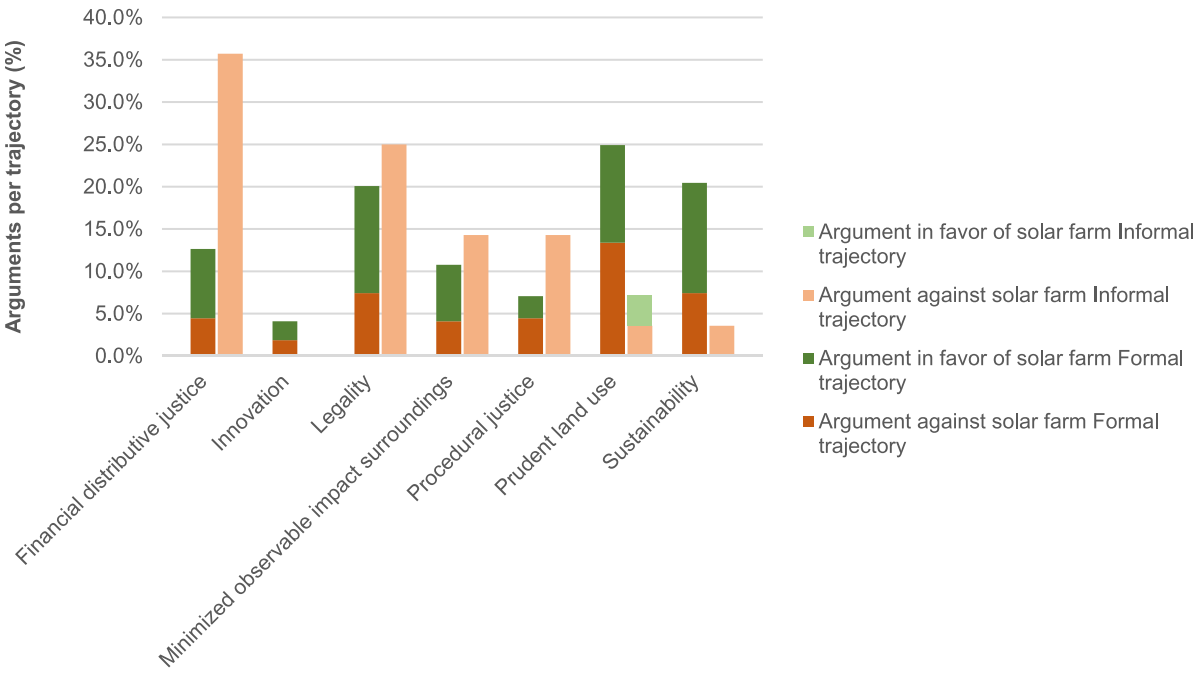

Fig. 4. Occurrence of values in Tholen in Phase I (2013–2017), as proportion of the total occurrences of values in the respective trajectory (269 in the formal trajectory and 28 in the informal trajectory).

condition that could be attributed to *Financial distributive justice*, whereas in the new framework two conditions could be attributed to this value. Moreover, one of these values almost literally took over the objection of the neighboring farmer of the first solar farm. The other mention of *Financial distributive justice* is less direct, but it could be argued that this is a response to the argument of a decreasing house value of both opposers; investments in livability could negate that effect.

When the framework was discussed, there were a few citizens who spoke in during the city council meeting. These were mainly directed against the wind farms that were also discussed, and also a large energy cooperation spoke in, which argued more solar and wind projects should be undertaken. The city council decided to alter the policy framework of the executive government: they changed "one, in the surroundings of the first solar farm" to "*at least* one, in the surroundings of the first solar farm. For demonstratable uneconomical (agricultural) land, the searching area is expanded to the whole area of Tholen". Fifteen out of twenty-one city council members voted in favor of this alteration.

In the subsequent informal trajectory, the local residents who opposed the first solar farm had organized themselves. The city council decision had decided *at least* one solar farm should be added in the area around the solar farm, but no limit was set on the number of solar farms. Therefore, the local residents feared a proliferation of solar farms, turning their surroundings from a rural area to a "semi-industrial" area. Note, while there is some notion about *Minimized observable impact on surroundings* in the evaluation framework, it is only translated to one specific design requirement (the 10-meter-wide green lane); here the overflowing is thus on a lower level of the value hierarchy: the informal trajectory has a broader interpretation of the value, and also takes the overall appearance into account, also in the context of the cultural history of the area. When the executive government started the process of permitting solar farms, the informal trajectory quickly came to action. They used their right to speak at city council meetings when a specific solar farm was on the agenda. The main characters of the organized public (including one of the local residents who protested in Phase I) mobilized the other local residents, resulting in tens of people on the public stance at the first city council meeting, and over a hundred at a second one – more than the public stance could accommodate. They also invited all city council members to their living area, to show how beautiful the area still was. Each city council member was coupled to a local resident; within the action group they tried to couple city council members to local residents where there was some kind of connection between the local resident and the political party, e.g., when the local resident was already member of a party.

Fig. 5 illustrates the values used in the formal and informal trajectory in Phase II. It shows that a wealth of arguments was used within the informal trajectory against the solar farms, spread over various values. Interestingly, *Financial distributive justice* played, relatively, a much smaller role than in Phase I – possibly because in this phase it was included in the evaluative framework. Fig. 5 also suggests that there is much more congruence between the formal and informal trajectory in this phase, especially visible when comparing to Fig. 4. Hence, the interaction between the formal and the informal trajectory seems to initiate backflowing from the informal trajectory to the formal trajectory. In the end, the informal trajectory succeeded in convincing the city council of their position. The requested permit was unanimously opposed by the city council, and also there was put a stop on developing solar farms until a new vision was developed. The new vision should emerge from an elaborate process, in which a city council member of every political party was involved, and local residents were invited to discuss ideas on the vision. The first part of the vision was established in 2022, the second part in which more specific policies on solar farms should be elaborated is still in development.

4.2.2. *Terneuzen*

In Terneuzen, the first formal evaluative framework was established in 2019 [36], and an updated version was established in 2020 [37]. All of our identified values are included in the framework, although most emphasis is placed on *Prudent land use* and *Minimized observable impact on surroundings*.

The informal trajectory in Terneuzen was modest in size. In our dataset, we have found 168 arguments in favor or against solar farms in the formal trajectory, compared to 26 in the informal trajectory. Five of the six permitted solar farms did not lead to significant overflowing, with in total only one submitted view which was retracted within the process. The city council voted in large majority in favor of these solar farms. The informal trajectory centered around a fifth solar farm,

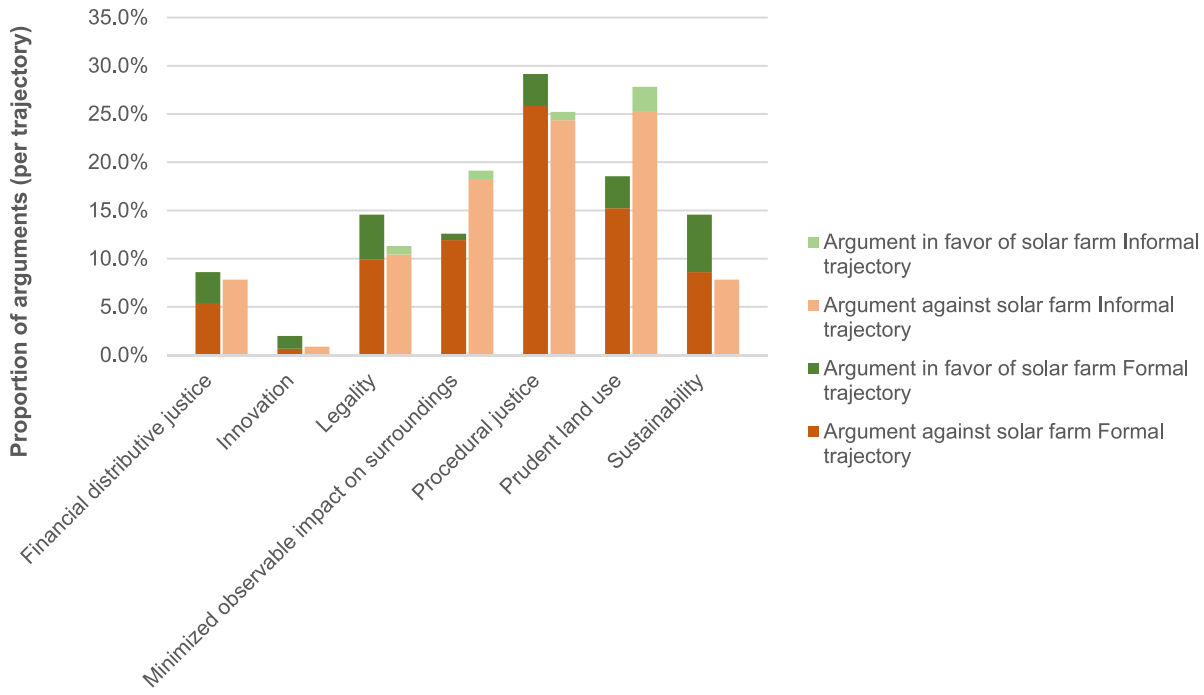

Fig. 5. Occurrence of values in Tholen in Phase II (2018–2022), as proportion of the total occurrences of values in the respective trajectory (151 in the formal trajectory and 28 in the informal trajectory).

foreseen on agricultural land just outside the village Sas van Gent within the municipality of Terneuzen. The focus within the informal trajectory was largely on *Minimized observable impact on surroundings* (see Fig. 6).

Some overflowing could be observed. The views submitted by the local residents revolved around three points, namely visibility, noise disturbance, and livability. The formal evaluative framework consisted of very detailed requirements for the landscape integration of the solar farm, i.e., just like the informal trajectory also adhering to *Minimized observable impact on surroundings*. However, the informal trajectory preferred to go one step further: complete invisibility of the solar farm. When confronted with this view, the municipality decided not to do adhere to it, as one border of the solar park was an important cultural-historic landscape element, namely the States-Spanish Lines.[1] High trees around the solar farm against these Lines would also result in a changed appearance of the States-Spanish Lines. In this case there was thus a different appraisal of the same value/norm (see Fig. 2). The second theme in the submitted views, noise disturbance, was not included in the evaluative framework. The local residents had read in the permit request that the transformer could produce as much as 101 dB of noise. It turned out this was a theoretical maximum, whereas in reality the long-term average would be 36 dB during the day. The installer did commit to additional measures against noise disturbance. This could be seen as a constructive form of backflowing: adapting the design of the solar farm to adhere to some of the citizen's concerns. Third, the livability of the area was claimed to be under pressure. Here it could play a role that a lot of industry was already placed around Sas van Gent, and also the canal along the village was busy with freight shipping. No specific argument was made regarding livability, merely the other two arguments culminated in an even further pressure on the livability. There was much discussion in the city council about this solar farm, with even the council members of coalition party VVD (liberal-conservative) divided between voting in favor and against the solar farm. City council members were mostly critical on the fact the solar farm was placed on agricultural land and that it was so close to the village of Sas van Gent. In the end, the city council agreed with the permission of the solar farm (21 votes in favor, 7 opposed).

4.2.3. Synthesis

In Table 3 we present a summary of the investigated solar farms including some indicators of the degree of controversy (see Section 3.4). The quantified indicators for controversy, such as votes against a solar farm in the city council, number of views submitted against a solar farm, consistently point to three solar farms being particularly controversial: both solar farms in Tholen, and Sas van Gent II in Terneuzen. Furthermore, we have observed substantial overflowing in these three solar farms (see Sections 4.2.1 and 4.2.2). Lastly, the majority of political debate centered around these three solar farms; with most arguments in the city council being related to solar farm in general, specifically to one of these three solar farms.

When comparing the assessments of solar farms in Tholen and Terneuzen, some similarities become evident. Firstly, both municipalities made the decision to permit solar farms on land that was initially designated for agricultural purposes. Additionally, both municipalities allowed the establishment of solar farms in close proximity to residential areas. Lastly, in both municipalities, there was at least one solar farm where a significant degree of overflowing was observed.

Nevertheless, there are a few notable differences as well. One such difference is the relative size of the informal trajectories, – which directly relates to the extent of overflowing. In the case of Tholen, the informal trajectory accounted for 25.4% of all arguments, with Phase II being particularly noteworthy, comprising an impressive 43.2% of total arguments that could be attributed to the informal trajectory. In Terneuzen, the informal trajectory had a much smaller contribution, accounting for only 13.4% of the total values. Additionally, it is evident that the discussion within the formal trajectory in Terneuzen was relatively balanced, with arguments for and against solar farms. On the other hand, in Tholen, while in Phase I, arguments were predominantly in favor of solar farms and in Phase II, a significant majority were against their establishment. Furthermore, it was evident that the value use in

[1] The States-Spanish Lines (in Dutch: "Staats-Spaanse Linies") are military defense lines, a reminiscence of the Eighty Years' War between the Netherlands and Spain (1568–1648)

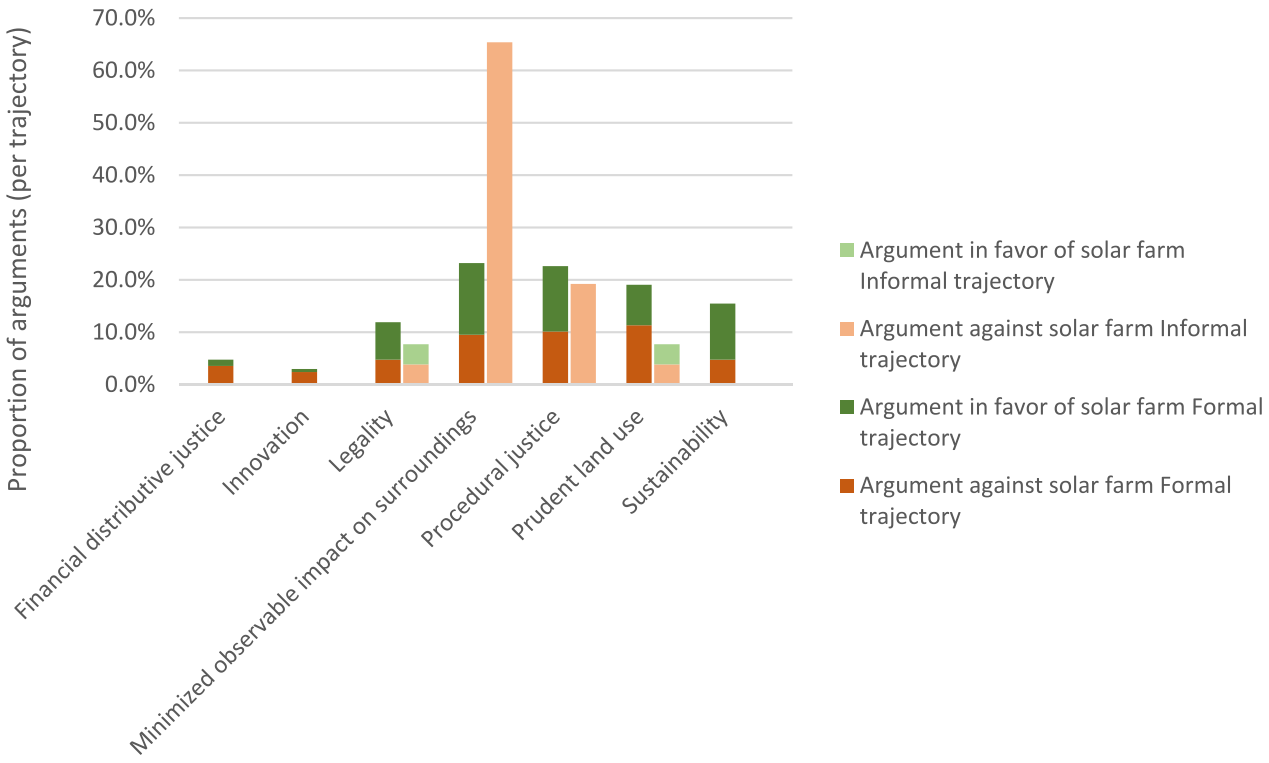

Fig. 6. Occurrence of values in Terneuzen in 2013–2022, as proportion of the total occurrences of values in the respective trajectory (168 in the formal trajectory and 26 in the informal trajectory).

Table 3
Indicators for degree of controversy of studied solar farms.

Solar farm	Municipality	# views submitted (# to court)	Votes in city council	Overflowing and/or backflowing observed?
Ceresweg I (17 MW)	Tholen	2 (1)	No vote	Yes
Ceresweg II	Tholen	N.A.	Unanimously opposed	Yes
Sas van Gent I (30 MW)	Terneuzen	0	26 in favor, 1 opposed	No
Sas van Gent II (19 MW)	Terneuzen	2 (0)	21 in favor, 7 opposed	Yes
Koegorspolder (31 MW)	Terneuzen	0	26 in favor, 1 opposed	No
Tractaatweg (40 MW)	Terneuzen	0	26 in favor, 1 opposed	No
Bontepolder (18 MW)	Terneuzen	1, retracted	Unanimously in favor	No
Mosselbanken (60 MW)	Terneuzen	0	Unanimously in favor	No

Tholen in Phase I in the formal and informal trajectory was in most discordance. This discordance is also evident in the city council's decision-making process, where they voted to expand the number of solar farms in 2017 but later unanimously decided to completely stop solar farms in 2019. Only in Tholen the backflowing led to a stop on solar farms, underscoring the considerable impact of the informal trajectory in Tholen. As a result, in relative numbers, absolute numbers, and in effectiveness, the informal trajectory in Tholen was far more prominent than in Terneuzen. At the same time, Terneuzen permitted many more solar farms (six solar farms compared to one, 196 MW capacity compared to 17 MW capacity). It could be argued that the extent of overflowing observed reflects on the evaluation framework in the formal trajectory: the more values (or norms) are missing or underrepresented in the evaluation framework, the more overflowing can be expected.

When looking for explanations of the aforementioned differences within the administrative processes towards permitting solar farms in both municipalities, two main differences can be identified. First, Tholen only had minimal formal evaluative frameworks, whereas Terneuzen had quite elaborative formal evaluative frameworks. This is already apparent from the length of the frameworks: Terneuzen had frameworks of 21 pages in 2019 and an updated version with 15 pages in 2020, whereas the two frameworks established in Tholen both were shorter than one page. As such, Terneuzens framework covered more values and more detailing of values (into norms, design requirements), whereas in Tholen's evaluation frameworks the values identified in this research were underrepresented. In Tholen, the most fundamental form of overflowing described in Section 2.1 occurred, namely values that were deemed important by the general public that were missing from the evaluation framework entirely (i.e., for example *Financial distributive justice*, *Legality* and *Procedural justice* were missing from Tholen's initial evaluation framework). In Terneuzen, overflowing occurred at lower levels of the value hierarchy (e.g., the debate centered around *how* the impact on surroundings should be minimized, not around the value itself). A similar pattern could be observed in the backflowing. In Tholen the more typical and fundamental backflowing was observed, similar as described in Pesch et al. [8] (i.e. actually leading to a complete stop on solar farms in the end). In Terneuzen on the other hand, a constructive form of backflowing could be observed (i.e. the additional sound measures on the solar farm), showing that backflowing not necessarily has to finalize in a stop on an energy project.

A second difference is that in Terneuzen much more opportunity was created for interaction between the formal and informal trajectory. For each solar farm, two information sessions were held, providing local residents the possibility to give feedback to the project developer (first session) and the developer presented how they processed this feedback (second session). Also the city council, eminently a place where the formal and informal trajectory can meet and interact, played a much

more prominent role in Terneuzen. The solar farm policy was discussed multiple times. Also, all permits were discussed in the city council; first, the city council discusses to give a preliminary positive decision. Then, local residents can submit views on the decision. Subsequently, there are renewed discussions in the city council for a final decision, also taking these views into account, before a final positive decision is made. In all city council meetings, local resident have the right to speak, creating additional feedback loops between formal and informal trajectory. The process also resulted in additional changes to the solar farm made by the project developer. This stands in stark contrast with the situation in Tholen. In Tholen, local residents were told in a few sentences by the landowner that he planned to lend his land for a solar farm; according to one of the local residents the other local residents had the idea that it would not proceed. Furthermore, local residents said they learned through the newspaper about the plans of the municipality to permit the solar farm. Also, the first solar farm was not discussed in the city council, and thus there was less opportunity for the informal trajectory to influence the formal trajectory. This could explain why the city council appeared unaware of the opposition, switching from a near unanimous decision of permitting many more solar farms in the municipality, to a unanimous decision to cease permitting any solar farms, within a mere two-year time frame.

4.3. Limitations

Our research is subject to some limitations. As is to some extent inevitable in an inductive approach, our analysis contains some hermeneutic elements, especially in determining the value taxonomy. As stressed before, we attempted to align closely with existing literature on energy values – however, given the context-specificness, new values had to be proposed. Other researchers may identify different values or would place certain arguments in different categories. We addressed this by being as transparent as possible, in our data availability but also in providing the tables detailing the values in Appendix A.

In Section 4.2.3 we made a comparison between Tholen and Terneuzen and provided some explanations for the differences in extent of overflowing we found. However, as mentioned before, the two municipalities cannot be compared one-on-one. First, Tholen was much earlier than Terneuzen in permitting a solar farm; even on a national level Tholen was very early. Therefore, Tholen had much less opportunity to learn from solar farms that had been installed elsewhere. Furthermore, one permitted solar farm in Terneuzen is not yet operational and two others became operational very recently. It is possible that controversy arises or increases after installation, when the impact becomes more visible to a larger public. On the other hand, it is also known that controversies can "spillover" [38], which potentially could have increased controversy in Terneuzen. Furthermore, evidence exists local residents generally perceive an energy project more positive post-installation than pre-installation [39]. A second important difference is that Tholen's landscape can be characterized more as a rural landscape, whereas in Terneuzen the landscape is more a mixture of rural and industrial landscape. It could be argued that any solar farm in Tholen has more impact than in Terneuzen.

Thus, while we stand by our conclusions, it is evident that this type of research is context-specific. A controlled experiment is evidently not possible. We therefore encourage other researchers to conduct similar research, in different contexts and regions, to gain a more complete understanding of the role of values in solar farms.

5. Conclusions

In this paper, we have examined the role of values in assessing solar farms. We have identified seven values that play an important role in the assessment of solar farms. In order of occurrence within our empirical data, these are *Prudent land use*, *Procedural justice*, *Minimized observable impact on surroundings*, *Legality*, *Sustainability*, *Financial distributive justice* and *Innovation*. Among these, *Legality* and *Sustainability* were most frequent values associated with arguments in favor of solar farms, particularly in the formal trajectory. On the other hand, *Procedural justice*, *Prudent land use* and *Minimized impact on surroundings* were the values most frequently associated with arguments against solar farms, in both trajectories.

We evaluated the process towards permitting a total of eight solar farms in two municipalities in Zeeland, a province in the Netherlands. Hereby we aimed to elaborate on the notion of the existence of two parallel trajectories of assessments of energy projects: formal (residing in the legal system) and informal (embedded in the public discourse). The informal trajectory arises from a perceived lack in value use in the formal trajectory when assessing energy projects – in our case solar farms. Subsequently, backflowing can occur if the values (or norms, or design requirements) promoted in the informal trajectory find their way to the formal trajectory by altering policy frameworks or putting energy projects or technologies to a stop.

We compared two municipalities, namely Tholen and Terneuzen. Tholen started the process with a minimal formal evaluation framework and a pilot solar farm, whereas Terneuzen began with developing an elaborate evaluation framework before permitting solar farms. Especially in Tholen, much overflowing and backflowing could be observed. After the decision was made to add more solar farms to the existing one, the informal trajectory gained momentum. This culminated in mobilizing a larger number of residents to attend the city council meeting than the public stance could accommodate, ultimately leading to the successful halt of the permission of a solar farm and a general stop on solar farms within Tholen. In Terneuzen on the other hand, many more solar farms were permitted and installed, but with much less social resistance. Overflowing and backflowing in Terneuzen could be considered more constructive, as it took place more on the specifics (i.e. the design requirements). Hence, if a project can be prevented to become very controversial, overflowing and backflowing can take a constructive form, avoiding a halt of the energy project or technology. This indicates that the policy process significantly influences the eminence of the informal trajectory and the degree of controversy of an energy project.

In general, if the evaluative framework is minimal, the opposition can become so widespread that the solution to halt solar farms altogether seems more evident than to consider all objections and make all these changes to the solar farm. In that case, the political desire to quickly increase renewable system installations can result in a backlash of having fewer renewables installed in the long term, hampering the energy transition as a whole. Based on our empirical study, for policymakers we therefore recommend a combination of establishing an elaborate and comprehensive formal evaluative framework and organizing many interaction opportunities between the formal and informal trajectory. An elaborate formal evaluative framework may cover a larger proportion of the values important to the general public, which could mitigate the controversy to some extent. The informal trajectory should ideally already be involved at the stage in which the evaluation framework is developed. An evaluation framework that is developed without involvement of the informal trajectory, combined with a developer that adheres to all formal requirements, can result in a solar farm that when installed is disapproved by consensus. Note there are various manners to implement this. Within the regular democratic process in the Netherlands, the public has the right to speak at council meetings when an evaluation framework is discussed. In this regard, it is recommended to allow for iterations of the evaluation framework at this stage. Alternatively, a dedicated participatory process could be designed, for example inviting a representative group of citizens by lottery to deliberate an energy strategy for the municipality [40]. Then throughout the process, in the interaction process between the formal and informal trajectory, the remaining objections from the informal trajectory can be considered. As this process takes place long before the construction of a solar farm, there is ample of opportunity to make changes to the design of the solar farm, or in some cases to reconsider whether to permit the

solar farm altogether. We believe that structuring the process in such a way may lead to decisions both better in quality and with higher societal support.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A

A.1. Value hierarchy

Table 4
Value specification: Prudent land use.

Norm/criterion	Examples
Less-usable land	- Exclude fertile land (versus solar farms and food are unrelated, hunger is a distribution problem) - Former landfill is preferred
Multiple land use	- Sheep between panels - Measures to increase biodiversity - Combination with agriculture - Combination with wind farms
Impact on land quality	- Long-term impact on ground quality (e.g., asbestos)
Alternative locations	- Solar panels preferred on roofs, parking lots ("Zonneladder", order of preferred options) - Rooftops are not adequate/sufficient - Location X is better (e.g., on water treatment plants)
Alternative renewable source	- Wind energy can be combined better with agriculture - Energy efficiency (decreasing demand) is preferred - Tidal energy - Nuclear energy
Proximity to relevant infrastructure	- Close to high-voltage network - Congestion: project comes at expense of other initiatives - Same cables as wind farms - Local use
Maximizing insolation	- Field is oriented south
Space availability	- Initiator willing to provide space of size 35 football fields - If not on location X, where then? - Far away from village
No industry	- Rather solar farm than industry
Protected areas	- Natura 2000

Table 5
Value specification: Procedural justice.

Norm/criterion	Examples
Timely and adequate information	- Local residents discover plans via newspaper - Local residents informed too late - No information from municipality to local residents - Questions unanswered
Consultation	- Decisions were set in stone before local residents were consulted - Information evenings
Collaboration/involvement	- Local citizens were not involved in whole process - Local citizens should be involved in determining searching areas - A *Klankbordgroep* (sound board, meaning a group that was used to evaluate initial ideas) was installed - The involved citizens are no representative sample
Participation process entrepreneur	- Just seven out of 30 local residents were informed by the initiator - Information letter in mailbox - Questions to Vattenfal from *Klankbordgroep* unanswered
Opinion of future generations	- "How will you explain this to our children and grandchildren?"
Referring to opinion local residents	- Unrest among the population - No support local residents - Negative impact on local residents - From seven informed local residents, three officially protested - Absence of protest of local residents

(*continued on next page*)

Table 5 (*continued*)

Norm/criterion	Examples
	- Not everyone can be satisfied - Most residents at information evening positive - Most parties *klankbordgroep* positive
Uncertainty impact	- The impact is very large and exact consequences impossible to determine - Previous energy transitions (coal to gas) turned out to have negative consequences
Liveability	- Decrease enjoyability living - "Liveability at stake"

Table 6
Value specification: Minimized observable impact on surroundings.

Norm/criterion	Examples
Landscape integration	- Trees of x meter high have to be planted around the solar farm - The landscape integration of the pilot is far insufficient, which hampers public support
Cluttering landscape	- Preferring large solar farm over multiple small ones - Concern area will be filled with solar farms - Searching area too large - Semi-industrial appearance landscape - Perceived sense of space
Cultural-historic importance land	- Tholen is historically an area of arable farming - Panoramic view connects to DNA of Tholen - We want to be proud on the open polder landscape - Tholen is known for quietness and spaciousness ("Rust & Ruimte")
Visibility	- Invisible solar farm is preferred - Visibility from public road - Not a nice view, experienced by everyone cycling and driving there
Size solar farm	- Preference large solar farm over distributed small solar farms - Preference small-scale initiatives over large-scale solar farms
Semi-industrial landscape	- The landscape will get a semi-industrial appearance
Glare	- Glare solar panels could impact safety automobiles
Nuisance/noise disturbance	- Additional noise from solar farm - Solar farm re-echoing other surrounding noise
Preferred over alternatives	- Rather solar farms than windmills

Table 7
Value specification: Financial distributive justice.

Norm/criterion	Examples
Negative spillover effects	- Decrease house value - Negative impact on neighboring businesses
Profit solar farm	- New source of income for farmers - Profit for installer
Attractiveness to tourists	- If a restaurant is in a nice area, it will attract more people
Land price	- Allowing solar farms will further increase land price
Attractiveness area	- Sustainability leads to attractiveness of living and working and thereby economic development
Companies more sustainable	- Shell wants to show it takes the transition to non-fossil, sustainable sources seriously - Yara - Cargill - Delta
Subsidy solar farm	- Against subsidies for sustainable energy
Financial participation	- Fund for local investment - Local initiative preferred - Profit goes to external investors - Local residents as owner

Table 8
Value specification: Legal justice.

Norm/criterion	Examples
Evaluation of alternatives	- The executive government didn't consider other locations - Careful analysis should be executed to determine searching areas
Congruence with higher level governance	- Not in congruence with provincial regulations - Fits in provincial and nation-wide policy - (Counterarguments: the municipality decides)
Congruence with own policies	- Planted trees around solar farms less wide than required - Structuurvisie: Cargill can expand, but now Vattenfall installs a solar farm there (for energy to Cargill).

(*continued on next page*)

Table 8 (*continued*)

Norm/criterion	Examples
Political pluralism	- Executive government made decisions on their own (no consultation city council) - Much support in city council for location Tuttelhoekje (over 'current efforts') - Support for policy because council will have final say
Development vision/evaluation framework	- A vision has to be developed before granting permission on solar farms - A pilot has to be executed as input for the vision - The evaluation framework should not have a searching area, should specific, etc.
Deadline (national) subsidy	- To meet the deadline for the subsidy for energy production and climate transition (SDE), there is some urgency in permitting the solar farm
Congruence with Sustainability goals	- Solar farm contributes to sustainability goals of the company installing - Solar farm contributes to sustainability goals of the company buying the electricity - Solar farm contributes to sustainability goals of the municipality/within the province - Sustainability goals of municipality are already met/municipality already performs better than average - More should be done to achieve sustainability goals
Project leader	- Deployment project leader for execution
Research has been done	- Independent research says […] - Doubt is cast on this research
Pilot	- Wait for results pilot
Reliable governance	- Meeting expectations/promises of/to entrepreneur - Rules of law
Politically sensitive	- The solar farm is incorrectly designated as "not politically sensitive"
Transparency	- Are promises made by the executive governments to entrepreneurs? - Is the policy construed to fit in the current initiatives?
Direction municipality	- Municipality must be more involved/in charge of the process - Municipality not present at meeting klankbordgroep
Municipality capacity	- Too many pilots for civil workers to process
Consultation civil society actors	- E.g. LTO, vereniging cultuurlandschap Nederland,
No response to critical letter	- Letter 'Leefbaar Sas' unanswered

Table 9
Value specification: Sustainability.

Norm/criterion	Examples
Waste	- The panels result in waste at end-of-life
Biodiversity	- Solar farms negatively impact habitat birds and gooses - Negative impact on insect population - Seeds will be planted which will increase biodiversity
Duty of care	- No harm to nature is done - Taking responsibility for enormous task
Impact solar farm is relatively small	- Impact of municipal efforts are minimal on global scale - Just a small part of Cargill's energy consumption - Other sources are much more pollutant (e.g., ships, flying)
Future generations	- Last opportunity to mitigate climate change - Children now rather have breakfast than solar panels
Climate scepticism	- Information on global warming is too one-sided

Table 10
Value specification: Innovation.

Norm/criterion	Examples
Largest solar farm in the Netherlands	- "Unique project"
Reception	- Many reactions of newspapers on solar farm
Technological development	- Technology develops fast, we can wait for better solar panels - New types of highly productive windmills - New types of nuclear energy - Tidal energy - 25 year is a long period - Technology isn't developing *that* fast
Innovative solutions	- Innovative solutions like solar farm welcome for task

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