# The role of project-related conditions on spatial integration of energy transition synergies

A qualitative comparative case study of Dutch spatial development projects

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# Summary

The transition towards a sustainable energy system is a complex challenge for countries around the world. This is especially the case for densely populated countries, such as the Netherlands. To make efficient use of scarce space and to gain societal support, the integration of large-scale energy transition solutions into other spatial development projects has been identified to be a viable solution in the Dutch context. These integrative projects where two (or more) spatial objectives are combined in a single project to increase the overall net value are referred to as synergies. Due to the increased complexity associated with implementing ET-synergies, certain project conditions can facilitate and halt the effectiveness of the integration process. Against this background, this research aims to identify the role of relevant project conditions on the spatial integration of ET-synergies.

To determine what conditions potentially influence the effective implementation of ET-synergies, the Institutional Analysis and Development (IAD) framework is used as a theoretical basis. Inspired by the IAD framework, a distinction is made between the internal social structure based on the actor-interactions and the external context based on the existing environment. The IAD-definitions were used to conceptualize the integral project context using nine relevant project conditions. The internal context is formed by seven rules: participation (1-boundary); role distribution (2-position); scope of possible synergies (3-scope); allowed actions (4-choice); communication with legislative supervision (5-aggregation); information sharing methods (6-information); and cost distribution timing (7-payoff). The external context is formed by two relevant external variables: the local participants (8-attributes of community) and the project location (9-biophysical conditions). These nine IAD-conditions were enriched and operationalised with insights from energy transition and climate adaptation integration literature, to select empirical indicators and a hypothetical supportive state for all conditions.

To examine which conditions are relevant, a systemic comparison was performed of 19 spatial development projects where synergies with the energy transition were explored. Data were collected on the basis of expert interviews and document analysis. Qualitative data about potentially relevant conditions and the outcome were transformed into fuzzy values (0, 0.3, 0.7 or 1). The relevant conditions were scored compared to the hypotheses, with a case condition identical to the hypothesis obtaining a 1 score. The implementation of the ET-synergies, referred to as the outcome, were scored based on the delays caused and on their achieved contribution to the energy transition.

The systemic comparison of the studied cases shows that effective implementation of ET-synergies is linked to two sufficient pathways: 1) presence of supportive payoff and biophysical conditions; and 2) presence of supportive aggregation; information; payoff and community conditions. Sufficiency implies that when all conditions of the pathway are in a supportive state, the ET-synergy will be implemented effectively. All 10 cases where the conditions of any of the two sufficient configurations were all present in a supportive state have resulted in an effective ET-synergy implementation.

Investigation of cases with low scores on the outcome show that failed implementation of synergies is associated with the following two pathways: 1) the absence of a supportive payoff condition; and 2) the absence of supportive position, scope, and biophysical conditions. Necessity implies that the (combination of) conditions needs to be supportive before effective ET-synergy implementation can occur. All eight cases where any of the two necessary configurations were absence resulted in a failed implementation of synergies.

The results particularly show that timely cost-distribution (supportive payoff) plays a crucial role in achieving successful synergies. When the costs related to the synergy are distributed too late into a project, the synergy is not transformed into a concrete objective and tends to remain an ambition. This delay is likely to result in an ineffective integration process. Hence, when project leaders involved in water-related spatial development projects are aiming to effectively implement an ET-synergy, it is recommended to focus on engaging adequate investors early in the project.

# Contents

# 1. Introduction

## 1.1 Background

The energy transition (ET) is one of the key challenges of 21st century with countries around the globe transitioning their fossil fuel-based energy system towards a sustainable one. The sustainable solutions often come at a much greater spatial cost compared to the existing fossil fuel systems and this generates significant societal opposition (Behrens and van Zalk, 2018). Integrating the ET-development with other spatial developments can increase the societal support and corresponding feasibility. By combining two or more projects to strive towards multi-purpose spatial occupation and development the energy transition can be implemented quicker and with less associated costs (van Ark and Hidding, 2002). Especially in recent years with the introduction of the legal obligations related to the Paris Agreement, public authorities are looking for ways, like integration, to increase the speed and efficiency of the energy transition (Pérez, Scholten and Stegen, 2019).

An opportunity to integrate two or more objectives in a similar project, to create a net benefit compared to individual projects, is referred to as a synergy (*in Dutch: meekoppelkansen*). An illustration of an ET-synergy is how a renovation of a canal wall can simultaneously be used to implement a heat exchanger (aquathermy). Like aquathermy, most water-related spatial development projects are well-suited to utilize ET-synergies as they frequently span a large area and involve a high number of both stakeholders and funds (van den Hurk, 2014). These characteristics enable a wide spectrum of synergies (van Buuren, Buijs and Teisman, 2010), which makes them well-suited contexts to analyze the integration of ET-solutions.

Integrating ET-solutions in a spatial development project is bound to increase in the overall complexity of the overarching project (Demirkesen & Ozorhon, 2017). This added complexity combined with the required willingness amongst the participants to integrate multiple objectives requires specific conditions to be present in a project environment before actions towards sustainable development can be undertaken (Kapsali, 2011). As certain project aspects can facilitate or halt the synergy integration process. Specific (combinations of) conditions can potentially be identified to be necessary or sufficient for effective integration, meaning that certain conditions need to be present in a certain state before the ET-synergy can be utilized (Cooper & Glaesser, 2015).

These required projects conditions for ET-integration are to some extent analyzed in other literature. Energy transition scholars stress the importance of a close cooperation between private and public organizations. Highlighting the impact of clear communication between the parties involved for effective sectoral ET implementation (Kemp, Rotmans & Loorbach, 2010, p. 315-331). For the implementation of integral solutions, the literature is centered around integrating climate adaptation (mainstreaming), with only limited focus on the ET. Climate adaptation literature show that both the presence of policy entrepreneurs and clear objective-linking are as impactful facilitators for integration (Runhaar, 2018; Uittenbroek, 2014).

To understand these conditions and complex interactions, the integral project context can be defined by the institutional factors at play. Institutional factors refer to the resilient aspects of the social structure that establish the actor-interactions and project processes. Especially in the large spatial development projects, institutions play a significant role in shaping the decisions and objectives. In the work of Lammers (Lammers, 2017; Lammers, 2018) institutional factors are used to assess the energy sector by analyzing both the internal project processes and the external context. The combination of literature on institutions, mainstreaming and the energy transition can create new insight in the achievements of ET-synergies.

## 1.2 Problem statement

Exploratory interviews with experts working at consultancy company Royal HaskoningDHV show that while ET-synergies are often (partially) identified in a spatial development project, they are seldomly fully implemented. The literature addressing integration in spatial developments emphasizes the added complexity, both systemically and organizationally, as a result of the increase in objectives and costs (Klostermann, Snep and Krijgsman (2020). Grey literature emphasises that only in recent years, 2016-2020, there was significant growth in the frequency of ET-synergy implementation in the Netherlands (Ruimtelijke verkenning energie en klimaat, 2018). This recent growth of ET-integration caused that there are still many stakeholders that perceive ET-integration as too complex, an unnecessary complication of an already complex transition.

Two knowledge problems could be identified that were related to this recent development based on the statements from Morales et al (2014) on energy integration difficulties: 1) there is an absence of practical ET-integration guidelines (as was also mentioned in the exploratory interviews); and 2) many parties have only limited experience with integrating ET-solutions. The complexity, absence of guidelines and the lack of experience leads to a situation where projects are not actively optimized for facilitating the ET-synergies. These relatively unsuited project conditions lead to suboptimal achievement of ET synergies, both in terms of frequency and effectiveness (Handboek koppelen NKWK, 2020). The problems identified from the practical knowledge and the literature can be shown in a problem tree detailing the core knowledge problem and the related issues (Figure 1).

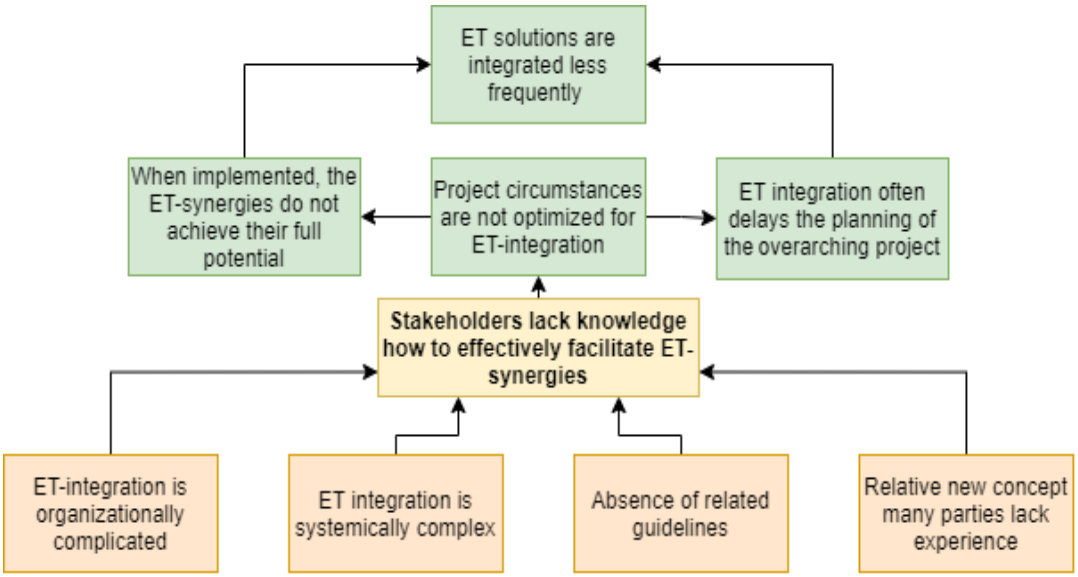


*Figure 1 Problem tree Dutch ET synergies adapted from Klostermann, Snep and Krijgsman (2020); Handboek koppelen NKWK, 2020); Ruimtelijke verkenning energie en klimaat, 2018; Morales et al, 2014.*

Considering this, the problem statement that is addressed in this thesis reads as follows: there is a lack of understanding of what project conditions contribute whether ET-synergies are achieved or not. This knowledge problem in turn implies that ET-synergies are frequently achieved in an ineffective manner or not at all, as projects are not adapted to facilitate the ET-integration. Analysing what role the different project conditions play in the ET-integration process can support the project teams and improve the existing knowledge gap regarding the facilitation of effective ET-synergy implementation.

## 1.3 Research questions & aim

The objective of this study is to analyse the role varying project conditions have on the integration of ET synergies. This leads to the main research question of this study:

What project-related conditions (and combinations thereof) play a role in achieving energy transition synergies in water-related spatial development projects?

To answer this research question, the following sub questions are formulated that each focus on a specific component of the study. The first sub question consists solely of an initial literature study and is not answered by the research findings but remains as a crucial component of the research.

1. According to literature, what project-related conditions can be used to conceptualize the actor-interactions and external context associated with the achievement of ET-synergies with water-related spatial development projects?
2. Based on project documentation and interviews, how do the different cases score on the conditions and to what extent are ET synergies achieved?
3. On a basis of systematic comparison of the cases and insights from the literature, what is the contribution of each relevant condition (or combinations thereof) on the achievement of ET synergies?
4. Based on the findings of the systematic comparison, can certain pathways be identified that lead to the achievement of ET synergies?

The fuzzy case scores (obtained from the case study of RQ. 2) of both the conditions and the synergies are systemically compared by applying the initial steps of Qualitative Comparative Analysis (QCA). The systemic comparison allows for the identification of potentially necessary or sufficient (combinations of) conditions (to answer RQ. 3). Based on the potential necessary and sufficient conditions, certain relevant pathways leading to failure or successful achievement of ET-synergies can be identified (to answer RQ. 4). These pathways provide an initial insight in what combination of project conditions impact the ET-synergy integration process. This only explores the general research approach used in this study, the full methodology will be discussed in more detail in section 3.

## 1.4 Research scope

The relevant conditions included in this study can be in the form of both specific project properties as well as prior existing external factors. This means that both the existing environment (participant- and location specific) and the project-related (organisational) conditions are analysed. This combination would ensure a complete view of how the different conditions affect synergy utilization, as both internal and external project conditions are relevant in the decision-making process (Kerzner, 2017, p. 202 – 2066). In this study, the combination of the internal and external project context is referred to as the project conditions.

While the energy transition is a global process, this study will focus solely on the Dutch context and Dutch projects. By only focussing on Dutch project conditions and choices, the potential impact of the geographical differences is reduced, and the findings can be compared more easily. All spatial development projects outside of the mainland borders of the Netherlands will not be analysed within the scope of this study.

This research focusses only on water-related spatial development projects. The water-sector is well-suited for potential ET-synergy implementation in the Dutch setting, and this creates a clear spatial

context for this study (see Appendix A.1 for a stakeholder analysis of Dutch water-related projects). All projects where water plays a relevant role are included: projects where water is linked to the main objective or is linked to the energy generation component. Focusing solely on projects associated with water allows for better inter-case analysis of the findings while maintaining a high potential number of suitable project contexts with ET-integration.

Spatial synergies can occur with many different objectives (e.g., climate adaptation or ecological solutions). In this study only synergies that contribute to the ET are included. These ET-synergies refer to any spatial synergy that provides benefits to energy generation (e.g., solar panels), energy storage (e.g., hydrogen systems) or energy saving (e.g., reusing energy). All other solutions that can be integrated into a spatial development that do not benefit the ET are excluded from this research.

Only project contexts where the ET is the synergy, ''the side-objective'', integrated into a larger overarching spatial development are included. There exists a significant difference between the two integration-scenarios, but only projects where the ET-solutions are the synergy are relevant for this study. All projects where other spatial objectives are integrated with the ET as the main objective are not included. In the period 2015-2021, integration occurred more frequently with ET as the ''side objective'' and this will allow for more available cases for this study.

Due to the timeliness of the ET (e.g., the sense of urgency of the stakeholder's changes over time), only project contexts operating (or finished) in the time period 2018 – 2021 are included in this study. All projects that are finished before 2018 potentially experienced a significantly different external context compared to more recent periods (Maibach et al, 2021). Limiting the potential cases to only the most recent projects does provide a clear insight in the current context, but it important to keep in mind that this data will not be firmly applicable in future contexts due to the same timeliness of the ET.

## 1.5 Study relevance

### Scientific relevance

This research analyzes to what extent the identified project conditions required for mainstreaming climate adaptation and the required institutional conditions for efficient energy governance can be combined and applied in the context of integral ET-solutions. The literature detailing the preferred institutional conditions (Spijkerboer, 2019; Lammers & Hoppe, 2018; Lammers, 2017) provides the basis for what project interactions are relevant, and what form of project interactions are preferred for effective energy governance. These identified relevant interactions are applied in the integral ET-integration context to create a conceptualisation of how the ET-integration context can be analyzed.

The second part stems from mainstreaming literature (Runhaar, 2018; Uittenbroek, 2014), the project-related conditions that are benefical for mainstreaming climate adapation are used as the basis for project conditons analyzed in this research. Testing to what extent the supportive climate adaptation conditions have a comparable supportive impact on ET-integration. These conditions are supplemented with the benefical project circumstances mentioned in the institutional analysis literature (Lammers, 2017).

To summarize, this research continues on the knowledge gained from studies on relevant conditions for mainstreaming and beneficial institutional conditions for integration, and analyzes to what extent a combination of this knowledge is applicable when integrating Dutch ET-synergies in large water-related spatial development projects. The findings of this research show if the conditions taken from the literature are applicable in this new context, based on emprical project data.

### Practical relevance

Empirical evidence shows that stakeholders involved with sustainable development are searching for solutions that not only serve sustainability but integrate the sustainable adaptation objective in existing policy domains (e.g. urban planning, water management, public health) (Uittenbroek et al, 2014). This means that the expected results of this study, a better understanding of the required conditions for the utilization of ET synergies in the water-related spatial domain, is requested by the relevant parties. By knowing what conditions are necessary or sufficient for ET-synergy implementation, the project teams can focus on improving those specific project conditions and can therefore improve the ET-integration process in a targeted manner.

Within the bigger picture, this study can lead towards a smoother implementation of synergies which in turn will increase the frequency of multi-role spatial development. Thus, the effectiveness, speed and the societal support of the Dutch energy transition will potentially benefit from the findings of this study.

## 1.6 Research components

The four research components of this study are based on the framework presented by Verschuuren & Doorewaard (2010): 1) literature study; 2) empirical research; 3) data analysis; and 4) conclusion. With each component concerned with one of the four sub research questions. In the modelled research approach of this research, the data analysis and conclusion components are combined (Figure 2), this way each component corresponds with a chapter in this document. The colors specify the research question (yellow: RQ 1; orange RQ 2; red RQ 3; and purple RQ 4) relevant to the components.

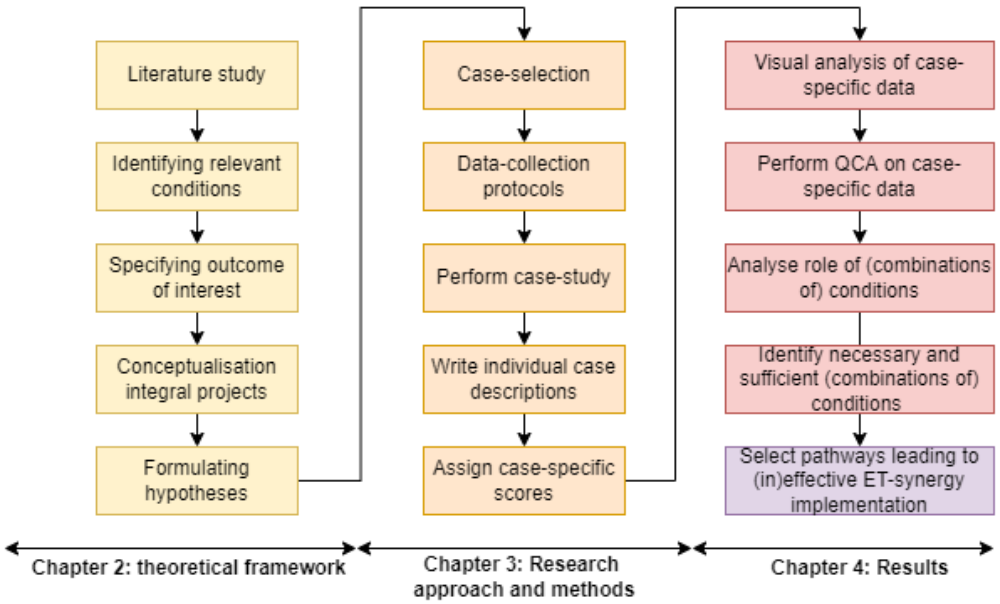


*Figure 2 Conceptual research approach modelled in separate tasks and objectives, adapted from Verschuuren & Doorewaard (2010)*

# 2. Theoretical model

## 2.1 Conceptualisation of integral projects

The literature on the governance of spatial development projects states that the core decision-making processes are shaped by the involved actors and their interactions (Edelenbos & Teisman, 2012). These complex internal interactions and choices are inherently difficult to conceptualize realistically. The relative high number of stakeholders and corresponding objectives present in the spatial development context makes understanding specific project-dynamics a complex process (Thollander, Palm and Hedbrant, 2019). To be able to identify and analyse specific project-conditions, a framework is used to approximate the core actor-interactions.

The framework that was selected in this study is the Institutional Analysis and Development (IAD) framework developed by E. Ostrom (Ostrom, 2010). The IAD framework can help organize knowledge from empirical studies and help understand complex social situations. This framework is especially beneficial for the conceptualization of the integral project context, as it provides a clear structure to perceive the complex social interactions of public spatial development projects. By dividing the complex actor-interactions into smaller, more understandable practical pieces, the IAD framework can be used to systematically approach the choices and interactions associated with integrating ET-synergies (Ostrom, 2011).

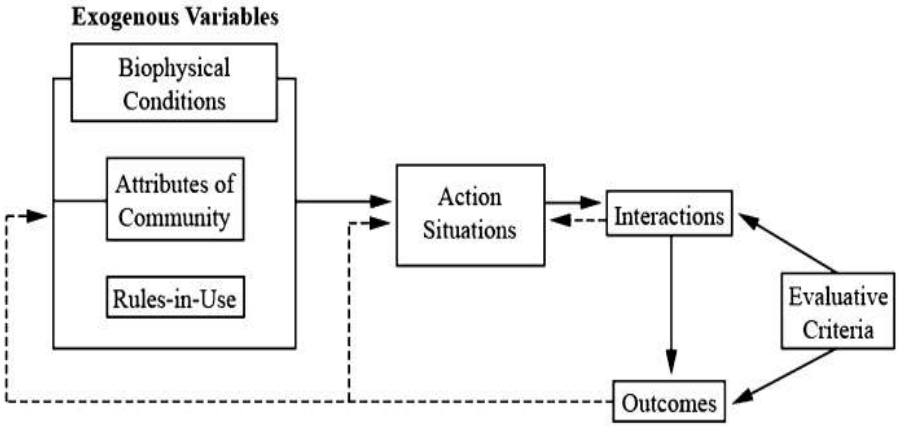


*Figure 3 Basic Components of the IAD Framework from Ostrom (2010).*

The core of the IAD framework is that the interactions behind certain outcomes can be conceptualized as an 'action situation' set within a context of external variables (described by the biophysical conditions, rules-in-use, and the attributes of community shown in Figure 3). An action situation is a ''black box'' where all policy choices are made within the project. Within this black box, all complex interactions are again broken down into seven manageable sets determined by 'rules' that define the working components and interactions (McGinnis, 2011). An action situation can be utilized as the conceptual unit to describe, analyze, predict and explain behavior within institutional arrangements. The internal structure of the action situation is defined by seven rules (boundary; position; scope; choice; aggregation; information; and payoff rules shown in Figure 4). With these ten components, all critical key features associated with the implementation of ET-synergies can be conceptualized. Allowing a systematic approach to assess and approximate the patterns of interaction and the choices made.

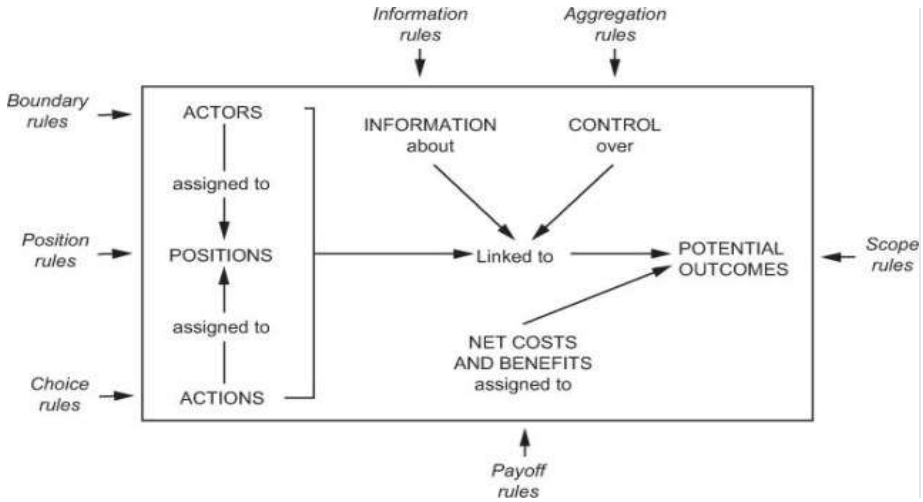


*Figure 4 The seven internal rules defining the interactions of the 'Action Situation' adapted from Ostrom (2010)*

A number of adaptations were required to be made to the structure of the IAD framework to allow the analysis of individual project-conditions related to ET-integration. This is due to the internal interactions between the seven rules of the action situation. An example of this can be seen by the input of the position component, this component is partly defined by the position rules but also by the internal interactions with both the boundary and choice rules (visible by the arrows on Figure 4). For the proposed conceptualization for this study, the internal interactions between the 10 components present in the IAD framework are not incorporated. Instead, each individual component interacts solely with the outcome (Figure 5). Using this simplified version of the IAD-framework, the impact of each component can be analyzed individually, without the need of including each complex internal step of the action situation. This would require an in-depth study of the internal mechanisms of project, which falls outside the scope of this research.

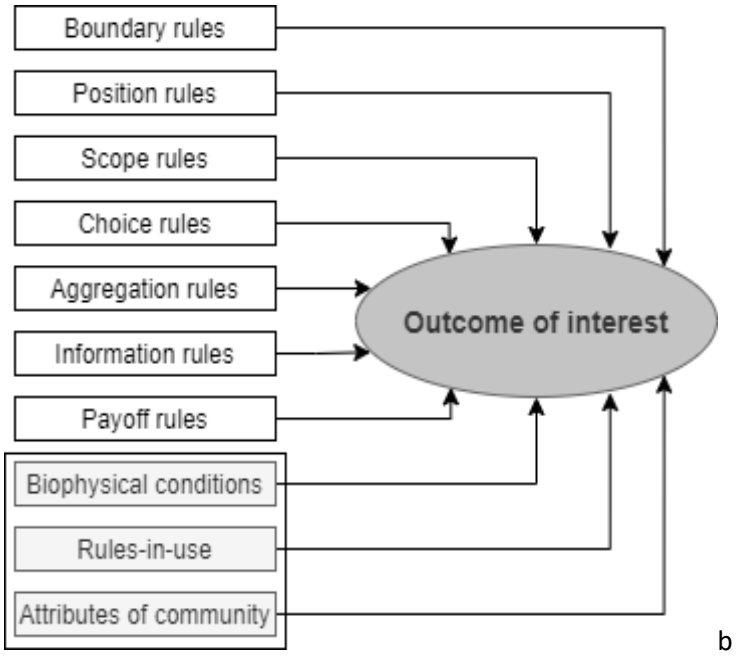


*Figure 5 Conceptualization of relevant project-interactions inspired by the IAD-framework (Ostrom, 2011); These ten components form the basis of the potentially relevant conditions analyzed in this context of this research.*

## 2.2 Outcome of interest

The outcome of interest of this research is centred around the effective implementation of ET-synergies. In literature there are a myriad of definitions for synergies, ranging from 'synergies are presented as an outcome of certain decision-making activities' (van der Veen & Venugopal, 2013), to 'synergies are an interrelationship between value adding activities of two or more networks' (Daum, 2012, p. 9 - 11). This research uses an adapted version of the definition provided by Schulz-Hardt and Mojzisch (2012, p. 4). Synergies refer here to the *outcome of a multi-actor interactive activity where various parties achieved more value compared to if they had operated separately*.

Applying this definition in the ET-context, an ET-synergy refers to any energy generation, storing or saving solution that can be integrated with a water-related spatial development project to increase the net value. The original spatial development (e.g., the enlargement of a dike) creates opportunities for ET-solutions to be realized in unison due to the similar (construction) location and stakeholders involved for both objectives (Lodewick, 2016).

To assess the level of synergy-presence in project, various approaches have been proposed in the literature. On the basis of a sustainable development assessment by Jaderi et al (2014), initially a crisp-logic perspective is adopted as a starting point in this study. A sustainable development can either be present in a project environment or not. In the context of the integration of ET-solutions, an overarching project can either implement the synergy (in any way or form), or not implement anything related to ET-synergies. However, by just applying crisp-logic, there would be no rating variation between an ET-synergy that only covered a 1 $m^2$ with solar panels after years of required investigations and an ET-synergy where all the potential solutions are achieved without significant delays. This would significantly limit the ability to differentiate between the success levels of varying outcomes.

Using crisp-logic is one end of the spectrum of assessment tools, on the other end there are assessment tools that use many different indicators like the one used by Demirkesen and Ozorhon (2017). Here a much more comprehensive method with a total of five project performance-indicators was utilized: 1) Time (reduced project durations); 2) Costs (e.g., financial costs); 3) External benefits (non-organizational benefits); 4) Safety & security (reduction of risks); and 5) stakeholder satisfaction (the perceived quality). While these five indicators provide a solid base upon which the synergy-effectiveness can be assessed, it does not suit the multi-case study nature of this research. A full quantification of the cost-reduction, the possible benefits, and the risk reduction of all individual cases falls outside of the scope of this research.

When looking at the middle ground between the measurement tools proposed by Jaderi and Demirkesen, the relatively superficial measurement gauge of Hossain & mahmud (2014, p. 17-41) is identified as a potential inspiration. Here the success of an ET-solution is measured by two general project performance indicators: 1) Effectiveness, defined by the total energy generated with respect to the physical costs; and 2) Efficiency, defined by the related time costs to setup and operate the processes. While Hossain & Mahmud (2014) was focused on implementing energy grid strategies, the measurement tools used in their system rating can be applied in the context of integral ET-solutions to analyze their value.

For this study, a combination between the measurement tools of Jaderi et al (2014) and Hossain & Mahmud (2014) is used. First the presence or absence of a synergy is defined by crisp logic and then the effectiveness is approximated by two simplified variables: 1) efficiency, in the form of the increase in total project duration; and 2) effectiveness, in the form of the achieved ET-contribution of the synergy. By using these two indicators, the benefits and the three negative effects of integrating projects that are often mentioned in Europe are covered. Increased complexity; additional required

work; and more involved stakeholders (Van Straalen, 2012), can all be roughly represented by an increase in project duration (efficiency). Similarly, the overall benefits of an ET-synergy are roughly represented by the contribution to energy generation or energy saving (effectiveness). Based on these considerations, the level of effectiveness of an ET-synergy in this research is defined by two main characteristics:

- 'The impact on the overarching project', defined by the increase of project duration as a direct result of the implementation attempt of the synergy. An example of this are the delays caused by the required additional safety checks and permits requests for the ET-synergy.
- 'The achieved potential of the ET-implementation', defined by the realized sustainable energy generation components compared to the identified potential. This value is determined by a personal judgement on the percentage of realized ET-synergies based on the project-data (interviews and project documents).

## 2.3 Selection of potentially relevant conditions

To identify which of the ten components of the conceptualization (Figure 5) are relevant within the scope of this study, the properties of each component are analyzed based on their original definition by Ostrom (Appendix B.1). The IAD framework is designed to incorporate all relevant project features that can affect actor-interactions, but in the decision-making context associated with ET-integration a number of adaptations were required to fit the ten components. For eight components the definitions used will be relatively similar to the original definitions, but for two components the definitions will be adjusted significantly due to the case-study nature of this research.

In the original IAD-framework (Figure 4), the payoff rules concern the cost-benefit distribution of the actual outcome in a project. This is relevant only after the implementation of the outcome (in this study context, after (and during) the implementation of the potential synergy). This research deviates from this definition as the interactions leading up to a certain outcome are mostly relevant for analysis. Based on a single component of the payoff definition used by Lammers & Hoppe (2018), the payoff is defined by the timeframe when the cost- benefit distribution related to the ET-synergy is accepted by all participants. The decision was made to not drop the payoff rules all-together as the cost- and investments associated with synergies were deemed to be critical based on the explorative interviews with Royal HaskoningDHV experts.

The scope rules concern the width of potential outcomes, this includes properties like the scale, location and type of the outcome. In this research only ET-solutions that are potentially integrated with a spatial development project are included. This severely limits the application of the scope rule, and the decision was made to deviate from the original IAD-application. Similar to the payoff rules, the definitions by Lammers & Hoppe (2018) are used for the scope. Interpreting the scope rules as the spectrum of possible ET-synergy-types (e.g., wind energy, solar energy) that are identified and analyzed.

The remaining five rules that define the internal structure of the action situation are deemed to be adequately relevant in their original definition for this research. While certain adjustments are made to each rule to interpret them in the study context, these are only minor and are discussed briefly in the next paragraph.

The external context is defined by the 1) attributes of community; 2) biophysical conditions; and 3) the rules-in-use. The first two are project-specific and vary significantly between spatial development

projects in the Netherlands. Both are deemed relevant in the study context as the two variables define the differences of the external context between projects. The third variable, the rules-in-use of the IAD-framework, refers to the formal rules present in the action situation. Defined by the rules-on-paper instead of the actual active rules (McGinnis, 2011). These norms, available strategic repertoire, and active rights (the formal rules) are relatively similar across the whole of the Netherlands in the context of spatial development. Based on the scope of this study, it is assumed that all formal rules present in the relevant contexts are too similar for adequate data collection. As a result, the rules-in-use are dropped for further analysis, and only the attributes of community and the biophysical conditions are analyzed as relevant external variables

## 2.4 Potentially relevant conditions and hypotheses

To operationalize the nine remaining conditions in the study context, a context specific definition and two empirical indicators are linked to each condition. On the basis of literature on IAD-framework applications the nine conditions can be defined in an ET-related project context. Directly using the definitions of Lammers (2017) for the internal rules (excluding the scope rules) and the previously established definitions of McGinnis, 2011 for the external variables. The definitions for the internal rules by Lammers (2017) were preferred over the original definitions as Lammers adapted the IAD definitions for the ET-governance context which makes them more suited for the integral ET-context relevant in this study.

For the selection of the empirical indicators that determine the state of the condition, a review of literature dealing with climate adaptation integration and Institutional analysis of energy governance) was conducted. Runhaar et al (2018) and Uittenbroek (2014) were selected as the most relevant climate adaptation literature based on their similar approach focussed on facilitating and halting conditions. For the institutional analysis literature, (Lammers & Hoppe (2018) was selected based on the focus on the energy sector. The relevant project-conditions mentioned in the three articles were then adapted to fit the ET-integration context. The two empirical indicators assigned to each condition are developed in more detail in Appendix B.2, allowing better assessment of practical cases.

The literature concerned with generally supportive project-aspects (Lammers & Vasenev, 2017; Demirkesen & Ozorhon, 2017) provides the basis for the hypothetical supportive condition-states associated with effective ET-synergy implementation. Combining the supportive project-aspects with the empirical indicators to create hypotheses, therefor linking the condition-states to a potential positive outcome of interest.

### Internal conditions

**Boundary rules** are defined by the criteria for selecting the participants in a project, and how and when they can enter or leave their positions (Lammers, 2017). In this research context the boundary condition is determined by: 1) the type of selection process for project participants; and 2) the amount of involvement these selected participants experienced (Lammers & Hoppe (2018). This condition is supportive of an effective integration of ET-solutions when all participants with relevant power or interest in the project are involved in the project (co-production of the synergy) as a result of a broad and flexible participant selection and involvement process (Lammers & Vasenev, 2017).

**Position rules** specify the role-distribution of the participants: what roles are possible and which participant is assigned to what role (Lammers, 2017). In this research context this condition is determined by: 1) The degree to which the synergy and the overarching project have overlapping decisionmakers; and 2) The clarity of role distribution in the project team (Lammers & Hoppe, 2018).

This condition is supportive when the initiating party has a clear and strong managing role who is the sole decision-maker for both the main project and the ET-synergies themselves (Lammers & Vasenev, 2017).

**Scope rules** in this research specify the scope of possible outcomes: what types of ET-synergies were possible (Lammers & Hoppe, 2018). The condition is determined by: 1) the synergy identification processes utilized in the project; and 2) the constraints posed by the main project relevant to ET-synergies (e.g., timeframe compatability) Runhaar et al, 2018. A supportive condition is defined by a broad and flexible scope that incorporates all technically feasible ET-solutions at the start of the main spatial development project (Demirkesen & Ozorhon, 2017).

**Choice rules** specify a set of actions that the initiating party is allowed to take to incorporate ET-synergies (Lammers, 2017). In this context the choice condition is determined by the extent to which the initiating party is allowed (and pressured) by authorities to: 1) exceed the sectoral standard for ET-contribution; and 2) utilize integral solutions (Runhaar et al, 2018). A supportive choice condition is defined by the absence of any authorative limitations for the initiating party associated with implementing ET-synergies and thus a broad set of possible actions associated with the ET (Lammers & Hoppe, 2018).

**Aggregation rules** determine how decisions are made and what decisions were legally restricted (Lammers, 2017). The aggregation rules in this research context is determined by: 1) the general decision-making hierarchy present in the project team; and 2) the required permit processes to integrate the ET-solution (Runhaar et al, 2018). A supportive aggregation condition is defined by an efficient communication process between the initiating party and the organisations with authorized supervision (Lammers & Vasenev, 2017).

**Information rules** concern what information is necessary and made accessible for the participants in a project and what information spreading methods are used (Lammers, 2017) . In this study context, the information rules are determined by: 1) the methods used to distribute information associated with ET-synergies to all relevant parties; and 2) the degree how informed all relevant participants are regarding synergy developments during the project (Uittenbroek, 2014). A supportive information condition is defined by a project that enables all relevant participants to share and communicate their ideas and information associated with the ET-synergy effectively via multiple dedicated channels and communication methods (Lammers & Hoppe, 2018).

**Payoff rules** specify the distribution of costs and benefits related to the ET-synergy amongst the relevant participants (Lammers & Hoppe, 2018). In the context of this research, the payoff rules are determined by: 1) the level of clarity and acceptance of the cost-distribution associated with the synergy; and 2) the speed with which the cost-distribution is accepted, and synergy-investors are identified (Lammers & Hoppe, 2018). This condition is supportive for effective ET integration when the cost-distribution associated with the synergy is accepted by all relevant stakeholders in an early phase of the overarching project without any unclear or conflicting aspects (Demirkesen & Ozorhon, 2017).

### External conditions

In the identification process of the conditions the two relevant external variables were shown to be relatively broad concepts. Both variables define a large part of the external context in which a project is situated, including all available resources and existing social values. Analyzing such broad concepts using case-specific differences can be a complex process. To ensure viable data is selected, the two external variables in this study context are narrowed down to just two indicators per condition, focusing on only a part of the broad definition.

**Attributes of community** encompasses all existing relevant aspects of the social and cultural context within which the action situation is located (McGinnis, 2011). In the context of this research, the attributes of community are determined by: 1) the existing openness to ET-developments of the local participants; and 2) the presence of the previous similar integral projects managed by the initiating party (Lammers & Hoppe (2018). Supportive attributes of community are defined by a community that is both open and facilitating to ET-developments with a project team that has prior experience with integral projects (Demirkesen & Ozorhon, 2017).

**Biophysical conditions** encompass all existing relevant aspects of the physical environment within which the action situation is located (McGinnis, 2011). The biophysical conditions in this study context are determined by: 1) the current spatial function on and around the project location and the corresponding physical limitations; and 2) the technical feasibility to store, generate or transport energy on and off the location (Uittenbroek, 2014). Supportive biophysical conditions are defined by a project location that has no conflicts with the ET-synergy and the existing surrounding spatial functions (Lammers & Vasenev, 2017).

### Overview of hypotheses

Table 1 shows the operationalisation of the identified conditions and corresponding hypothesized supportive states for ET-integration. Showing how the nine relevant IAD-components can potentially influence the ET-integration process.

*Table 1 Overview of hypotheses of the potentially relevant conditions*

| Condition | A high degree of ET-synergies is associated with the presence of: |
|---|---|
| **Boundary rules** | **A flexible and broad** participant selection and involvement |
| **Position rules** | **A single strong manager-role** for the initiating party responsible for all major strategic decisions associated with the synergy and the main project |
| **Scope rules** | **A flexible and broad** objective assessment for ET synergies including all possible ET-synergies |
| **Choice rules** | **A broad set of allowed actions** (set by authoritative parties) to strive towards ET-synergies |
| **Aggregation rules** | **An efficient communication process** between the initiating party and the organization with authorized supervision |
| **Information rules** | **Effective methods** dedicated to the spread of information between **all relevant participants** |
| **Pay-off rules** | A fully accepted distribution of costs (associated with the synergy) in **an early phase of the overarching project** |
| **Attributes of community** | A community who has **experienced similar integral projects and is open to ET-solutions** (Community referring to all local participants) |
| **Biophysical conditions** | **A project location which has no conflicts** with the ET synergy and existing surrounding spatial functions (both in terms of physical placement and energy demand) |

No hypotheses for a combination of conditions are formulated as the existing literature was not sufficient and this individual approach allows for a condition-specific impact-analysis. However, the hypotheses will also be tested with respect to causal complexity present in this context, to a feasible extent. These tests are formulated by combining multiple conditions (and the respective hypotheses) and will not feature a new hypothesis.

### Study hypothesis

From the reviewed studies on IAD-rule adaptation, the need for the project-conditions to be supportive for ET-synergy integration can be identified. Integral projects are less likely to implement an effective ET-synergy when the nine relevant conditions do not have a high level of supportiveness. This leads to the main hypothesis of this research: '*A high level of ET-synergy utilization can be achieved if the relevant conditions in a project environment are supportive of ET-integration'.* Coincidently, this would mean that a change in the conditions towards a more supportive state would result in a higher level of integration.

# 3. Methods

## 3.1 Introduction to qualitative comparative analysis

In this research, the initial steps of QCA are used as an approach and method. QCA is a set-theoretic method that helps with systematically comparing a larger number of cases (e.g., between 20 and 50) with respect to causal complexity instead of only individual relations. This approach offers the researcher the possibility to understand individual case contexts, while simultaneously offering the possibility for a quantitative approach that can see patterns between the cases (Rihoux, 2006).

As this study is dealing with complex social phenomena with a broad variety of stakeholders in different project environments, an analysis with respect to causal complexity is required for a realistic representation. Causal complexity refers to a study-context where: 1) different combinations of conditions can lead to the same outcome (equifinality); 2) a condition can potentially affect the outcome differently in combination with other conditions (conjunctural causation); and 3) the presence of an effective ET-synergy does not allow the explanation of its potential absence (Schneider and Wagemann, 2012).

The initial steps of QCA allows for the examination of the relation between the relevant conditions and the outcome. Describing these relationships in terms of necessary and sufficient (combinations of) conditions based on the case contexts. A condition is defined as necessary for the outcome when it is always present when the outcome is present. This occurs when all cases show that a condition scores higher than the corresponding outcome. A condition is defined as sufficient when the outcome is always present when this specific condition is present. This occurs when the outcome of all cases is defined by that individual condition (Schneider and Wagemann, 2012).

Not all steps of the QCA are performed in this study. Conventionally the necessity and sufficiency patterns are analyzed using computer software and coverage parameters. Both these software-related steps and the coverage parameters will not be utilized in the context of this research, and only a manual analysis by the researcher is performed on the obtained data. These manual steps to identify necessity and sufficiency patterns are further explained in section 3.4.

The selected QCA steps used in this research allow the researcher to analyze what (combinations of) conditions are related to a certain outcome in terms of necessity or sufficiency. Though the internal interactions of these conditions, i.e., the project mechanisms that lead to a certain outcome, remain open for interpretation by the researcher. It still provides insight in the role of these conditions on the corresponding outcome with respect to causal complexity.

## 3.2 Case selection

This study analyzes varying spatial development contexts to understand the potential necessity or sufficiency of the relevant project-conditions for ET-synergy integration. Here, a case is defined as a water-related spatial development project where the possibility for ET-synergy was explored.

To obtain an adequate set of cases with variation in the outcome and selected conditions, two general steps are defined in the case selection process, adapted from Berg-Schlosser & de Meur (2009):

First, the boundaries of the cases are defined, this is a relative homogeneous area from which cases are selected to ensure that cases display certain background characteristics. The boundaries are defined by the research scope supplemented with feasibility considerations.

These boundaries indicate that all potential cases need to have at least identified the possibility to integrate ET-synergies (this includes both projects where ET synergies were implemented and where ET synergies were identified but failed to be implemented). However, by solely analyzing projects that already identified synergies, there is a great bias in the case-selection. As the first steps of synergy implementation (the willingness and identification process) are potentially all present in these projects.

The other critical aspect of the homogenous area is that only projects where the initiating party of the overarching project is a public authority are included (a municipality, a provincial government, a regional water authority, or any national government agency). Private organizations (e.g., as investor) can play a major role in these projects but they cannot be initiators. Including cases where the initiating party is a private party would potentially provide a too wide array of case data.

Secondly, the extent of diversity of the cases is determined. Within the boundaries set by the homogenous conditions, there needs to be sufficient variation to test the hypotheses. Within the case selection of this research, the most critical diversity is that both projects where the ET-synergy was 'implemented' and 'failed to implement' need to be selected. In addition, the selected IAD-conditions need to be present in a broad spectrum in the selection of cases.

Based on the presented hypotheses (Table 1) there are nine conditions that need to be varied for an accurate assessment of their impact. Due to the high number (80) of potential cases that are identified and assessed for this study, it is not feasible to analyze all potential cases on all nine conditions. Many components of the internal structures can only be analyzed properly via an in-depth interview or document analysis. This meant that it was unfeasible to analyze the approximate presence of all selected conditions in all 80 potential cases.

Of the nine conditions, there were three conditions that could feasibly be approximated based on a short initial conversation about the case: 1) Boundary rules via a brief description how participants were involved in the project; 2) Information rules via a brief description how participants exchanged information; and 3) Attributes of community via a brief description if the local participants had any experience with ET-synergies. The short conversations (and online documentation) provided sufficient information to get an adequate insight in these three conditions for each potential case. Within the case selection, these insights were used to obtain a broad spectrum of these three conditions. This allowed that the selected cases showed varying levels of participation (Boundary rules), varying levels of information sharing methods (information rules) and varying levels of experience and local support (attributes of community) (Table 2).

By limiting the preferred extent of diversity in the case selection to a feasible set of just three of the nine selected conditions, an issue occurs with the analysis of the other six conditions. The case selection can potentially lead to a situation where selected cases are too similar on these conditions. As the extent of diversity of the position, scope, choice, aggregation, pay-off and biophysical conditions are all not considered in the selection of the suitable cases. This potential issue should be taken into account during the analysis of the data.

*Table 2 Case selection criteria: degree of condition variety*

| Condition | Case selection criteria |
|---|---|
| **Boundary** | Include projects with a varying number of participant-types and participant selection criteria |
| **Information** | Include projects with different information sharing methods and moments and varying informing levels for the participants. |
| **Community** | Include projects with local participants with varying levels of experience |

Finally, to select projects with interviewees with different functions and backgrounds, a preference is given to obtain a set of cases with adequate variation in the associated organizations and sources. Involving sufficient other organizations in addition to Royal HaskoningDHV will reduce the potential risk of a biased case selection.

#### Case selections decisions

The cases are primarily based on their suitability within the scope boundaries and the preferred extent of diversity, the two steps defined by Berg-Schlosser & de Meur (2009). But in addition, there are pragmatic considerations that were made in addition to these two steps. These considerations predominantly revolved around the accessibility and availability of project documents and the potential interviewees. To ensure this study has sufficient and appropriate data, all interviewees need to be willing and able to provide internal project information about the cases. These pragmatic considerations influenced the final selection of the cases as there were a number of cases where the interviewee was not allowed to talk about the project in detail as it was still in progress. These cases could not be selected to be analyzed for this research.

It is expected that due to the complex nature of the study context, accurate predictions on the patterns of interactions and subsequent outcomes are difficult to assess and prone to be case specific. To reduce the risk of case-specific circumstances, a preference is given to a higher (as feasibly reasonable) number of cases. Within the relatively large selection of potentially suitable cases (80), it was possible to select a set of 19 cases. This selection provided suitable project contexts and an adequate degree of diversity on the three selected potentially relevant conditions and outcomes.

## 3.3 Data collection and processing

### Data collection setup

The final case selection consisted of 19 cases, centered around four project types. The decision to focus on specific spatial development project-types allows for deeper analysis of certain specific spatial contexts and limits the number of different contexts (which could potentially reduce the applicability of the study results). Based on their frequency of occurrence in the list of potential cases the four types were selected: 1) Dike strengthening; 2) Sewage treatment plant renovation; 3) Heat network installation; and 4) strategic planning.

For this research, data are collected about how the 19 project contexts score on the nine selected IAD-conditions and the corresponding outcomes of interest. There are two main steps that are taken to obtain the relevant data from the cases.

(1) A document analysis of project documents and online information. This document analysis included all project documents and information that is available online and through internal contact with Royal HaskoningDHV and other partners. For each case, at least one form of project documentation is

obtained and analyzed. While the source of data of this study is predominantly focused on the interviews, it is crucial to obtain at least a basis of relative unbiased project information. Appendix C.2 shows an overview of the available documents per case for this initial document analysis.

(2) Semi-structured interviews with the involved consultant and/or with someone from the involved public authority. These interviews took place after the document study, as an initial understanding of the project is required to adjust the interview to the specific circumstances of the selected case. In these interviews the main topic was the presence and supportiveness of the relevant conditions and the implementation of the ET-synerg(y)(ies).

The aim of the interviews was to identify the most relevant conditions that enabled or inhibited the integration of the ET-solution in the main project. To create an understandable interview structure corresponding to the interviewees, the structure was designed with input from Royal HaskoningDHV experts (potential interviewees who were not selected but consulted prior to the start of the interviews). The interview itself lasted for around an hour and was constructed around six separate components based on the recommendations from the experts: 1) General project circumstances; 2) Project organisation; 3) Participant involvement; 4) Synergy identification; 5) Challenges; 6) Success factor and requirements. With these six components, all nine relevant conditions could be assessed during each interview in a streamlined order.

Because of the regulations in place regarding the 2021 Covid-19-epidemic, all interviews were conducted via an online medium. This online environment did allow that all interviews could be recorded and stored efficiently. These recordings were used for the transcription process of the interviews and were later deleted. The interviews were conducted in a semi-structured way, this approach allows for a more flexible interview where the interviewee can explain freely about certain complex topics. A list of rigid questions is less suited for these complex integral project contexts.

In total 23 separate interviews were conducted on the 19 selected cases, 15 of which with an interviewee related to Royal HaskoningDHV and eight related to an external party. With the external parties consisting of public authorities (municipalities and regional water authorities) and consultancy TAUW. The list of interviewees and the seven components can be viewed in more detail in Appendix C.3 where the interview considerations are displayed.

### Data processing setup

All interviews were transcribed verbatim based on the recordings. All sentences mentioned in the conversation are documented and were reviewed by the interviewee. After the review of the transcripts was accepted, the used recording has been be deleted. The final transcripts are stored on the protected databank of the University of Twente.

The interview transcripts were used prepare the qualitative descriptions and to score each condition for all 19 cases. To allow this translation, the 'IAD-definition and indicator Table' (Appendix B.2) was used to create a condition template. This template includes all nine conditions, each connected to the two appropriate empirical indicators. For all indicators mentioned in the interview, a qualitative description is written detailing the state of the indicator. Doing this for each relevant indicator provides sufficient information to write a qualitative description of the state of each condition. For all 19 cases, the condition-template was utilized using the data from the interviews, providing a database of qualitative descriptions of all 19x9 condition-states (Appendix C.4).

An outcome-template was designed based on the definition of the outcome-of-interest stated in the theoretical framework (section 2.2). Initially, the presence of any form of ET-synergy is analyzed for

each case using crisp-logic. Then the two selected indicators of an effective ET-synergy are utilized in the template: 1) delays caused to the main project; and 2) achieved potential related to the ET. Similar to the condition template, the outcome criteria are qualitatively described for each case based on the interviews (Appendix C.4).

## 3.4 Data analysis

### Scoring system

The templates (Appendix C.5) provide a qualitative description of each relevant condition- and outcome state. These can be used to formulate a quantitative score by utilizing a scoring-system. For the scoring of the condition-states, fuzzy logic is applied. All conditions are rated with a 0, 0.3, 0.7 or a 1 based on the level of supportiveness of the conditions compared to the hypotheses. The decision to work with fuzzy logic provides the ability to show an easily understandable quantitative value for the state of each condition while maintaining the possibility to differentiate between for example a highly supportive condition (1) and a moderately supportive condition (0.7).

The condition- and outcome scores are calculated based partly on inter-case differences. The complexity inherent to integral project contexts makes it difficult to rate a condition as ''optimal'' which would correspond to a 1-score. Instead, this study refers to a 1-score when a state matches best with the state described in the hypothesized supportive state (shown in the theoretical framework) relative to the other cases.

#### *Scoring system: outcome*

The outcome template provides a solid qualitative base upon which this scoring system can be designed. The three outcome components (implementation, duration and achieved potential) are used to define a score for each case outcome. Using crisp logic, each case was assigned a 1 or 0 value for all three outcome criteria. The 0's and 1's of the three criteria are added to obtain a fuzzy score of 0, 0.3, 0.7, or 1 for the outcome of each case. These fuzzy values are attributed to the cases in the following situations:

- A 0-score is attributed to all cases where no ET-synergy was implemented in any way or form.
  *These cases score a 0 on the implementation criteria and are not assigned a crisp value for the other two criteria, as the delays and achieved potential are not relevant.*
- A 0,3-score is attributed to cases where only a small ET-synergy was implemented (compared to the identified potential ET-synergy) at the cost of significant delay to the overarching project.
  *These cases score a '1' on the implementation criteria and a '0' on both the duration and achieved potential criteria.*
- A 0,7-score can be attributed in two situations, 1) a project where a relatively small ET-synergy is implemented without any significant delays; or 2) a project where all possible ET-synergies were implemented but at the costs of significant delays of the overarching projects.
  *These cases score a '1' on the implementation criteria and score '1' and '0' on the two remaining criteria (both combinations result in a 0,7 score).*
- A 1-score is attributed to case where all possible ET-synergies were implemented without any significant delays.
  *These cases score a '1' on all three criteria.*

When projects are still in progress, the scores are based on the project thus far combined with the expectations of the interviewee of future developments described in the interview transcripts. For six out of the 19 cases (cases 1, 7, 8, 11, 18 and 19) this was relevant as the ET-synergy had yet to be fully implemented.

### *Scoring system: conditions*

The condition scoring system is based on the hypotheses, shown in the theoretical framework. This system is constructed using the descriptions of the hypothesized supportive conditions as the basis for a preferred optimal condition-state, which was given the 1-score. This is followed by defining the 0-score as the opposite of this preferred supportive state. Then by descriptively interpolating two linear points between the extreme descriptions, a ''mixed supportive/unsupportive state'' with the 0,3-score could be created and a ''fairly supportive state'' with the 0,7-score. The complete scoring system used for each condition and an example score calculation can be found in Appendix C.6.

To clarify, a case scoring a 0 for a condition does not mean that there was an absolute absence of supportive aspects. It means that the condition was in an unsupportive state and highly resembled the 0-score description. When working with cases where the score is unclear or ambiguous, the relative difference with the other 18 cases is used to determine the score.

## Interpretation of results

The general expectation was that when all conditions are in a supportive state for integration, the ET-synergy would be effectively implemented. To test this, each case has been assigned a fuzzy score for the outcome and each of the nine individual conditions. These scores are used as the main source of information for the QCA-steps and the testing of the hypotheses. Though, in the analysis of the case-scores, and especially in case-specific reassessments (in case of anomalies), the qualitative data (interview transcripts and project documents) was utilized as a supplementation to the fuzzy quantitative scores. While the hypotheses state that the presence of supportive conditions leads to high outcome scores, there is also a possibility that the absence of a supportive condition is linked to a high outcome score. In a similar way each condition will be analyzed if the presence or absence of the supportive state is necessary for effective ET-synergy implementation.

The overview of scores is visualized using color codes, with green (1), light green (0,7), light red (0,3) and red (0) representing the scores. This allows for an effective visual analysis of the data, with potentially inadequate datasets being visible in the score-overview. By systemically comparing the scores of this overview, it is possible to identify potential necessity and sufficiency both for individual conditions and for combinations of two to nine conditions.

Based on the study hypotheses, certain expectations can be formulated regarding the systemic comparison:

1) It is expected that multiple individual conditions are necessary for the effective implementation of ET-synergies, as the nine hypotheses state the potential supportive effect of each individual condition.
2) It is unlikely that the absence of any supportive condition is necessary for the effective implementation of ET-synergies, as the supportiveness of the conditions are defined based on comparable literature and are thus expected to have a positive impact.

3) The absence of certain conditions can be compensable by the presence of other conditions. In the conceptualization of this research, all conditions individually affect the outcome, and this makes it possible that an unsupportive state of a certain condition can be compensated by other conditions. A similar compensation process was seen in the study of Runhaar et al (2018) where not all facilitating condition were required to be present for climate adaptation integration.
4) It is highly unlikely that a single condition is sufficient for integration. In this scenario, the one condition would solely determine the outcome score, making the other hypotheses irrelevant. According to Cooper & Glaesser, (2015) (a study on logical expectations), this is not expected.
5) For the sufficiency analysis it is expected that a combination of (two to five conditions) conditions are required to be in a supportive state for effective ET-synergy implementation, with the other conditions being interchangeable.

### *Necessity and sufficiency analysis of individual conditions*

To analyze the necessity and sufficiency for ET-synergies of all nine conditions, the approach specified in Appendix C.1 is utilized. By using the scores of each case, an outcome-condition plot (Figure 6) can be created. By drawing a diagonal line in these graphs, a clear visualization can be created showing if a condition is necessary or sufficient. When all datapoints are below the diagonal line, it shows that there is no outcome score higher than the condition score. Such a situation would refer that necessary condition for a high outcome score. On the contrary, when all datapoint are above the diagonal line, it means that all outcome scores are higher than the condition scores (indicating a sufficient condition).

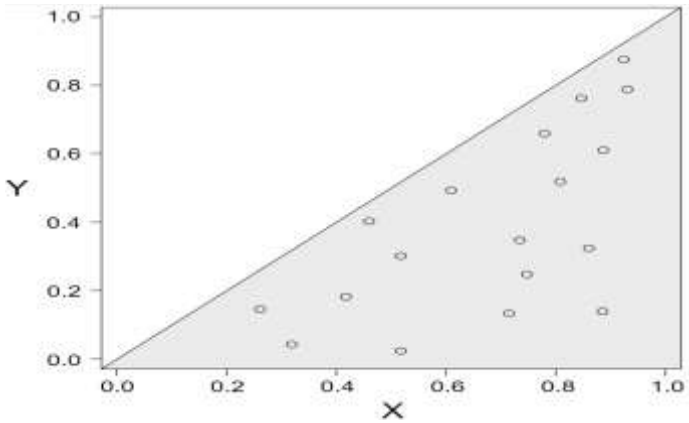


*Figure 6 Illustration of the graph analysis with outcome-scores on the Y-axis and condition-scores on the X-axis.*

When looking at the necessity of the absence of a supportive condition, the diagonal line is changed to go from the top left to the bottom right of the outcome- condition plot. The absence of a supportive condition is necessary when all datapoints are located underneath this new diagonal line (Dul, 2020). In such situation all high outcome scores are linked to low condition scores which indicates that the absence of the supportive condition is necessary for effective ET-integration.

For all nine conditions, similar outcome-condition plots are created, and the necessity/sufficiency analyses are performed. It can occur that an analysis of a single condition shows that almost all data points are underneath the diagonal line. It is important to have an in-depth look at the singular exceptions to see if there are unique circumstances present that significantly differs from the other cases. Potentially, the same case can be conflicting with other necessity or sufficiency analyses as well.

*Necessity and sufficiency analysis of combinations of conditions*

For the analyses with respect to causal complexity, logical operators are applied on multiple combinations of two to nine conditions. These combinations are analysed using fuzzy logic to analyse sufficient or necessary configurations of conditions. The combinations themselves are selected manually using a visual analysis of the color-coded data matrix and the identified potential necessity of the individual conditions.

The described plot-based method is applied for configurations of conditions in a similar fashion as with the individual conditions, both using the plots and the fuzzy condition- and outcome data points. To find these potentially relevant configurations, a strategy was designed for the necessity and the sufficiency analysis based on the strategies used by Pruditsch (2017):

- The fuzzy OR-operator is used to find necessary configurations of conditions. The highest fuzzy scores within the selection of conditions are analysed to identify potential necessity (indicating that achievement of an outcome score necessitates the score of only one out of a set of conditions to reach that score). To find these configurations, all possible condition-pairs (approximately 81 pairs, excluding the individual conditions that were necessary) were assessed for necessity by trial and error. For larger configurations of three or four conditions, not all possibilities were analyzed. Only the configurations that were mentioned in the interview transcripts or were based on the identified pairs of conditions were analyzed in more detail.

- The fuzzy AND-operator is used to identify the sufficient configuration of conditions. The sufficient solution can be identified by looking for the shortest possible configuration of conditions that leads to a positive outcome score when all are in a supportive state. The starting point of the sufficiency analysis is the combination of all (identified) individual necessary conditions. From this initial selection, each time a single condition is added, and the sufficiency is analyzed to see how many cases can be explained by the new configuration. This way multiple configurations can be identified that would explain the cases scores, with the shortest configuration being the most relevant. A method that can be used to find sufficient configurations when this initial method is inadequate is to analyse all cases with high outcome scores and comparing the case-similarities. In these similarities it is possible to find potential sufficient configurations which can later be checked for contradiction by looking at all case outcome scores.

  For the necessity analysis it is expected that the fuzzy scores are adequate to find (combinations of) conditions that meet the requirements for the necessity statement. However, for the sufficiency analysis it is possible no clear sufficient configuration can be identified due to the relatively large variety in the fuzzy scores. When this occurs (which happens more frequently when dealing with a low number of cases like with this study, Skaaning, 2011), the fuzzy scores of each case are rewritten as a binary set. With supportive conditions (>0.5) and positive outcomes (>0.5) shown as a binary 1 score. Using the cut-off of the 0.5 score, it still allows for the distinction of unsupportive and supportive condition states but increases the likelihood of identifying a sufficient configuration. Using the fuzzy scores provides more clarity and firmness regarding the potential necessity and sufficiency findings and is preferred over crisp scoring logic. Crisp score sets are only used when no clear sufficient (or necessary) configurations can be identified in the fuzzy scores.

# 4. Results

## 4.1 Qualitative overview of outcomes

In the 19 cases that were analysed in the context of this study, there was an adequate variation of outcome scores. The cases showed diverse scores on the ET-synergy rating: four cases showed no sign of ET-synergy realization (score = 0), five cases scored moderately low (0.3), nine cases scored moderately high (0.7) and only one case had a score of 1 (Table 3).

*Table 3 Overview of case characteristics and outcome scores*

| Case nr. | Project name | Implemented ET-synergy (or attempt to) + Project type | Outcome of interest | Implementation | Duration | Achieved potential |
|---|---|---|---|---|---|---|
| 1 | RES Drechtsteden implementatie | Solar energy - aquathermy<br>Varying spatial development projects | 0,7 | 1 | 0 | 1 |
| 2* | Zonnedijk Moerdijk | Solar energy<br>Dike strengthening | 0,7 | 1 | 0 | 1 |
| 3 | Rijnkade Arnhem | Aquathermy<br>Canal renovation | 0 | 0 | - | - |
| 4 | Lauwersmeerdijk renovatie | Solar energy<br>Dike strengthening | 0 | 0 | - | - |
| 5 | Helmond gekoppeld | Solar energy & Aquathermy<br>Renovation heat network | 0,3 | 1 | 0 | 0 |
| 6 | Landtong Roozenburg | Solar energy<br>Dike strengthening | 0,7 | 1 | 0 | 1 |
| 7 | Port of Rotterdam – Amsterdam | Required space for future ET-synergies<br>Spatial planning | 0,7 | 1 | 0 | 1 |
| 8 | STAIN Zwolle | Urban ET-solutions (broad spectrum)<br>Spatial development | 0,3 | 1 | 0 | 0 |
| 9 | Schoteroog energy lake | Solar & wind energy<br>Spatial development | 0,3 | 1 | 0 | 1 |
| 10 | Maasvlakte II | Wind energy<br>Dike strengthening | 0,7 | 1 | 0 | 1 |
| 11 | Raalte RAS – RES-adaptatie | Urban ET-solutions (broad spectrum)<br>Climate adaptation<br>Neighborhood developments | 0,7 | 1 | 0 | 1 |
| 12 | RWZI Land van Cuijk & RWZI ooien | Solar energy<br>Sewage treatment plant renovation | 0,7 | 1 | 1 | 0 |
| 13 | Culumborgse Dijk ontwikkeling | Solar energy<br>Dike strengthening | 0 | 0 | - | - |
| 14 | Den Bosch RWZI | Solar energy + biogas<br>Sewage treatment plant renovation | 1 | 1 | 1 | 1 |
| 15 | Den Haag kademuren | Aquathermy<br>Canal renovation | 0 | 0 | - | - |
| 16 | RWZI Beverwijk & RWZI Echten | Aqauthermy<br>Sewage treatment plant renovation | 0,7 | 1 | 0 | 1 |
| 17 | Grebbedijk integrale gebieds-ontwikkeling | Solar energy & wind energy & aquathermy<br>Dike strengthening | 0,3 | 1 | 0 | 0 |
| 18 | Waterketen Delfland Wijkaanpak | Aquathermy & solar energy<br>Underground spatial development | 0,7 | 1 | 0 | 1 |
| 19 | Best Bedrijven visie | Solar energy & energy reuse<br>Industrial area redesign | 0,3 | 1 | 0 | 0 |

An example of a case that scores moderately high (0,7) is case 12 where only a portion of the ET-solutions were integrated in the project to prevent any potential delays. This resulted in a positive fuzzy score for two outcome indicators: the realisation and corresponding delays. However, as only a small solar field was realized instead of the envisioned farm, the outcome indicator detailing the achieved potential was negative. Another example of a case scoring moderately high is case 18, this case involved a very close collaboration between the main stakeholders, namely the regional water authority, the drinking water cooperation, and the local municipality. All decisions were discussed thoroughly between these three partners, this ensured that a relatively large number of possible ET-synergies were found and incorporated (aquathermy and solar panels) in the spatial plans (high achieved potential). However, the close collaboration and the variety of required scans and feasibility analyses delayed the renovation of the drinking water infrastructure significantly (negative impact on project duration).

Case 9 is a suitable example of a moderately ineffective ET-synergy (0,3 score) that was integrated in the overarching spatial development. After significant delays caused by a lot of opposition from local parties, in the end only a small solar farm was realized. This was only a fraction of the potential identified ET-solutions that could be materialized. Case 5 is another example of a moderately ineffective ET-synergy. In this case there was a pair of ET-synergies that could be connected and was financially feasible only after two additional years of scans and feasibility analyses (negative impact on project duration). But due to the inability to obtain the suitable permits and subsidies the project starts with only a fraction of the envisioned sustainable energy (also low achieved potential).

Only two cases showed no indication of significant delay to the main project, all other 17 (89%) cases showed a significant increase in project duration caused by the synergies. In the interviews of cases 3, 4, 10 and 17 these delays were associated with the increase in the amount of stakeholder meetings and required permits for ET-synergies. This meant that only one case scored a 1 (5%) on the outcome, project 14. This project integrated two ET-synergies into the planned restructuring of their sewage treatment plant (solar panels and a biogas installation) without any delays to the original construction plans as the permits were in order and no participants were opposed to the integration.

The ET-solutions integrated in a heat network development had low outcome scores (0 or 0,3) for three out of four cases. The ET-synergies in this subgroup all experienced significant project delays and two cases even failed to integrate a single ET-solution. Another subgroup with remarkable outcome scores is the ET-solutions integrated with a renovation of a sewage treatment plant. All four cases of this subgroup scored a high score (0,7 or 1) for the outcome. These project-type specific findings will be further discussed in section 4.8.

## 4.2 Visual analysis

Based on a visual inspection of the data matrix (Table 4), it can be stated that there is an adequate degree of variation is present in the outcome and condition scores of the cases. While the selection procedure of this research only included a degree of variation of the information rules, attributes of community and boundary rules, there is a broad spectrum of scores (between 0 and 1) for both the outcome indicators and almost all conditions.

When inspecting each condition individually, an exception can be identified regarding the degree of variation. The choice rules all score a 0,7 or higher (with the exception of case 2) for nearly all cases. This lack of variation can be traced back to the selected definition of choice rules and the case selection of this study. Only projects with an identified ET-synergy were included in the list of potential cases, and for this identification process to happen, the initiating party should initially be allowed to develop integral ET-solutions. For 18 cases, the managing project team was allowed or even encouraged to develop ET-synergies by the authoritative organizations. This could potentially be explained by a potential necessity of the choice condition, though this statement cannot be fully supported by the available data. With the exception of case 2, the choice condition does not have an adequate degree of variation as a result of the biased selection of cases of this study. Because of this inadequate variation, the choice rules are excluded from further comparative analysis in this study.

*Table 4 Data matrix showing how each case scores on the potentially relevant conditions, the outcome indicators and the overall outcome of interest. With dark green showcasing project states that are highly supportive of ET-integration; light green showing moderately supportive project states; light red indicating limiting project states; and dark red indicating unsupportive project states.*

| Case nr. | Potentially relevant conditions | | | | | | | | | Outcome of interest |
|---|---|---|---|---|---|---|---|---|---|---|
| | Boundary | Position | Scope | *Choice** | Aggregation | Information | Payoff | Community | Biophysical | |
| 1 | 1 | 0,7 | 1 | *1* | 0,7 | 0,7 | 1 | 0,7 | 0,7 | 0,7 |
| ***2**** | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 1 | 0,7 | 1 | 0,7 |
| 3 | 1 | 0,7 | 1 | *1* | 0,3 | 0,3 | 0 | 0,3 | 0,3 | 0 |
| 4 | 0,7 | 1 | 0,7 | *1* | 1 | 0,7 | 0 | 0,7 | 0,3 | 0 |
| 5 | 0,7 | 0,3 | 0,3 | *0,7* | 0 | 0,3 | 1 | 0,7 | 0,3 | 0,3 |
| 6 | 0,3 | 0,7 | 0,3 | *0,7* | 0,7 | 0,7 | 1 | 1 | 1 | 0,7 |
| 7 | 0 | 0,3 | 0,7 | *1* | 0,7 | 0,7 | 0,7 | 0,7 | 0,3 | 0,7 |
| 8 | 1 | 0,7 | 1 | *1* | 0,3 | 1 | 0,3 | 0,7 | 0,3 | 0,3 |
| 9 | 0 | 0,3 | 0,7 | *1* | 0,3 | 0,3 | 0,7 | 0,3 | 0,3 | 0,3 |
| 10 | 0,3 | 0,7 | 0,3 | *0,7* | 0,3 | 1 | 0,7 | 0,7 | 0,7 | 0,7 |
| 11 | 0,7 | 1 | 0,7 | *0,7* | 0,7 | 0,7 | 0,7 | 1 | 0,3 | 0,7 |
| 12 | 0,7 | 0,7 | 1 | *1* | 0,7 | 0,7 | 1 | 1 | 1 | 0,7 |
| 13 | 1 | 0,7 | 1 | *0,7* | 0,3 | 0,7 | 0 | 0,3 | 0,7 | 0 |
| 14 | 0,3 | 1 | 0,3 | *1* | 0,7 | 1 | 1 | 0,7 | 1 | 1 |
| 15 | 0 | 0,3 | 0,3 | *1* | 0,7 | 0,3 | 0,7 | 0 | 0 | 0 |
| 16 | 0,3 | 0,7 | 0,3 | *1* | 0,7 | 1 | 1 | 1 | 1 | 0,7 |
| 17 | 1 | 1 | 1 | *1* | 1 | 1 | 0,3 | 0,7 | 0,3 | 0,3 |
| 18 | 0,3 | 0,3 | 0,7 | *0,7* | 1 | 1 | 0,7 | 1 | 0,3 | 0,7 |
| 19 | 0,7 | 0,3 | 1 | *1* | 0,7 | 0,7 | 0,3 | 1 | 0,3 | 0,3 |

Comparing the scores of each case, again case 2 is visually an anomaly in matrix. In addition to having the only low level of choice, five other conditions score low (<0.5) while the outcome score is still relatively high (>0.5). In the interview transcripts it was mentioned that the circumstances regarding this ET-implementation were relatively unique, with a well-suited project location (highly supportive biophysical conditions) and very interested investors actively coming to the regional water authority, even before the start of the dike strengthening (highly supportive payoff). These two factors alone pushed the integration of the solar panels, which compared to the interview transcripts of the other cases is an exception. Case 2 is the only case where an external private organization solely pushed for the integration of an ET-solution while the public authorities were not enthusiastic. This was a unique situation amongst the analyzed case, but the case can still provide interesting insight in a potential sufficient configuration of conditions. Case 2 is therefore not excluded from the general QCA but due to its unique circumstances the case is marked in further analyses.

Another set of cases that can be identified clearly in the coloured matrix are 3, 4, and 13. All three cases scored a 0 for the cost-distribution paired with a 0 for the outcome. This can be an indication that the payoff distribution is a necessary condition in an integral project. But in practice, the score system used to value the payoff scores for each case overlap partly with the outcome scores. This potential issue is further explored in the discussion but does not have any significant impact on the analyses. The potential necessity of the payoff condition can still be determined normally.

## 4.3 Necessity analysis

### Individual conditions

The first step to understand if the presence or absence of individual conditions is necessary for the effective utilization of ET-synergies (high outcome scores), is to test each potentially relevant condition using the outcome-condition plots described in the theory development paragraph (chapter 3.4). For the necessity analysis of the presence of the conditions, the data matrix showed multiple conditions that consistently scored higher than the outcome: 1) Information; 2) Payoff; 3) attributes of community; and 4) biophysical conditions. To verify whether the statement of necessity applies to these four conditions, a visual analysis of the outcome-conditions plots was performed (Appendix D.1). Only for the payoff condition there were no contradicting cases identified in the plot, for the attributes of community there was 1 case who contradicts the statement of necessity.

The **payoff condition** is shown to comply with the necessity requirement, all outcome scores are equal or lower than the condition score as shown in the corresponding plot (Figure 7). This would mean that for a high degree of ET-synergy implementation, the payoff condition needs to be supportive. In addition to the graph, the interviews state the importance of finding suitable investors early on in the design phase. The interview transcripts (of cases 3, 5, 9, 12 and 15) mentioned that when a cost-distribution is accepted early in the project, the processes surrounding the ET-synergy implementation experience a boost in effectiveness. The statement of necessity for a supportive payoff state can be defined as strong based on the result of this presented results.

The **attributes of community** show to almost comply with the necessity requirement. There is one contradiction (case 14) visible in the condition-outcome graph (Figure 7). Case 14 is defined by a community that is open to ET-solutions but with limited experience with any ET-developments in their area (community scores 0,7). Still the sewage treatment plant renovation of case 14 realized a highly effective ET-integration (outcome scores 1). This exception implies that the attributes of community are not a necessary condition. Though, a statement can be made for the necessity of the community for outcomes of 0.7 and lower. But based on this case study, the statement of necessity does not apply to the attributes of community.

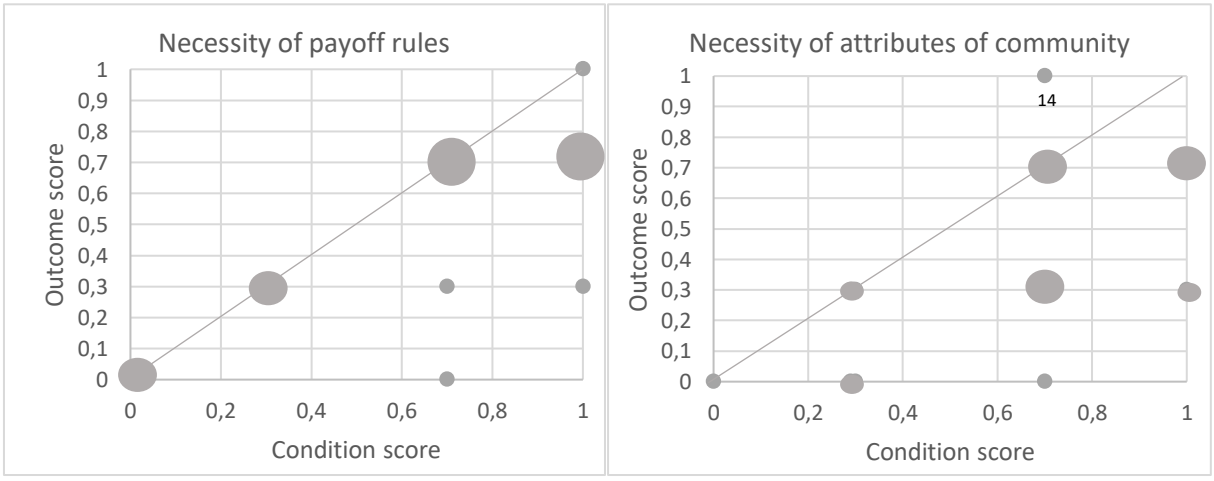


*Figure 7 Necessity analysis of a supportive payoff condition and of a supportive community condition. The size of the circles indicates the number of cases on a single data point, 1, 2, 3 and 4 corresponding with the size.*

The remaining two promising conditions, information, and biophysical conditions have at least three cases that contradict the statement of necessity, therefore only payoff condition is deemed a necessary condition for high outcome scores.

A similar method using the condition-outcome plots can be applied to analyse if the absence of individual conditions is necessary for the effective utilization of ET-synergies. All eight conditions show a minimum of five cases contradicting the statement of necessity for the absence of the supportive condition. **The boundary condition** showed the most cases where a low condition score (absence of supportive boundary) was linked to a high outcome score, seven cases scored between 0,7 – 1 on the outcome and between 0 – 0,3 on the condition (Figure 8). Still with five cases contracting the statement of necessity as can be seen on the five datapoints above the diagonal line in the plot, there are no individual conditions where the absence is shown to be necessary for effective ET-synergy integration.

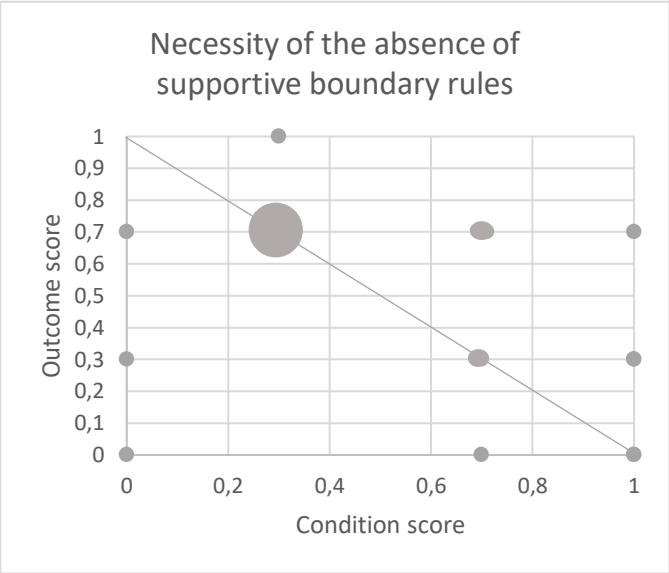


*Figure 8 Necessity analysis of an unsupportive boundary condition with datapoints of 1, 2 and 5 cases corresponding to the size.*

### Necessary combination of conditions

Only the payoff condition was shown to not contradict the statement of necessity. By using the logical operator OR, it is possible to potentially identify necessary combination of conditions. This implies that condition A OR condition B (…OR condition …) needs to be present for an effective ET-synergy implementation. The absence of the payoff condition can explain the (low) outcome scores of cases 3, 4, 8, 13, 17 and 19, but for this necessity analysis these cases will also be included to see if other necessary configurations of conditions can also explain the outcome scores. The choice-condition (case selection bias) is excluded from this analysis.

There are a high number of possible combinations that would result in a suitable outcome-condition plot for necessity. For example, the attributes of community can be paired with 5 different conditions using the logical OR-operator to form a pair that complies with the statement of necessity in the outcome-condition plot (as only case 14 was contradicting for the community condition individually). To avoid these conditions that only rely on a single case, the qualitative data from the interviews are used to identify pairs with more cases supporting the statement.

Using the OR operator, one combination of conditions was identified that supported the statement for necessity with adequate cases and interviewees supporting the statement. This combination consists of **scope rules + position rules + biophysical conditions**, a visual inspection of the plotted outcome-condition graph (Figure 9) shows that there are no cases that contradict the statement of necessity. This implies that for ET-integration there needs to be a clear and strong managerial role for the initiating party (position), or the scope of the project needs to be adequately broad (scope), or the

location needs to be well-suited for a particular type of ET-synergy. The importance of this specific configuration of conditions was based on the statements by the interviewees of cases 3, 5, 8, and 15. The necessity of this combination of conditions was shown more clearly in cases 5 and 15. All three conditions were in an unsupportive state for these two cases, both resulting in a low outcome score. While only two cases provide limited evidence, the statements of the four interviews and the absence of any contradictions makes it a relatively firm necessary combination of conditions.

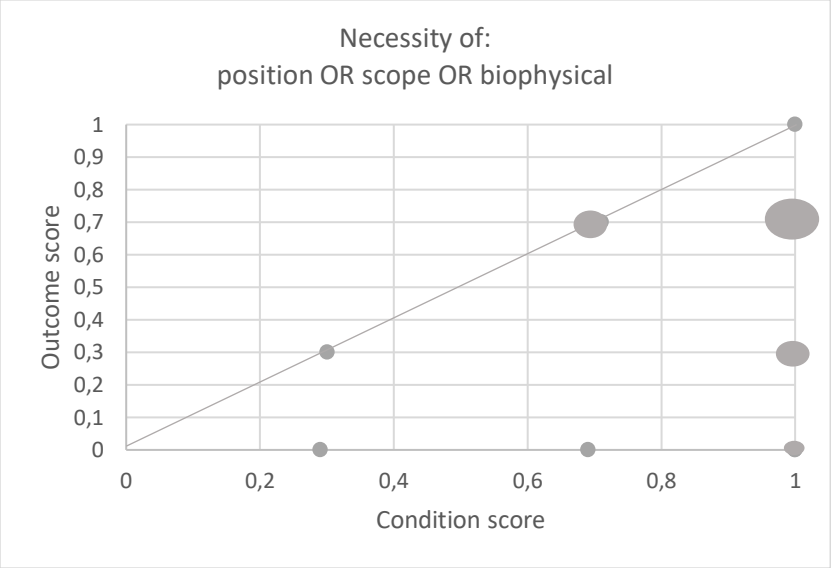


*Figure 9 Necessity analysis of the configuration: scope OR position or biophysical conditions. The size of the data points indicates the number of cases with a similar score: 1, 2, 3, and 5 data points respectively of the four circle sizes.*

To conclude the necessary analysis of the (combinations of) conditions, two selections have been identified. The presence of a supportive payoff condition is necessary for effective ET-integration. All cases with an unsupportive payoff condition, cases 3, 4, 8, 13, and 17 are shown to be linked to a low outcome score. The absence of a supportive payoff condition is the first pathway that is linked to ineffective ET-integration.

Finding adequate investors early in the project was also stressed heavily in several case interviews (cases 6, 8, 12, 13 and 17). In these five interviews the word ''synergy leader'' (in Dutch: *koppelkans trekker*) was mentioned. These synergy leaders are investors that accept to fund the ET-synergy, and therefor transform the ET-synergy from an ambition into an actual objective. When the synergy leaders were identified early in the project, potential complications and design requirements related to the synergy could still be solved and adjusted adequately. When the investors accept the costs too late into the project, it was frequently no longer possible to effectively implement the synergy opportunity.

The second necessary selection consisted of the configuration of scope, position, or biophysical conditions. This means that any of the three conditions need to be in a supportive state for effective ET-integration to occur. The low outcome scores of cases 5 and 15 can be explained by the absence of any of the three conditions, making it the second pathway leading to low outcome scores.

The interviewees of cases 3, 5, 8 and 15 describe two possible situations that enable ET-synergy implementation: 1) when there is a clear favorite ET-synergy enjoying priority above other ET-synergies; 2) when there is no clear prioritized ET-synergy and a broad variety of possible ET-synergies are analyzed to find the potential most fitting outcome (supportive scope rule). The first situation occurs when the project is set on a certain location that suits a single ET-synergy type (supportive biophysical conditions) or when the project manager pushes heavily for the implementation of a

particular type (supportive position rule). The data of the four interviews support this specific necessary configuration of three conditions.

## 4.4 Sufficiency analysis

To understand if potential combinations of potentially relevant conditions are sufficient the logical operator AND is utilized. Appendix D.3 can be consulted for the corresponding Tables used. The sufficient configurations linked to low outcome scores are formed by the absence of the necessary conditions identified in the previous section, and in this section the aim is to find pathways leading to high outcome scores.

For the sufficiency analysis for combinations of conditions linked to high outcome scores, again the irrelevant cases and conditions are excluded. These include cases 3, 4, 8, 13, 17 and 19 (necessary payoff of 0 and 0,3); and the excluded choice condition (case selection bias). The cases with a payoff score of 0 or 0,3 are excluded because for the sufficiency analysis, the payoff condition is the starting point of the assessment and the low outcome score of these cases is explained by the absence of a supportive payoff condition. The fuzzy scores used for the necessity analysis do not show adequate indications for any sufficient configuration of conditions. Therefore, as described in the methods section, the remaining cases are rewritten using a binary crisp set with 1's for positive scores (>0.5) and 0's for negative scores (<0.5), shown in Appendix D.3. With this new set there is only a distinction between supportive and unsupportive conditions and effective and ineffective outcomes. While the level of detail of the data is reduced by using a crisp set instead of the fuzzy set, the crisp scores can still provide valuable insight in potential sufficient configurations, whereas the fuzzy scores could not be used to identify sufficient configurations.

The first sufficient combination of conditions is formed by combining the two necessary selections. Based on trial and error, the biophysical conditions are selected from the position, scope and biophysical condition configuration identified in the previous section. Adding supportive biophysical conditions to the necessary supportive payoff condition creates the first sufficient configuration. The data matrix with the remaining cases (Appendix D.3) shows that all cases with a supportive payoff and biophysical conditions are linked to a high outcome score.

This configuration of payoff and biophysical conditions is the shortest possible solution for sufficiency with the lowest number of logical operators. The sufficient solution:
**Payoff AND biophysical conditions** fit for 13 out of the remaining 13 and explains the high outcome score of cases 1, *2*, 6, 10, 12, 14 and 16. With no cases contradicting the statement of sufficiency, this selection is the first condition pathway that explains the high outcome scores of the six cases.

This proposed solution implies that any case with an accepted cost distribution for the ET-synergy early in the project (supportive payoff) and a project location with no conflicting aspects with the ET-synergy (supportive biophysical conditions) is associated with effective ET-synergy implementation.

The short configuration of just two conditions is the most relevant but finding another configuration that fits the statements of sufficiency and explains more cases is also relevant. Starting with the payoff condition as the basis, one by one conditions are added to the configuration. Conditions were added until the highest number of high outcome scores can be explained without any cases contradicting the statement, this occurred with a configuration of four conditions:

**Aggregation AND information AND community AND payoff** fits for 13 out of the remaining 13 cases and explains the outcome of cases 1, 6, 7, 11, 12, 14, 16, 18). All cases where the four conditions are

in a supportive state are linked to a positive outcome score, this sufficient configuration defines the second pathway linked to high outcome scores.

This second proposed sufficient solution implies that any integral project where these four conditions are in a supportive state will succeed in effectively implementing ET-synergies: 1) efficient contact with legal supervisory parties (aggregation); 2) effective information sharing methods for all participants (information); 3) local participants who have experienced integral projects in the past (community); and 4) an accepted cost distribution for the ET-synergy early in the project (payoff).

No interviewees specifically stated that any combination of project conditions always leads to successful integration of ET-synergies. However, the interviewees of cases 8, and 13 did provide a list of what is essential before synergies can be utilized. Both mentioned a list of four required conditions: 1) A dedicated investor (supportive payoff); 2) Strong management team that pushes the synergy into the overarching project regardless of authoritative and legal opposition (supportive position & aggregation); 3) Adequate space around the project location (supportive biophysical conditions); and 4) An experienced and willing team of relevant stakeholders like the municipality, local inhabitants, and the project team itself (supportive community). These two cases supported the sufficient configuration identified in this study, but also stressed the importance of the position rule (which was deemed necessary but compensable). The other two interviewees who provided a list of essential conditions, the interviewees of cases 10 and 17, were both focused more heavily on obtaining funding and accepting all financial matters within an adequate timespan.

Based on the sufficiency analysis, two pathways can be identified that are linked to high outcome scores. All cases with a supportive payoff condition and supportive biophysical conditions were shown to have high outcome scores. Similarly, all cases where the aggregation, information, payoff, and community conditions were in a supportive state were shown to have high outcome scores.

## 4.5 Conditions producing low outcome scores

In the necessity analysis the relevant conditions were analyzed if a low score (absence of supportiveness) was necessary for high outcome scores. No conditions showed any firm signs to meet the requirements for absence necessity. Continuing this initial analysis into low-outcome production, the conditions are analyzed if a high conditions score can be linked to low outcome scores. For each of the nine cases with low outcome scores (cases 3, 4, 5, 8, 9, 13, 15, 17 and 19 score 0 or 0,3), the score can be attributed to the absence of any of the two identified necessary (combinations of) conditions (Appendix D.4.1). But in addition to these two already identified pathways, it is possible that other pathways linked to low outcome scores can be identified.

Cases 3, 4, 5, 8, 13, 17 and 19 all have high scores for the **boundary condition** but low outcome scores (Appendix D.4.2). For these cases, the low outcome score can be explained by absence of the necessary supportive payoff condition (which scores <0.5 for cases 3, 4, 8, 13, 17 and 19). But another potential pathway is mentioned by the interviewees of cases 3 and 17. The experts of these two cases mentioned that there exists a potential risk in creating a project environment with too many participants and too many ambitions associated with potential synergies. Such a situation would lead to a complex project process with too many objectives and demands, where it is difficult to select the most feasible ET-synergy and make concrete steps. When looking at the data matrix to see if this potential over-complexity is supported by the data, it is found that cases 1, 11 and 12 contradict the statement. In these three cases a high boundary score (0,7 or 1) resulted in a high (0,7 or 1) outcome score. Based

on the available data, no firm statement can be made in regard to the potential low outcome production of a supportive boundary score.

The seven other relevant conditions show no indication of producing low outcome scores. Each condition produced an outcome-condition plot (Appendix D.4) where low outcome scores were mostly linked to low condition scores, as was expected based on the hypotheses formulated for each condition in this study. Consequently, it can be concluded that the effective implementation of ET-synergies is not negatively influenced by the supportive presence of any of the eight relevant conditions.

## 4.6 Potentially irrelevant conditions

The data matrix, the interviews and the performed analyses show that from the eight remaining conditions, seven are relevant due to associations with necessary or sufficient condition configurations. Only the boundary condition is shown to be potentially irrelevant, as there are multiple cases where a high boundary score is related to a low outcome score (cases: 3, 4, 8, 13, 17, 19) and multiple cases where a high boundary score is related to a high outcome score (cases 1, 11, 12). Based on this data, it is indicated that the **boundary condition** can potentially be irrelevant in the implementation process of ET-synergies. Showcasing the potential unimportance of a very broad and flexible participant involvement process. In the discussion section, this potential relation between a broad and flexible participant selection (high boundary score) and a low outcome score is further explored with case specific examples and the potential irrelevancy is discussed.

## 4.7 Qualitative explanation of case pathways

To explain the outcome of each case, four pathways were identified using the results of the necessity and sufficiency analyses. It is possible that multiple pathways are possible to explain the outcome of a single case (Table 5 and 6). The qualitative explanation for the relevant pathways for each individual case can be found in Appendix D.5.

*Table 5 Identified relevant pathways linked to high outcome scores*

| **Relevant pathway linked to high outcome score** | **Fits for cases** | **Qualitative description** |
|---|---|---|
| Presence of supportive payoff AND biophysical conditions | 1, *2*, 6, 10, 12, 14 | A high outcome score is linked to a high score for the sufficient configuration consisting of the conditions: payoff and biophysical conditions.<br><br>All cases where the cost-distribution was accepted early in the project (payoff) AND the project location created no conflicts with the potential ET-synergy (biophysical conditions) experienced high outcome scores. |
| Presence of supportive aggregation AND information AND payoff AND community conditions | 1, 6, 7, 11, 12, 14, 16, 18 | A high outcome score is linked to a high score for the sufficient configuration consisting of the conditions: aggregation, information, payoff and community.<br><br>All cases where the legal communication was efficient (aggregation), the information sharing was effective (information), cost-distribution was accepted early in the project (payoff) and the local participants were open and experienced with integral projects (community) were associated with high outcome scores. |

*Table 6 Identified relevant pathways linked to low outcome scores*

| Relevant pathway linked to low outcome score | Fits for cases | Qualitative description |
|---|---|---|
| Absence of supportive payoff condition | 3, 4, 8, 13, 17, 19 | A low outcome score is linked to the absence of a supportive payoff conditions.<br><br>All cases where the cost-distribution related to the synergy was accepted too late in the project (low payoff scores) were linked to low outcome scores. |
| Absence of supportive position AND scope AND biophysical conditions | 5, 15 | A low outcome score is linked to the absence of a supportive condition for all three conditions of the necessary configuration (position, scope, and biophysical conditions)<br><br>All cases that lack a single strong manager (low position score), a broad scope (low scope score) AND a project location without conflicts (low biophysical conditions) was associated with low outcome scores. |

Case 9 is only project that is not explained by any of the pathways. Case 9 does not contradict any of the pathways, the case has both necessary (configurations of) conditions and did not meet the requirements for any of the sufficient configurations. This meant that both pathways leading to a low outcome score and both pathways leading to high outcome scores were not relevant for case 9. It can be speculated that the low scores for aggregation, information, and community (all three are part of a pathway linked to high outcome scores) have contributed to the low outcome score. However, as only a single case provides evidence for such claims, no firm statements can be made regarding the explanation of the low outcome score of case 9. To conclude, the outcome scores of all other 18 cases (including case 2) are explained by the four identified pathways.

## 4.8 Subgroup results

In this study the cases analysed could be divided into four specific spatial development types, with four to six cases of each individual context. The data matrix components of each individual and the interview transcripts have led to a set of context-specific findings regarding the required conditions for ET-integration. The necessity and sufficiency analyses would not lead to suitable results for such small sample sizes and are therefore not utilized.

### Dike strengthening & renovation

Development projects involving a dike show a wide variety of outcome scores. In the interviews it was mentioned that this was associated with the potential absence of local energy demand (unsupportive biophysical conditions) as dikes can potentially be located far away from any energy demand. With three out of the six cases, the ET-synergy scored a low outcome score as the result of the inability to find investors in time because of the often large, required investments. When the biophysical conditions were supportive, the dike strengthening projects were much more likely to be suited for ET-integration. The interviewees also mentioned that other types of synergies were also implemented in the scope of the dike-project. The long project duration and large space made the projects excellent contexts for a broad variety of integral solutions (like nature, mobility, or recreation).

*Table 7 Pathways related to subgroup: Dike strengthening and renovation*

| Case ID. | Outcome of interest | Relevant pathway |
|---|---|---|
| 4 | 0 | Absence of necessary condition:<br>**Absence of supportive payoff condition** |
| 6 | 0,7 | Presence of both sufficient configurations:<br>**Supportive payoff and biophysical conditions**<br>**Supportive aggregation, information, payoff and community** |
| 9 | 0,3 | ***Unexplained*** |
| 10 | 0,7 | Presence of sufficient configuration:<br>**Supportive payoff and biophysical conditions** |
| 13 | 0 | Absence of necessary condition:<br>**Absence of supportive payoff condition** |
| 17 | 0,3 | Absence of necessary condition:<br>**Absence of supportive payoff condition** |

### Sewage treatment plant renovations

The high scores of the sewage treatment context were attributed in the interviews to the reduced opposition faced for ET-solution on an area that is already industrially used (higher community score) combined with a location where energy demand is close by (biophysical score). The scores imply that the spatial development projects involving a sewage treatment plant are very suited for the implementation of ET-synergies. The case pathways show a similar explanation, as all four can be explained by the two sufficient configurations of conditions.

Cases 12 and 14 were the two projects where no significant delay could be attributed to the synergy implementation. These two cases were an exception as the existing function of the project location was already occupied by an industrial function (the sewage treatment plant remains on the same location but occupies less space due to the development). This resulted in less opposition (and thus less required investigations and participation) for ET-developments. Cases 1 and 16 did not have this benefit, as the area surrounding these plants were designated to have an ecological function (which had to be preserved to a significant degree).

*Table 8 Pathways related to subgroup: sewage treatment plant renovations*

| Case ID. | Outcome of interest | Relevant pathway |
|---|---|---|
| 1 | 0,7 | Presence of both sufficient configurations:<br>**Supportive payoff and biophysical conditions**<br>**Supportive aggregation, information, payoff and community** |
| 12 | 0,7 | Presence of both sufficient configurations:<br>**Supportive payoff and biophysical conditions**<br>**Supportive aggregation, information, payoff and community** |
| 14 | 1 | Presence of both sufficient configurations:<br>**Supportive payoff and biophysical conditions**<br>**Supportive aggregation, information, payoff and community** |
| 16 | 0,7 | Presence of both sufficient configurations:<br>**Supportive payoff and biophysical conditions**<br>**Supportive aggregation, information, payoff and community** |

### Heat network installations

The low scores of the projects involving the installation of a heat network were attributed in the interviews to the complex project environment already present in these projects. In comparison to the other project types, the heat networks projects deal with a broader spectrum of objectives and numerous opposing parties. This subgroup is involved in both cases where the absence of a necessary configuration of conditions (instead of the necessary payoff conditions) led to a low outcome score (cases 5 and 15). This is explained by the complexity of the development of heat networks. A small aquathermy synergy can be financially interesting, but the added complexity wards off many project

teams to implement it. Coincidently, the state of the position-rule is relatively important in this subgroup (position has a role in two of the four pathways) and was mentioned actively in the respective heat network interview. A strong manager who can decide whether an ET-synergy was mentioned to be valuable for a project is important in these complex contexts.

*Table 9 Pathways related to subgroup: heat network installations*

| Case ID. | Outcome of interest | Relevant pathway |
|---|---|---|
| 3 | 0 | Absence of necessary condition:<br>**Absence of supportive payoff condition** |
| 5 | 0,3 | Absence of necessary configuration:<br>**Absence of supportive position, scope, AND biophysical conditions** |
| 11 | 0,7 | Presence of sufficient configuration:<br>**Supportive aggregation, information, payoff and community** |
| 15 | 0 | Absence of necessary configuration:<br>**Absence of supportive position, scope, AND biophysical conditions** |

## Strategic planning

Incorporating ET-synergies in long-term strategies has in all cases led to a significant delay of the planning process. In the scope of these projects there is no physical implementation of the synergy, this has resulted in less opposition for the ET-solution compared to other project types, but also led to a situation where no suitable investors were found in time for the synergies (in two out of four cases, the low payoff score led to a low outcome). The project characteristics of these cases show the importance of adequate governing capacity of the initiating organisations. All four cases had a relatively large public authority as the initiating party. Other initiators like small municipalities do not have the capacity (in terms of manpower and expertise) to effectively include ET-synergies in their (long-term) strategies.

*Table 10 Pathways related to subgroup: Strategic planning*

| Case ID. | Outcome of interest | Relevant pathway |
|---|---|---|
| 7 | 0,7 | Presence of sufficient configuration:<br>**Supportive aggregation, information, payoff and community** |
| 8 | 0,3 | Absence of necessary condition:<br>**Absence of supportive payoff condition** |
| 18 | 0,7 | Presence of sufficient configuration:<br>**Supportive aggregation, information, payoff and community** |
| 19 | 0,3 | Absence of necessary condition:<br>**Absence of supportive payoff condition** |

# 5. Discussion

## 5.1 Qualitative comparison of study findings

### Necessity of the payoff condition

A supportive payoff condition was shown to be necessary for high outcome scores, but the other conditions can potentially impact the supportiveness of the payoff condition. The quote from the interview transcript of case 6: ''there is always money for a great idea'' encapsulates the complexity of the necessity statement. A supportive payoff state can, for example, be the result of supportive information, aggregation, and biophysical conditions. The perfectly suited location, efficient communication and adequate information sharing could persuade the participants to invest early in the ET-synergy opportunities. This inter-condition dependency and corresponding ambiguity for necessary conditions does not invalidate the findings, the necessity of the payoff condition is still supported. Rather, it provides insight in the complexity of understanding the role of conditions and warrants future research into the inter-condition dependencies that fell outside of the scope of this study. Specific scenarios are possible where due to the supportive presence of other conditions the state of the payoff is redundant, but the necessity is still supported by the (relatively limited) number of cases available.

When comparing the necessity of the payoff to the broader literature on ET-integration, comparable statements can be identified. Though the definition in the literature is centred more around acquiring adequate funding and less on the timing of the funding. A study on ET-developments (Kemp, Rotmans & Loorbach, 2010, p. 315-331) mention the importance of a close cooperation between private and public stakeholders for the funding of synergies. Stressing how efficient communication and sharing of information (supportive information rules) between private and public parties lead to a better understanding and quicker accepted cost-distribution (supportive payoff rules).

The study on mainstreaming climate adaptation (Runhaar et al, 2017) that was used to formulate the hypothesis for a supportive payoff condition reaffirms the statement of necessity for the payoff condition in particular. The study mentions how 'obtaining adequate investors' was an inhibiting factor in 27 out of the 50 analyzed cases, one of the main inhibiting factors analyzed in the study. Other factors like the political commitment (community), information sharing (information) and a flexible scope (scope) were less inhibiting compared to the payoff.

### Conditions that meet the necessity criteria

The position, scope and biophysical conditions were shown to be a necessary combination of conditions. Only one of the three conditions is required to be in a supportive state to allow high outcome scores, which may suggest that there is a form of compensation between the conditions. As an example, the position and biophysical conditions can be in an unsupportive state, but a supportive scope can compensate the two unsupportive states to still obtain a high outcome score.

When compared to the broader literature on integration, partially resembling statements can be identified for the individual conditions but not for the compensable combination of the three. The mainstreaming literature (Runhaar et al, 2017) mentions that clear leadership is a driving factor for integration in 23 out of the 50 analyzed cases. Showcasing how a supportive position rule (clear managing role) is one of the main driving factors for integrating synergies (in this case related to climate adaptation). However, the width of the objective definition (scope rules) was shown to be a driving factor only in 1/50 cases. Indicating a potential irrelevancy of the scope condition and thus not fully supporting the necessary configuration.

The mainstreaming literature does not include the physical location in the research, but grey literature does focus heavily on the biophysical conditions. Practical integration guidelines (Handboek koppelen NKWK, 2020) stress the importance of implementing the ''low hanging fruit'' of ET-synergies. The guidelines mention how by looking at all possible synergies (supportive scope condition), certain simple integration opportunities can be identified based on the properties of the project location (state of the biophysical conditions). Interestingly, this implies that both a supportive scope and supportive biophysical conditions need to be present for effective ET-integration according to the grey literature. This contradicts the compensation mechanism between the conditions identified in this study.

There is a possibility that more necessary combinations of conditions exist, especially with the relatively low number of cases there are many configurations that met the necessary requirement. However, the two necessary (combinations of) condition(s) were both supported by the interviewees and to an extent by literature. Other analyzed configurations did not have a similar backing and thus are deemed less relevant compared to the two identified necessary configurations.

### Conditions that meet the sufficiency criteria

The choice to consider sufficiency in a binary manner in the analysis limits the explanatory power and applicability to an extent. The use of more sophisticated explanatory model than the one used however could not be supported by the limited dataset, as was tried by initially using the fuzzy scores. With the binary model, the sufficiency analysis still complies with the initial statement for sufficiency. A configuration of conditions needs to be in a supportive state to always lead to a positive outcome score. The score cut-off for this supportive state has been set to >0.5 (crisp) for both the conditions and the outcome.

The literature does not provide any statement of a sufficient configuration for ET-integration. However, the mainstreaming literature used to hypothesise the supportive states (Runhaar et al, 2017) does specify the importance of each of the four conditions specifically. Political commitment (driving factor in 31/50 cases) and awareness (driving factor in 15/50 cases) show how the attributes of community are crucial for effective integration. Insufficient information sharing was shown to be an inhibiting factor in 18/50 cases and a supportive regulative framework (aggregation) was a driving factor in 8/50 cases. The fourth condition, payoff, can be traced back to finding adequate investors, which was inhibiting in 27/50 cases. These four conditions were all shown to be relevant and especially community and payoff were one of the most impactful conditions analysed by Runhaar et al (2017).

Case 2, which was deemed unique and consequently highlighted in the analyses, was in hindsight a form of evidence for the sufficient configuration of supportive payoff and biophysical conditions for effective ET-integration. While most conditions were unsupportive, no necessary conditions were absent and the payoff and biophysical conditions of case 2 alone were sufficient for the ET-synergy to be implemented effectively.

### Boundary condition: Irrelevant or low outcome score producer?

In the interview transcripts the potential relation between a supportive boundary and an unsupportive payoff condition was mentioned. From the selection of nine cases with a high boundary score, six cases obtained a low outcome score (cases 3, 4, 8, 13, 17, and 19). This can indicate that a boundary that is too broad and flexible can potentially lead to a situation where investors are selected too late in the project process. Based on the available data it cannot be firmly stated if the boundary condition has an internal effect on the payoff, as this dependency falls outside of the scope of this research.

Another potential explanation is that the role of the boundary condition does not follow a linear path as described in the scoring system and the hypotheses. With all conditions, the supportive state was based on literature, the unsupportive state was the opposite, and two linearly interpolated scores were created between the two scores. However, it is possible that for the boundary condition it needs to be not too-broad and not too-narrow to be in a supportive state. Looking at the data matrix (Table 4) there is a potential support for this theory. The 11 relevant cases with a boundary score of 0,3 or 0,7 have a high outcome score of 0,7 or 1 in 8/11 cases. Within the selection of eight relevant cases with a boundary score of 0 or 1 (highly supportive and fully unsupportive) only 2/8 cases show a high outcome score of 0,7 or 1. Though there are still five cases that contract this potential non-linearity, it does provide an interesting insight in how the design of the score system can have significant consequences.

In the literature on ET-developments no indication on the potential negative side of involving too many relevant participant types can be found. On the contrary, Kemp, Rotmans & Loorbach (2010, p. 315-331) mention how adequate participation, in addition to the private-public cooperation, is crucial for developing ET-solutions. The literature shows how involving all relevant parties (supportive boundary) in the process leads to reduced opposition and increases the likelihood of implementing ET-solutions. Similar statement can be found in the mainstreaming literature (Uittenbroek et al, 2014). Sharing responsibility by actively involving all relevant parties (supportive boundary) in the decision-making process is deemed one of the three crucial requirements for integrating climate adaptation.

The interviewees of cases 1, 8, 13 and 17 all mentioned that the boundary condition was especially important for the identification of spatial synergies not related to the energy transition. While these types of synergies fall outside the scope of this research, it is interesting to note that out of the four projects that did not realize any ET synergy, three cases did succeed in implementing synergies with other spatial objectives like ecology or recreation. This indicates that there exists a potential difference between the supportive states for ET-integration and other spatial objectives. The outcome of case 17 is a great example of this scenario, here only a small aquathermy solution was implemented with the dike strengthening, but a wide variety of ecological and recreational synergies were successfully implemented. This was credited to the high number of stakeholder types (supportive boundary) that were involved in the design process of the synergies. Organisations linked to nature, recreation and mobility worked together with local inhabitants to identify and implement the spatial synergies (also indicates the role of supportive position and information conditions). Studying the role of the relevant conditions on the achievement of spatial synergies that are not related to the energy transition can be interesting for future research, which is further explored in section 6.2.

## 5.2 Practical implementation of study findings

The findings of this study highlight the necessity of a supportive payoff condition for effective ET-synergy implementation. The moment a participant wants to cover the investment-costs the ET-synergy changes from a potential idea to an actual component that can be effectively integrated in the overarching project. The project managers can focus on assigning investors to specific identified ET-synergies early in the identification process. The interviews (of cases 3, 4 and 17) show how interactive sessions like workshops and discussion can help greatly with this persuading process of potential investors.

The necessity of the presence of a supportive position, scope or biophysical conditions can be utilized in projects by properly analyzing the project circumstances. When a project team is focusing on a single ET-synergy type (for example due to an optimal location or a pressuring project manager), a broad

scope is not required. However, when both these conditions are not present, the project team needs to broaden the scope of potential ET-synergies to benefit the implementation process of these ET-synergies.

The sufficient configurations of conditions can be practically utilized by using it as shortened lists of crucial conditions. Project teams can start by thoroughly scanning the project location and the local community to see if the external environment is supportive of ET-synergy integration. If for example the location is well-suited for ET-synergies or if the local participants have positive experiences with ET-integrations the ET-synergy can potentially be implemented effectively. The project team must make sure the authoritative parties are aware of the ET-integration opportunity to streamline communication (improve aggregation). At the start of the project, information sharing methods should be designed specifically to share all information concerning the ET-synergy effectively amongst all participants (improve information). Finally, possibly the most essential step, the project team should stress on identifying and persuading potential investors of the synergy, as early as feasible. By focusing on these steps and relatively less on the boundary, position, and scope of the project, the project team is able to implement ET-synergies more effectively.

The findings show some indications that creating a highly supportive boundary condition is potentially irrelevant for the ET-integration. The indications show that there might not exist a linear increase in impact when the boundary becomes broader and more flexible, which was expected in the scoring system. This would mean that heavily focusing on involving as many participant-types as feasibly possible might not be an effective strategy to benefit ET-integration. Project teams should not neglect the number of participant types, but the results show that creating a too-broad boundary condition is not a supported effective strategy to implement ET-synergies based on the available case data. Instead, after a reasonable number of participants (mostly sectoral) have been involved, the focus should shift towards other conditions (like the previously mentioned sufficient configurations).

## 5.3 Reflection on methods and approach

### Reflection on research approach

This research combined the definitions of the IAD framework and the steps of the comparative analysis approach of QCA. Both IAD and QCA have shown to be potentially valuable parts of a research approach when dealing with the interpretation and analysis of ET processes. QCA allows a more generally applicable interpretation and analysis of the varying unique case conditions that are present in the complex ET context. Pruditsch (2017) shows how QCA enables the researcher to identify the role of specific (combinations of) conditions in the complex context of sustainable energy projects. The utilization of the IAD framework allows researchers to use a recognizable basis of defined processes to conceptualize the complex social actor interactions present in the ET-integration context. Milchram (2019) utilized this framework to analyze the change over time of the core values of parties involved in the energy transition.

By using both the recognizable definitions of the IAD framework and the generally applicable analysis of the QCA, this study attempted to combine the benefits of both research approaches to interpret and analyze the integral ET context. The combination of IAD and QCA did not allow a detailed analysis on the causal relations of the condition dependencies, and both approaches did not provide firmly supported conclusions without ambiguity. Still, it provided a feasible research approach to create generally applicable results based on an existing and recognizable framework and a systemic analysis of cases. The potential scientific benefit of combining the IAD and QCA methods when studying complex social actor interactions can most clearly be recognized in the context of explorative studies.

The ambiguous answers created by this research approach are especially well-suited in the scope of identifying the most crucial conditions (in this study the payoff condition). For a more detailed analysis of single conditions the QCA – IAD combination might not be the preferred research approach.

### Study limitations

This research involved multiple qualitative case studies, which are prone to be inherently complex due to case-specific irregularities (Yin, 2009, p. 127 - 167). Because of this complexity, producing generally applicable results from the analyses can be difficult. The QCA approach selected for this study helps with handling these irregularities. By using fuzzy and crisp logic to score the cases on nine selected relevant conditions, the scores can be easily compared between cases and generally applicable results can be identified. Still, the complexity of the integral project context (large number of human interactions and choices) makes stating general conclusions difficult. Due to this complexity, it is difficult for the results to be firmly claimed to be generically valid. This is also reflected in the ambiguity of the scoring system and the necessity and sufficiency analyses. The combination of QCA and IAD also reduced the impact of this complexity, as recognizable processes and actor-interactions taken from the IAD-framework were analyzed.

The scoring system utilized in this study is still prone to researcher bias, even with precautions to reduce subjectivity. The difference between a 0,3 and a 0,7 score can come down to the personal choice of the researcher when the state of the condition is situated between two scores. This can potentially affect the results, as subtle subjective differences can significantly impact the findings. Similarly, the input of this study is mainly based around the interviews. The acquired data of this research is inherently prone to subjectivity as the interviewees all have a personal view and opinion on the projects they worked on. To help with the potential researcher and interviewee bias, all case scores can be traced back to the condition- and outcome templates and multiple experts were interviewed per case. Both precautions helped with creating data that can be linked to the templates and the scoring system, which will be further explained in the internal validity section.

Only the direct interactions between project-conditions and the outcome have been assessed. All internal interactions shaping the interactions between the conditions have only been analyzed superficially. Understanding the internal mechanisms of a project would require a more in-depth study for each case and falls outside the scope of this research. The identified necessary and sufficient (combinations of) conditions are still relevant findings and can be utilized in practice. However, to get a complete insight in how the ET-integration processes are affected by the conditions, it is recommended to also understand the internal dependencies shaping the conditions themselves.

Not all possible sufficient and necessary configurations have been identified or fully analyzed. Only a select number of combinations have been analyzed in more detail based on the interview transcripts and the findings on the individual and paired conditions. It is possible that other relevant necessary and sufficient configurations can be identified. Though this is unlikely as the most promising (to a feasible extent) configurations have been analyzed adequately based on the available interview data.

The number of cases (19) analyzed in the scope of this study was modest compared to the high number (9) of relevant conditions and the complex nature of the context. The data matrix alone (Table 4) is too limited to firmly support all conclusions, as not all condition combinations have been adequately covered by the 19 cases. There exists the possibility that the internal dependencies of the conditions significantly affect the interpretation of the sufficient and necessary configurations due to collinearity. While involving more cases would have improved the firmness of the claims, it would not have allowed a similar in-depth analysis of each case, making it unfeasible for this study.

To define and value the project-conditions, it was assumed two indicators taken from the literature could approximate the state of the conditions. This method allowed for a systemic rating of all cases based on similar indicators but is prone to subjective and potentially limited rating. As two indicators are not fully adequate to represent the realistic state of the conditions. However, putting in more indicators per relevant condition could potentially clutter the data and increase the required time for the analysis, which was deemed unfeasible compared to two indicators.

Cases 1, 8, 11, 18 and 19 were not yet fully finished (with the ET-synergy not fully implemented) at the time of the interview. This resulted in a minor limitation on the amount of available online project documentation and interviewee information. In the interview it was mentioned that for all five cases it was anticipated that the identified ET-synergies would be implemented as expected at the time. It is still possible however that complications or opposition could have occurred between the time of the interview and the finalization of the project. But these possible scenarios have not been considered in the analyses when not mentioned by the interviewee.

### Internal validity

To produce generally applicable results from the varying unique case circumstances, a number of adjustments have been applied to the research methods to strengthen the validity of the findings and reduce the risk of irrelevant results. These adjustments revolve around the case selection, the data collection, and the data analysis.

For the case selection, to ensure all cases were selected based on similar principles and qualities, the selection protocols were similar for each type of project. Ensuring each project was assessed objectively based on their potential contribution to the set of available data and not based on the personal preference of the researcher. Moreover, the cases selected were all still active or finished in the period 2019-2021 to reduce the possible impact of a gradual historical change in actor interactions.

In the QCA-steps used in the data analysis of this research, a combination of fuzzy and crisp logic is applied to a scoring system. This allowed for case scores to be traced back to a specific condition mentioned in the interviews without significant room for a personal interpretation by the researcher. Individual situations can occur when condition scores can for example be interpreted both as a 0,7 or a 1 based on the score system during a reproduction. However, the case-system and relatively simplified crisp- and fuzzy scores reduce the severity of these complications.

The data collection of this study involved interviews as the main source of information. This method of data acquirement is prone to a personal bias of the interviewee. To reduce the impact of this possible bias, three sets of actions were implemented in this data collection protocols of this research. First, the interview structure was setup to not steer the interviewee towards explaining a (for example) possible negatively phrased condition effect. The questions asked in the interview were aimed to allow the interviewee to talk openly and only steer when certain topics had to be covered. The second action was to ensure data obtained from individual organizations are comparable. Four cases (1, 2, 4, 15) were selected to have two separate interviews with associates from separate organizations. The third action involved selecting the interviewees based on their function and organization to reduce the potential bias from a certain background. Though an adequate variety of functions were involved in the interviewees (Appendix C.3), a high number (15/23) of the interviewees were associated with Royal HaskoningDHV. There appeared to be no significant difference with cases involving two interviewees (case 1, 2, 4, 15) between the information provided by Royal HaskoningDHV interviewees and the interviewee associated with the public authority.

The data (both the data matrix and the interview transcripts) collected were visually scanned to see if any datapoints showed signs of unexplained and unique results. The entire dataset of the choice-condition was deemed an anomaly as a result of a biased case selection. The scores would not provide any suitable data and were therefor excluded from further analyses. Similarly, an anomaly was identified in the interview and corresponding scoring of case 2, which was subsequently highlighted in the QCA analysis to see if the unique circumstances would interfere with the necessity and sufficiency analyses.

### External validity

Case studies are prone to be difficult to reproduce as cases can potentially produce unique data or be interpreted as such. To ensure the methods used can be applied to other cases and produce comparable results, precautions have been implemented in the conceptualization, case selection and data analysis components of this study.

The conclusions made in the data analysis component of this study were all anchored in existing literature. The initial hypotheses, upon which the pathways and the scoring system are based, are selected from comparable literature. Making these hypotheses and corresponding conclusions at least plausible. All identified pathways were to an extent confirmed by literature (only the necessary configuration was not supported but was strongly confirmed by the case-evidence). Each pathway was also supported by multiple interview transcripts, further increasing the plausibility of the conclusions. The variety of literature and interviews supporting the identified pathways indicates that the pathways can potentially be applied in contexts other than the water-related spatial development projects.

The IAD framework that was used to conceptualize the actor interactions ensures the selected relevant conditions are more easily recognized and reproducible. This reproducibility allows the potential application of the findings on other non-water-related contexts without significant changes to the conditions. By using the IAD components as a basis, the selected conditions include a general representation of the relevant project aspects that can be associated with actor interactions. This ensures that biased, personal or too context-specific conditions are not easily incorporated in the data-collection protocols of this study while simultaneously providing a basis of easily applicable actor-interactions and processes.

In the case selection, only projects with the ET as a ''side-objective'' were included. This allows the results to be potentially valid for spatial development projects in other contexts as well when the ET is perceived as a side-objective, similar to the cases in this study. On the contrary, the results of this research may not be valid for projects where the ET is the primary objective as it fell outside of the scope and case selection.

The ET-context is constantly developing and changing the landscape of ET-synergy implementation. This means that even though this study only analyzed very recent cases (2018-2021), the findings may not be valid in future contexts. There are constant changes like the legal objective to reduce the CO2 emissions by 49% (even 56%) by 2030 through the Paris agreements and recent developments like the Urgenda-verdict which dictates that the state needs to put more effort (e.g., more funding) in the Dutch ET. These developments only increase the pressure and urgency to implement ET-synergies and can affect the role of the nine relevant conditions. The scope of this research is also affected by the timeliness of the ET, as only projects where the ET is the synergy, ''the side-objective'' are included in this study. It is possible that in the future due to the increased urgency, all projects have the ET as the primary objective, reducing the representativeness of the results. While the case selection of only the most recent projects (2018-2021) reduced the impact of this timeliness, the findings may still not be valid for future contexts. When implementing the results of this study in practice in future periods, it is important to analyze the potential impact of the ET-landscape change.

# 6. Conclusion and recommendations

## 6.1 Conclusion

Public authorities often lack the required knowledge to adjust project processes to facilitate the integration of ET-synergies in their spatial development projects. These spatial development projects where ET-synergies were achieved with varying levels of success were studied to understand the role of individual project conditions on effective ET-synergy implementation. The findings show four condition pathways that are associated with the absence and presence of effective ET-synergy implementation. Two pathways are linked to low outcome scores, one consisted of the absence of a single necessary condition and the other consisted of the absence of three conditions together forming a necessary configuration. The other two identified pathways were linked to high outcome scores and consisted of two sufficient configurations of conditions which, when all in a supportive state, would in all cases lead to an effective ET-synergy implementation.

The integration of ET-synergies in spatial development projects is a complex study context where decisions are made through multiple actor-interactions. To interpret these complex interactions, nine conditions were selected from literature to conceptualize the study context. The conditions suggested to be relevant were inspired by the Institutional Development & Analysis (IAD) framework. The external conditions were formed by the prior experience of the local community (1: attributes of community) and the physical project location (2: biophysical). While a combination of participation (3: boundary), role-distribution (4: position), scope (5: scope), allowed actions (6: choice), communication with authorities (7: aggregation), information sharing (8: information) and the timing of cost-distribution (9: payoff), formed the conceptual internal project context.

Using fuzzy scores, the ET-synergies implemented in the 19 selected cases were scored based on their negative impact on the overarching project (delays caused by the synergy) and on their achieved contribution to the ET (in the form of total energy generated or saved by the synergy). In addition to the synergy-outcome, each case was also scored based on the level of supportiveness of the nine relevant conditions. Only the choice condition showed insignificant variation in the case data, all other conditions and outcomes showed an adequate degree of variation.

The comparative analysis of these condition- and outcome scores identified that a supportive payoff condition is necessary for effective ET-synergy implementation. The timing when the costs of an ET-synergy is accepted is crucial for the synergy's level of success. When the costs are distributed too late into a project (which would indicate an unsupportive payoff condition), the integration is less effective overall as a 'synergy leader' is missing who transforms the synergy into a concrete objective. No other individual conditions were deemed necessary or sufficient for effective ET-integration.

The necessity of the individual payoff condition is one of the four identified pathways. The second pathway linked to low outcome scores consists of the absence of the necessary configuration of the position, the scope, and the biophysical conditions. It was identified that within a project there either needs to be a clear focus on one single ET-type, or a very broad scope of ET-synergies had to be analyzed. The single ET-type can be the result of clear managerial focus (supportive position) or a location that highly benefits a certain ET-type (supportive physical conditions). When no clear focus was present and the scope was narrow, the case obtained a low score for the synergy implementation.

The third pathway that was identified was the shortest sufficient configuration that was linked to high outcome scores. This configuration consists of the conditions: payoff and biophysical conditions, which fits for all 19 relevant cases. All six cases where the conditions are both in a supportive state, have effectively implemented an ET-synergy. The fourth pathway was also a sufficient configuration linked

to high outcome scores, consisting of the conditions: aggregation, information, payoff, and community. All nine cases where these four conditions are all in a supportive state have effectively implemented an ET-synergy.

This research showed how the absence and presence of effective ET-synergy implementation can be explained by four pathways. In practice, these pathways can be utilized to optimize the project conditions to support effective ET-integration. Project leaders aiming to integrate an ET-synergy can focus on ensuring the necessary and sufficient combinations of project conditions are all in a supportive state. It is especially recommended for project leaders to focus on engaging adequate investors early in the project, as the individual payoff condition plays a crucial role in the achievement of ET-synergies.

## 6.2 Recommendations for further research

This study experienced a number of limitations, and the findings posed several new questions. To address these aspects, five recommendations for further research are put forward based on this research.

The first recommendation for future research is a continuation on this research. The QCA-IAD combination was well-suited to identify the most impactful conditions, which was shown to be the payoff condition. But for an in-depth analysis of a single condition the study structure was suboptimal. Therefore, it is recommended that in further research the payoff condition is analysed individually. The approach to study 9 conditions simultaneously does not allow for adequate in-depth insight in the role of the conditions. Future research can provide this information by focussing on a lower number of conditions simultaneously, like fully focussing on the role of a timely cost-distribution.

The second recommendation is aimed at expanding the performed research. By expanding the number of cases and including more steps from the QCA approach, it is possible to provide more evidence to support the identified statements. Four types of cases are recommended to be added for this potential research expansion: 1) cases where the ET-synergy failed to be implemented to test the identified pathways leading to negative outcome scores; 2) cases where the state of the choice condition varies adequately to allow analysis of the impact of the choice condition; 3) cases where no delays were registered as a result of the ET-integration as the current selection only includes two cases without delays; and 4) cases where the ET-synergy was implemented effectively (achieving high potential and without delays, the 1 score) as the current selection only includes a single case with a very effective outcome score. In addition to a high number of cases, it is recommended to include QCA coverage parameters and the related software in the research methods for future research. Though more cases and QCA steps will lead to firmer conclusions, the study structure is not suited for in-depth analysis of the individual conditions. The missing cases and QCA steps should only be added when all nine relevant conditions need to be exploratively studied without the requirement to do any single in-depth analysis.

For the third recommendation, it is advised that in future research, a more comprehensive model is developed with respect to inter-condition dependencies. The current IAD-inspired conceptual model did not allow for any analysis of the internal mechanisms. Incorporating the interactions present between the conditions in the model will allow more insight to be gained in how conditions are interacting and what configurations are required for certain outcomes. With the current conclusions regarding necessity, analysing the condition dependencies can for example provide insight in how the payoff condition is influenced by the state of the other conditions.

The fourth recommendation focusses on the potential optimum in the broadness and flexibility of the boundary condition that was identified in the discussion. This would mean the current linear scoring system (broader = more supportive) is inadequate to appropriately rate the boundary condition. Future research should focus on this theory and look into a potential optimum of the broadness and flexibility for the boundary condition. It is beneficial to study the other eight conditions as well, but there is little evidence indicating a non-linear relation compared to the boundary condition.

For the fifth recommendation for future research, a study with a similar structure but focussed on a different type of spatial synergy can be setup. While all synergies not related to the ET fell outside of the scope of this research, the interview transcripts did support certain theories concerning the implementation of these non-ET synergies. This would allow a comparison between the required project conditions for ET-integration and other types of synergies. For example, the data matrix shows that a supportive boundary condition (broad and flexible) could potentially be strongly linked to the implementation of other spatial synergies with ecological, mobility, or recreational objectives.

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# Appendices

# Appendix A: Study context-analysis

## A.1 General context

*Table 11 Involved stakeholders in Dutch energy transition, adapted from R. Kemp (2010)*

| Stakeholders | Authorised supervision | Decision makers |
|---|---|---|
| Electric utilities & energy company | When concerning large scale or region transcending projects: Environment ministry, energy ministry and other relevant ministry officials | Regulators & Power system planners |
| Renewable energy project developer and contractor | Environment, energy resource, and land-use departments in the local municipality | Initiating and managing organisation (varying identity) |
| Environment, social, and other interest groups | Environment and land-use departments in the provincial government | Governmental organisations through their authorized supervision (permits) |
| Economic & social departments in the local municipality | When concerning primary dikes: Rijkswaterstaat | Project landowner (varying identity) |
| Experts (consultancies) | When concerning water related objects: regional water authority | |
| Investors | | |
| Local inhabitants | | |
| Local businesses | | |

## A.2 Scope specific contexts

### Solarfarms

*Table 12 Solarfarm context stakeholder analysis, adapted from (Bremere & Indriksone, 2017)*

| Stakeholder | When involved | Objective |
|---|---|---|
| Municipality | Involved throughout all project processes to ensure regulations are met, to provide advice and input and to align the project.<br><br>Potential initiator | Contribute to organization-own spatial plans and policies: e.g., development of livability, renewable energy, nature or other social goals |
| Provincial government | Throughout the project for advice, during initial orientation and design phases for permits and authorization | Contribute to provincial spatial plans and policies: e.g., development of livability, renewable energy, nature or other social goals |
| National government | Only involved with large scale (>100 MW projects) or region-transcending projects (multiple RES regions), then taking a role similar to the provincial government | Contribute to national spatial plans and policies: e.g., development of livability, renewable energy, nature or other social goals |
| Rijkswaterstaat | Only involved when the farm is placed on and closely to infrastructure, e.g., highways and primary dikes, then taking a role similar to the provincial government | Contribute to energy transition without risking any damage to the flood safety of the Netherlands |
| Local water authority | Involved when the farm is placed on or close by surface water, then taking a role similar to the municipality.<br><br>Potential initiator | Contribute to becoming energy-neutral without damaging their main objectives of water quality, water quantity and flood safety. |
| Energy producers | Involved actively after design phase when not the initiating company, involved as a potential consultant before the realization phase.<br><br>Potential initiator | Mainly a net positive financial cost-benefit estimation of the solar farm over its lifetime |

| | | |
|---|---|---|
| Network operator | Involved shortly in orientational and design phases of the project to ensure feasibility and approval. During realization phase actively involved. | A fully operational (100%) energy network with satisfied users (energy producers) and a positive financial net profit. |
| Experts | Involved as an advisory body throughout the entire project process after the initiating organization performed very early orientational studies | Satisfied client combined with a correctly finished project and payment for the work |
| Investors | Involved throughout the project for approval<br><br>Potential initiator | Mainly a net positive financial cost-benefit estimation of the solar farm over its lifetime |
| Interest groups | Involved in the orientation and design phases of the project for approval and advice. Mostly nature preservation groups. | No damage to local nature or local views/esthetics |
| Local residents | Involved in the orientation phases of the project for advice (and to some extent approval). Occasionally involved during the design phase for approval and advice. | No negative impact on their local esthetics, mobility and spaces. Preferably obtaining some form of reward from the local solar farms. |
| Local businesses | Involved in the orientation phases of the project for advice and approval<br><br>Potential initiator | No negative impact on their business operations and profits while looking for a opportunity to connect to the solar energy |

## Wind turbines

*Table 13 Wind turbines context stakeholder analysis compared to solar farms from (Bremere & Indriksone, 2017)*

| Stakeholder | Different from solar farms |
|---|---|
| Municipality | More hesitant to avoid negative public outcry, often a ''no-turbine'' policy for certain regions |
| Provincial government | Has a strict policy in regard to what regions are suitable for wind turbines, much stricter than with solar power |
| National government | Mainly active with the offshore wind turbines farms in the North Sea and other large-scale project. The national government is more involved with the realization of wind turbines than with solar farms. |
| Rijkswaterstaat | Less interested in wind turbines compared to solar farms as it poses a greater risk towards the water defenses |
| Local water authority | Less interested in wind turbines compared to solar farms |
| Energy producers | When talking about multiple wind turbines, there are often only large corporations that provide these systems. With solar farms it could be a relatively small business. |
| Network operator | In general wind turbines generate more Power per square meter which in turns increases the pressure on the local network |
| Experts | More investigations needed; more experts involved to test out any form of negative impact of the project |
| Investors | Wind turbines requires larger initial investment and larger investment corporations |
| Interest groups | Bird and esthetics related interest groups are relatively more involved compared to nature-focused groups |
| Local residents | In nearly all neighborhoods there is more resistance towards local wind turbines than solar farms |
| Local businesses | Local airfields have the power to stop the development of wind turbines in certain areas |

## Heat networks

*Table 14 Heat networks context stakeholder analysis compared to solar farms from (Bremere & Indriksone, 2017)*

| Stakeholder | Different from solar farms |
|---|---|
| Municipality | Is working neighborhood by neighborhood to make the buildings in those areas ''aardgasvrij'' via a strict policy |
| Provincial government | Is only advising and pressuring the municipalities to reduce the amount of natural gas usage in the province |
| National government | Is only advising and pressuring the municipalities and provinces to become ''aardgasvrij'' |
| Rijkswaterstaat | Is not actively involved with heat networks |
| Local water authority | Is actively involved when water (be it effluent, surface water or wastewater) is involved as the heating source |
| Energy producers | Similar to wind turbines as the initial investments and required subsidies are much greater with heat networks |
| Network operator | A new heating system requires the old system to be replaced which also induces costs and lost profits, which means that only in situations where the old heating system was due for a replacement the network operators are content |
| Experts | More focused on feasibility, business cases and estimated project durations than nature and permits |
| Investors | Similar to wind turbines as the initial investments and required subsidies are much greater with heat networks |
| Interest groups | Are actively battling at the start of projects to minimize the negative effects on local (poor) residents |
| Local residents | All residents need to change the heating systems in their houses to connect to the new system which leads to more resistance and less societal support |
| Local businesses | Local industries can potentially provide a component of the current heating system via leftover heat, which leads to more resistance and a loss of an efficient practice when replacing the heating system. |

## A.3 Water related energy production:

The scope of this study focusses more on the water-related projects of the Dutch energy transition. The three most prominent additions are the regional water authority (which are always involved when working with forms of water), Rijkswaterstaat (when working with primary dikes) and the provincial government (when the Natura2000 or the NNN is involved through the provincial government).

All three additional parties have a role of authorised supervision when involved in the project but are also often also deeply involved in the design process with ET-synergies as each organisation has their own energy transition goals and standards they aim to achieve.

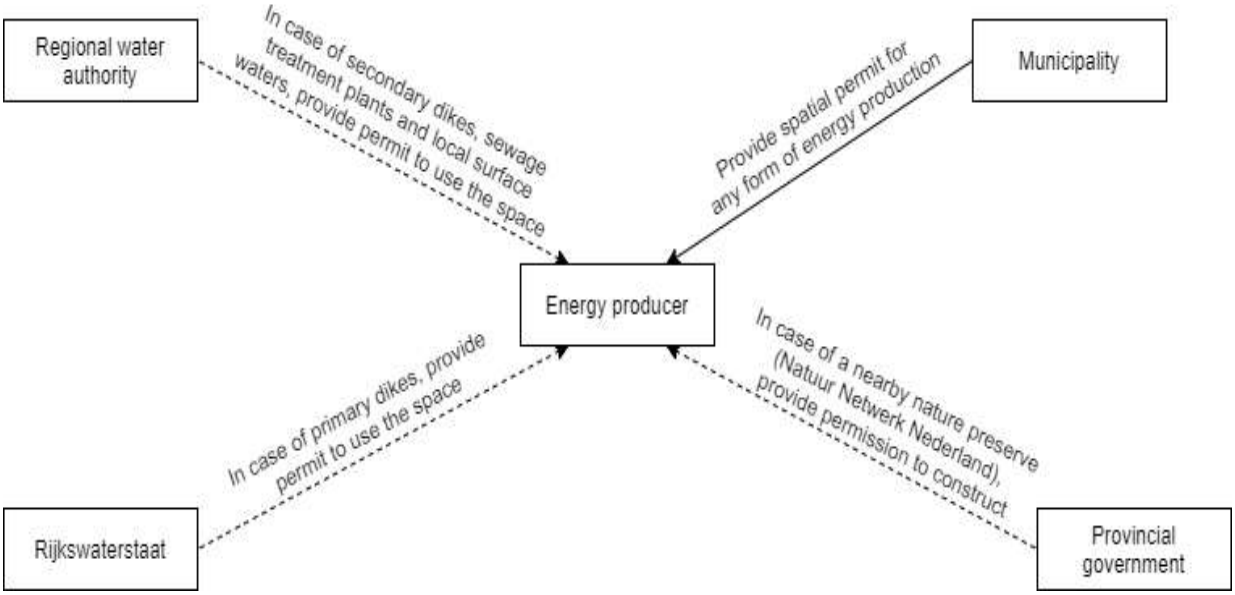



*Figure 10 Relevant stakeholder in water-related project contexts, adapted from Aquathermie MCA (Witteveen en Bosch, 2019)*

# Appendix B: Condition definitions & indicators

## B.1 Original definitions

Definitions described by Ostrom (2010) used as an inspiration for the definitions used in this research.

Internal situation

- **Boundary rules** specify how participants enter or leave these positions.
- **Position rules** specify a set of positions, each of which has a unique combination of resources, opportunities, preferences, and responsibilities.
- **Scope rules** specify a set of outcomes.
- **Authority rules** specify which set of actions is assigned to which position.
- **Aggregation rules** specify the transformation function from actions to intermediate or final outcomes.
- **Information rules** specify the information available to each position.
- **Payoff rules** specify how benefits and costs are required, permitted, or forbidden to players

External context (excluding rules-in-use)

- **Attributes of the community** is a term used to encompass all relevant aspects of the social and cultural context within which an action situation is located.
- **Biophysical conditions** specify the physical environment that set the context within which an action situation is situated, in terms of resources, services and material conditions.

## B.2 Specific indicators

*Table 15 Indicators and definitions of relevant conditions*

| Ruleset definition | Potential Indicator categories (adapted from: [5] [7] [8] [9] [10][11][12]) | Empircal indicators used in template |
|---|---|---|
| **Boundary rules:** Determines the criteria for selecting participants and when they should enter/leave their positions | • Project participant selection process: [7] [8] [9]<br>• Project participant involvement: [7] [8] [9] | • How were participants determined?<br>• How were criteria for selection determined?<br>• Why were the locals/government excluded? |
| **Position rules:** Concerns with which actors should be involved, their roles and the possible roles in the project process | • Distribution of roles in the project (e.g., investor, initiator, users) : [7] [8] [9]<br>• Missing roles or parties: [7] [10][11] | • What type of investors were involved? (e.g., commercial or societal)<br>• Who is the initiator of the synergy and the main project?<br>• Who is the final user of the synergy and the main project?<br>• In retrospect, what party/role should have been involved?<br>• Who was the daily coordinator?<br>• Was there a dedicated team for synergy implementation? |
| **Scope rules:** Specifies the scope of possible outcomes, what type and to what extent were synergies possible | • Synergy identification and incorporation: [5] [10]<br>○ Timeframe compatibility: [10] [11][12] | • How are synergies identified and incorporated?<br>• Are the projected lifetimes compatible? |
| **Choice rules:** Specifies the set of actions that must and must not be taken a specific point in time to enable integration | • Exceeding environmental standards: [10] [12]<br>• Self-assigned role in the energy transition: [5] | • What standard does the initiator set for himself?<br>• What is the role of the initiator in the ET context? |
| **Aggregation rules:** Determines how decisions are made in the project and what decisions were legally restricted | • Required permits: [10]<br>• Challenges related to the synergy: [5] [12]<br>• Hierarchical or levelled decision-making and strategic vs daily decision-making: [10] [11][12] | • How (many) were permits acquired for the synergy?<br>• Which challenges were related to the synergy?<br>• Did the overarching project become feasible?<br>• Were there subsidy challenges with the synergy?<br>• Was the decision-making hierarchical or levelled?<br>• Did the decision-making structure differ for strategic versus everyday decisions? |
| **Information rules** Concerns what information is available and necessary for participants and how this information is spread to all relevant participants | • Risks related to the synergy: [10] [11]<br>• Project progress and synergy analysis information sharing: [5] [7] [10] [11]<br>○ Perception of uncertainty: [5] | • Which technical risks are associated with the synergy?<br>• Which societal risks are associated with the synergy?<br>• Which potential synergy types were recognized and analysed for the overarching project and how was this information shared?<br>• What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?<br>• Was information about the project progress (risks, benefits) available/shared with all the participants? |
| **Payoff rules:** Concerns the distribution of costs and benefits | • Investor identity: [7] [8]<br>• Cost-benefit distribution: [7] [8] | • Which stakeholders invest in the project and the synergy and how is this distributed<br>• What is the societal added value of the synergy?<br>• What impact does the synergy have on the local environment?<br>• Were all participants in agreement on the costs and benefits of the project?<br>• Who and how were the costs/benefits assessed?<br>• How were the cost/benefits distributed between the involved parties? |
| **Attributes of community:** Determines the existing social and cultural context of the internal and external environment of the project | • Stance of local population: [5]<br>• Synergies incorporated in local policy: [5] [10]<br>○ Energy transportation and storage: [5] | • What is the stance of the local population on the synergy and the overarching project?<br>• Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?<br>• Were there any complications regarding the storage and transportation of the energy in the local environment of the project? |
| **Biophysical conditions:** Describes the physical environment of the project location | • Current spatial function: [11][12]<br>○ Soil usage: [12] | • Which spatial function is currently in place at the project location? (e.g., nature, industry)<br>• Is the soil of the project location already full of other wires, tubes and networks? |

# Appendix C: Methods

## C.1 Necessity and sufficiency analysis background

### *Fuzzy necessity*

The necessity analysis can be performed by utilizing the score visualizations as explained by A. Duşa (2021). In these figures you can see that the condition X is the superset of the outcome Y (in this study: synergy score). As all Y-scores are lower or equal to the X-scores, the X-circle fully encompasses the Y-circle (Figure 11), and all data-points in the graph being located below the diagonal line (Figure 12). THis implies that the condition is necessary for the outcome, the condition needs to be present in a supportive state before the can be achieved. These necessary conditions (or combinations thereof) can be analyzed by using these graphs as shown by Figure 12. The ruleset scores of each case can be graphed on the X-axis with the synergy scores on Y-axis.

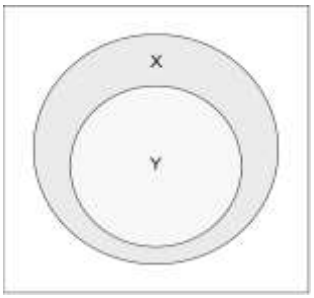



*Figure 11 Necessity: X superset of Y (A. Dusa 2021).*

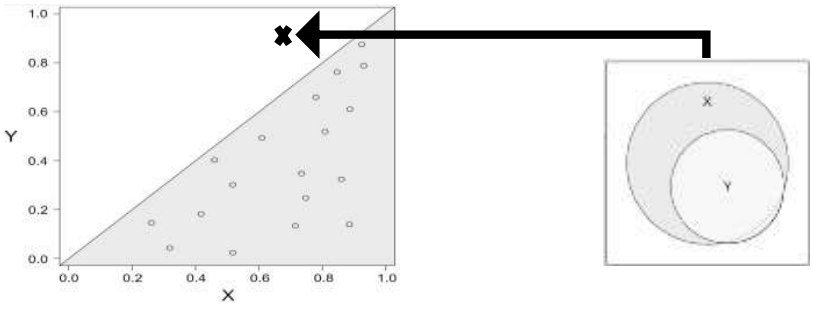



*Figure 11 Fuzzy necessity graph with deviant case (A. Dusa, 2021)*

As this study is dealing with complex institutional structures, individual cases can have unique circumstances which potentially reduces the possibility for clear necessary rulesets. An example of these unique, deviant cases is shown in Figure 12. While not all data points are located below the diagonal line, it can still potentially be concluded that X is necessary for Y. However, it is key to analyse these deviant cases individually to provide clarity.

### *Fuzzy sufficiency*

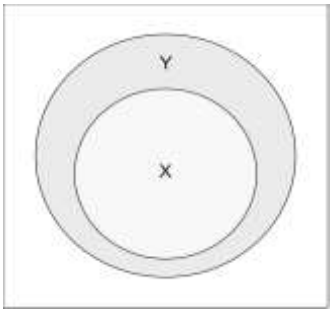



*Figure 12 Sufficiency: Y superset of X (A. Dusa, 2021)*

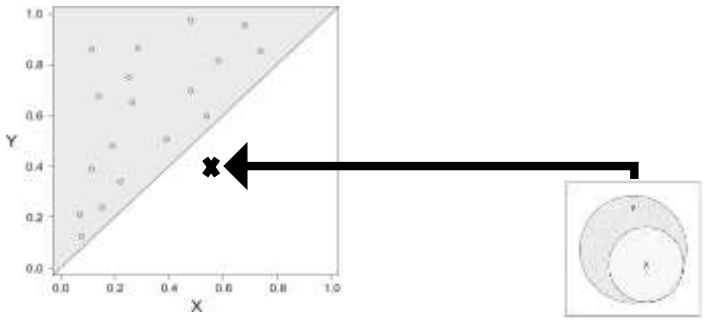



*Figure 13 Fuzzy sufficiency graph with deviant case (A. Dusa, 2021)*

In addition to finding the rulesets that are necessary for synergy utilization, it is beneficial to analyse the minimal configuration of rulesets that are sufficient for synergy utilization. Similar to the necessity analysis, the relation of sufficient rulesets can be visualized by a superset-relationship. In a fuzzy sufficiency graph this is visualized in the opposite way of the necessary fuzzy graph, with all datapoints located above the diagonal line. Similar to the necessity analysis, deviant cases can occur as is shown in Figure 14 which will require additional individual analysis. It is not expected that individual rulesets are sufficient for an outcome.

## C.2 Case sources, names and interviews

Figure 15 provides a summary of the sourced used in this study.

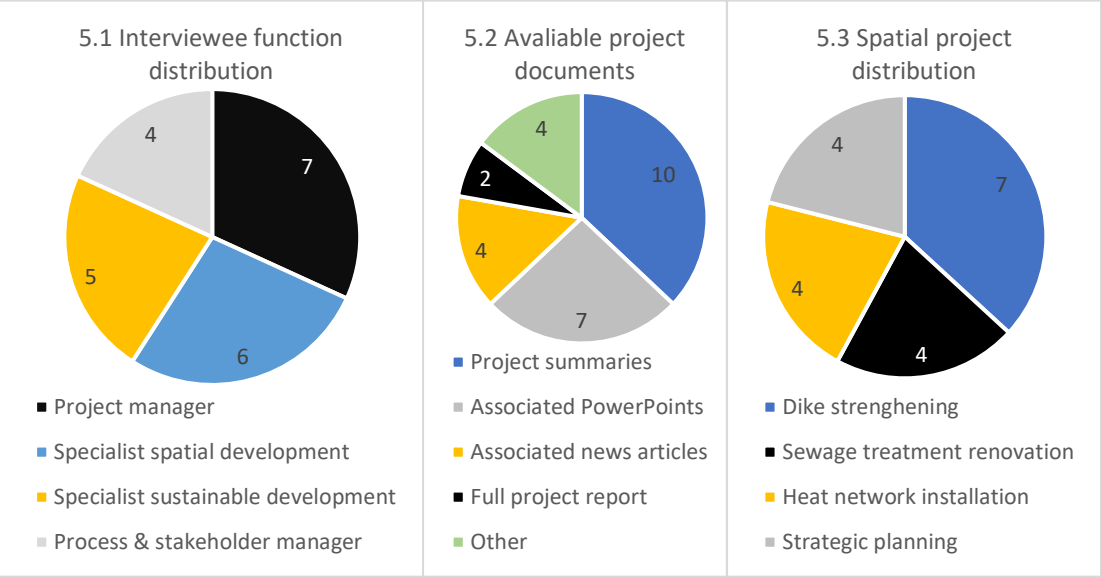



*Figure 15 Data sources: case-types, interviewee functions and available documents. 5.1 and 5.2 show more interviewees and document types than cases as a single case could have multiple interviewees and documents available.*

Table 16 and 17 show an overview of the used data sources and project types respectively.

*Table 16 Overview of case sources*

| Case nr. | Project name | Function contact persons | Available document types |
|---|---|---|---|
| 1 | RES Drechtsteden | Projectmanager, stakeholder manager | Project orientation summary<br>Stakeholder report<br>Stakeholder meetings (live) |
| 2 | Zonnedijk Moerdijk | Project manager, spatial development advisor Water Authority | Project summary |
| 3 | Rijnkade Arnhem | Project manager | Project summary |
| 4 | Lauwersmeerdijk renovatie | Project manager,<br>Contract manager Water Authority | Project summary |
| 5 | Helmond gekoppeld | Project manager | News articles |
| 6 | Landtong Roozenburg | Process manager | Project summary |
| 7 | Port of Rotterdam – Port of Amsterdam | Safety manager | Project summary<br>News articles |
| 8 | STAIN Zwolle | Advisor integral spatial development | Project presentations<br>(similar) Project summaries |
| 9 | Schoteroog energy lake | Energy transition manager municipality | Project presentation<br>Project photoshoot |
| 10 | Maasvlakte II | Project manager | Project summary<br>News articles and reports |
| 11 | Raalte RAS – RES-adaptatie | Advisor heat transition | Full project report |
| 12 | RWZI Land van Cuijk & RWZI ooien | Project leader, sustainability advisor | Project report |
| 13 | Culumborgse Dijk ontwikkeling | Sustainability advisor | Project Ireport (online version) |
| 14 | Den Bosch RWZI | Energy manager, project leader | News articles and reports<br>Project presentation |
| 15 | Den Haag kademuren | Advisor aquathermy | Project summary |
| 16 | RWZI Beverwijk & RWZI Echten | Advisor aquathermy | Project presentations<br>Project memos |
| 17 | Grebbedijk integrale gebiedsontwikkeling | Project manager | Project presentations |
| 18 | Waterketen Delfland Wijkaanpak | Stakeholder & process manager | Project presentations |
| 19 | Best Bedrijven visie | Climate adaptation advisor | Project presentations<br>Project summary |

*Table 17 Overview of project names with identified synergies and related interviewee origin*

| Case nr. | Project name | Project type | Identified synergies | External contact (x) |
|---|---|---|---|---|
| 1 | RES Drechtsteden | Exploration of ET synergies in area where multiple spatial development is planned | • Mobility infrastructure combined with solar panels<br>• Sewage treatment plants combined with solar energy and wind energy | 2x RHDHV |
| 2 | Zonnedijk Moerdijk | Realization of solar energy during dike renovation | • Primary water defense dike combined with solar panels | X (and internal) |
| 3 | Rijnkade Arnhem | Design of a local heat network using an aquathermy extension | • Local canal wall renovation combined with a heat exchanger and local heat network | 1x RHDHV |
| 4 | Lauwersmeerdijk renovatie | Integral renovation and strengthening of dike | • Dike strengthening combined with various synergies | X (and internal) |
| 5 | Helmond gekoppeld | Renovation of existing heat network using multiple ET synergies | • Aquathermy combined with solar panels | 1x RHDHV |
| 6 | Landtong Roozenburg | Wind turbines constructed during dike renovation | • Dike renovation combined with the construction of wind turbines | 1x RHDHV |
| 7 | Port of Rotterdam – Port of Amsterdam | Broad long-term spatial development port areas | • Urban energy transition synergies and requirements in the long term | 1x RHDHV |
| 8 | STAIN Zwolle | Resilient project planning in urban area | • Climate adaptation and energy transition aspects combined with both private and public spatial development | 1x RHDHV |
| 9 | Schoteroog energy meer | Integral spatial development | • Local dump area near water body renovation combined with solar energy and wind energy | X |
| 10 | Maasvlakte II | Wind turbnes constructed during a dike renovation | • Primary water defense dike renovation combined with large scale wind energy | 1x RHDHV |
| 11 | Raalte RAS – RES adaptatie | RES and RAS gets integrally approached with neighborhood developments | • Realization of the RES project plans combined with climate adaptation synergies with urban heat networks | 1x RHDHV |
| 12 | RWZI Land van Cuijk & RWZI Ooien | Sewage treatment plant energy generation | • A smaller renovated RWZI combined with a solar field | X (and internal) |
| 13 | Culumborgse Dijk ontwikkeling | Integral renovation and strengthening of dike | • Dike strengthening combined with various synergies | 1x RHDHV |
| 14 | Den Bosch RWZI | Sewage treatment plant energy generation | • A full renovation and expansion of the plant gets combined with a large-scale | X |

| | | | | |
|---|---|---|---|---|
| | | | biogas system and solar panels | |
| 15 | Den Haag kademuren | Canal wall renovation aquathermy | • A heat exchanger was designed to be placed in the canal wall during renovation | 1x RHDHV |
| 16 | RWZI Beverwijk & RWZI Echten | Sewage treatment plant energy generation | • A full renovation and expansion of the plant gets combined with aquathermy which powers the creation of biogas | 1x RHDHV |
| 17 | Grebbedijk integrale gebiedsontwikkeling | Integral dike renovation | • A dike renovation is combined with numerous synergies | X |
| 18 | Waterketen Delfland Wijkaanpak | Integral spatial water system development | • Circular water usage combined with climate adaptation and the energy transition in urban area | X |
| 19 | Best Bedrijvenvisie | Integral spatial development | • Industrial area development combined with climate adaptation and the energy transition | X |

## C.3 Interview structure (Dutch)

### Informele start

- Uitleg thesis onderzoek
- Uitleg en akkoord opname
- Uitleg en akkoord samenvatting
- Zoeken naar mening en expertise 20+ experts

### Algemene introductie project

Het eerste gedeelte wat wordt opgenomen, veel van de onderstaande onderdelen zijn al beantwoord via de projectdocument-studie.

- Rol binnen het project (Position)
- Projectlocatie (biophysical)
- Projectduur (scope)
- Projectteam (Position)
    - Hiërarchie en decisionmakers, who made daily/strategic decisions (Aggregation)
    - How to join (Boundary)
- Stakeholders (Boundary)
    - Initiator for project (Position)
    - Investeerder (Position)
    - Users (Boundary)
    - Landowner (Boundary)

### Bestuurlijk & organisatosch

- Welke vergunningen waren nodig voor het project en specifiek voor de koppelkans (Aggregation)
- Welke rol had de gemeente/provincie/waterschap (Choice)
    - Doorvragen of hoe de publieke overheid werkte in het project (Position)
    - Subsidies en financiële constructies (Aggregation)
- Hoe ziet de publieke overheid de noodzaak van de energietransitie (Position)
- Hoe ziet de publieke overheid de rol van koppelkansen in dergelijke projecten (Position)
- Welke politieke partij was aan de macht in de gemeente (Position)

### Lokale impact & participatie

- Op welke manieren zijn de lokale inwoners meegenomen in de verkennings- en ontwerpprocessen van het project? (Boundary)
- Hoe werd de regio beïnvloed door het project en de koppelkans? (Payoff)
    - Wat was er eerst op het grondgebied (biophysical)
- Local risks as a result of the synergy/ET (Information)
    - Technical (Information)
    - Societal (Information)
- Did all parties have similar information and how do they obtain information? (Information)
    - Uncertainties for certain parties? (Information)

### Synergie identificatie

- Welke koppeling is herkend (en benut) (information)
    - Welke andere opties waren er (information)
- Who were involved with the synergy (Position)
    - Initiator, investor, net operator, producer, provider (Position)
    - Who should be (more) involved to streamline the process? (Position)
- Tijdlijn van de koppelingen (Scope)
- Beoogde voordelen van deze koppeling, zoals haalbaarheid vergroten (Aggregation)

### Uitdagingen

Relatief open vraag naar de tegengekomen complicaties, blokkades en moeilijkheden gedurende het project. Dit is eigenlijk het belangrijkste gedeelte van het interview.

- Welke uitdagingen (challenges) liep je tegen aan? (Aggregation)
    - Tegenstand van stakeholders voor/na? (position)
    - Wat stond er eerst op het land/bodem (biophysical)
- Opslaan van energie (biophysical)

### Succes factor & benodigheden

Hoe tevreden waren alle belanghebbenden met de uitgevoerde koppelkans en het overkoepelende project.

- Iedereen tevreden met de meekoppelkansen?
- Open vraag over hoe de koppelkans en het project ervaarde als betrokkene.
- **Waarom hier wel gelukt**

## C.4 Condition and outcome templates

*When indicators were mentioned to be unimpactful or not interested in the interviews, the indicator state would be left blank in the template.*

### Case 1: Drechtsteden RES

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Minor dike repair<br>○ 1 year (the strategic part)<br>○ Solar farms, wind turbines on multi-purpose locations with a dumpsite and a sewage treatment plant |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Municipal collaboration<br>○ Municipal collaboration, the energy cooperation, and the regional water authority<br>○ Neighbouring municipalities, the provincial government |
| Financial | ○ Percentual investment synergy | ○ Minor (<20%) of total |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • There were three ET-synergies identified and implemented. |
| **Delays related to synergy** | +0 | • There was severe delay caused by the synergies as the wind turbines and the solar panels created a lot of local opposition and required time and effort to implement. |
| **Achieved ET-potential** | +0.4 | • After the delays and required information & participation meetings on all potential synergy locations there was an achieved synergy. Solar farms were built on a dumpsite, next to a sewage treatment plant and wind turbines were placed. |
| | | |
| **Total outcome score** | 0.7 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**

  The involved of participants were determined by the stakeholder manager who had a lot of experience with integral ET project. As a result, thereof, many different parties were able to express their opinions and ideas on the project.

  It was even mentioned by the municipalities involved that the synergies identified and incorporated into the policies were a direct result of the broad and open participation strategies.
  **Score: 1**

Related conditions:

- **How were the participants determined?**
  The experience of the involved spatial-stakeholder manager ensured all relevant stakeholder were contacted and invited to provide input. These included all (both local and regional) parties that were affected by the project.

- **How were the criteria for selection determined?**
  The selection criteria were very broad to allow as many parties to involve themselves in the project process as they want. All affected parties could speak about their wishes and ideas.

- **Why were the government/locals excluded?**
  All local and regional parties were involved, only the national ministries (het Rijk) were not directly involved, mainly because of the relative limited size of the RES – region and the early stage of the project.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**

The project team for the RES Drechtsteden has a special composition where the 7 involved municipalities formed an organisation who as a single entity tackled the ET in the region. This cooperation ensured more synergies were identified and the entire region could be analysed. It did lead to a more complex decision-making system, but there was still clarity as the group of 7 was the main initiator, investor and coordinator of all involved aspects in the project. The positions were rigid in that regard, however because of the relative power of the 7 municipalities, they could identify and develop the synergies without other coordinating parties.
**Score: 0.7**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Societal investors in the form of local governments (a group of 7 municipalities formed the RES Drechtsteden organisation).

- **How stable is the commitment of the local governments for the integral energy transition?**
  The group of 7 municipalities were actively looking to incorporate the synergies in their RES. They are the drive behind this project.

- **Which party is the initiator of the overarching project?**
  The group of 7 municipalities that form their cooperation to achieve the regional RES.

- **Which party is the initiator of the potential synergy?**
  Again, partly the 7 municipalities as well. But now also supported by an energy cooperation with 500+ local members (both com
  panies and inhabitants) that want to smoothen the energy transition in their region.
- Who is the final user of the overarching project?
  The 7 municipalities themselves will use the specified RES to start the follow-up project where the identified ET synergies are actually implemented.

- **Who is the final user of the synergy?**
  There were multiple synergies incorporated into the RES, the users thereof vary between the local inhabitants, transport trucks, energy producers, nature preservation organisations and the local municipalities.

- **In retrospect, who else should have been involved to make the process easier?**
  As the boundaries of this project were flexible and broad, all relevant parties were involved.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The group of 7 municipalities who did have specific people working on the synergies specifically.

- **Who were the supervising legal coordinators of the project?**
  The group of 7 municipalities of their own individual municipal area and the provincial government.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**

  **The scope of the RES Drechtsteden was very flexible since the start of the project. The goal of the 7 municipalities was to identify and inventory all potential synergies with the ET. This led to the situation where all potential sectors were checked for synergies, mobility, health, nature and other transitions.**
  **Score: 1**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  The overarching project and the synergies are heavily intertwined, as the main goal was to find suitable synergies with solar parks and wind parks. All identified synergies had a lifetime similar or lower than the project lifetime of these parks.

- **How are potential synergies determined and incorporated in the overarching project?**
  They are identified by the local inhabitants, companies and other organisations. Interestingly, all these parties could voice their ideas about potential synergies and the 7 municipalities would select and invest in the most promising.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The forming of a 7 municipality-wide energy-collaboration was efficient for the utilization of synergies. This collaboration was eager to find integral solutions and was steering heavily towards an innovative approach where efficient ET-solution could be identified and integrated. The project team was allowed and even encouraged to utilize synergies.

**Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  The group of local municipalities were an active party in this project, both initiating and funding the overarching project and the identification of the synergies.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  The local municipalities wanted to achieve the goals mentioned in the RES for 2030, but do not specifically alter the nationally provided environmental standards.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  The group of 7 municipalities had the clear decision-making power in this project, but for the potential ideas and opposition of the synergies they heavily involved the input of all local parties. This clear distinction between parties providing information and parties making the decision proved relatively efficient. All permits' complications and potentially relevant opposition was also minimised by the fact that all important municipalities were already incorporated into the project team.
  **Score: 0.7**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  No permits were yet required for this project as it only identified and analysed all potential synergies, selecting the most promising. The implementation phase is scheduled for the upcoming years.

- **What is the application period of the required permits?**
  No permits required.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  More parties had to be involved as certain combinations with wind turbines were negatively perceived by local organisations and inhabitants. Many conversations and potential solutions had to be discussed before a suitable ET + synergies combination could be found.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  It has not been implemented yet, but the parties who were against the ET become more content with the addition of the synergies (increased mobility & nature). So, it did increase the feasibility (and even the possibility) for the solar parks and wind turbines to be accepted.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  Subsidies will be requested during the implementation phase of the project.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**

It was levelled in a sense that all municipalities had an equal say on the project. And that all parties willing to provide input were able to do so on a levelled basis. However, all decisions were fully made by the group of 7 municipalities. So, the decision-making was a case of levelled hierarchy.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  For this project it did not differ greatly, both strategic and everyday decisions were made by the group of 7 municipalities.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  All participants were provided with the information relevant to their situation. This was the most efficient way to obtain valuable input for the synergies while keeping the amount of info per participant minimal. All participants did share all their info with all other involved parties.
  **Score: 0.7**

Related conditions:

- **Which technical risks are associated with the synergy?**
  Safety risks with the wind turbines were identified and analysed.
- **Which societal risks are associated with the synergy?**
  The impact of the ET on the local nature were identified and analysed. Additionally, the potential impact of the local opinion was incorporated heavily in the decision-making process.
- **Which potential synergy types were recognized and analysed for the overarching project?**
  A list of 53 synergies were identified and analysed varying from mobility-based synergies (building a road next to the solar panels), to nature-based synergies (adding small parks and ponds to the different ET parks).
- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  They did not know where the ET-parks would be placed, and they did not want it to be close to them for esthetical reasons. The different participants were provided with different amounts of information, due to the large variety in participants. A municipality outside the RES region who is against wind turbines is provided with different information than a farmer who is living next to a potential solar park – sewage treatment plant combination.
- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  When requested all information was provided, however as mentioned above this differed between the involved parties. The project was very broad with many different types of participants who were each affected differently.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  **So far, many of the exact costs have not been assessed or distributed. However, because of the clear boundaries with the investors, namely the 7 municipalities, it is relatively efficient and easy to distribute the costs and benefits.**
  **Score: 1**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed?**
  All investment is done by the group of 7 municipalities. The distribution between the 7 is divided based the local benefits (energy being region-wide and mobility/nature being municipality-local)
- **What is the societal added value of the synergy?**
  Improved local ecology and biodiversity and improved mobility.
- **What impact does the synergy have on the local environment?**
  Nature obtains more area to freely grow and flourish around the ET-synergies.
- **Were all participants in agreement on the costs and benefits of the project?**
  The exact costs and benefits still need to be determined as the implementation of the identified ET project and synergies still needs to commence.
- **Who and how were the costs/benefits assessed?**
  The exact costs and benefits still need to be determined as the implementation of the identified ET project and synergies still needs to commence.
- **How were the cost/benefits distributed between the involved parties?**
  The exact costs and benefits still need to be determined as the implementation of the identified ET project and synergies still needs to commence. But the different municipalities will distribute the costs according to the benefits on the local area (municipality) and regional area (RES-region-wide).

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  The local population and companies are, relatively speaking, against any ET-project in their neighbourhood. Also, neighbouring municipalities and nature organisations are against the projects. However, paradoxically, this has led to a situation where more synergies are being identified and analysed. As the synergies were required to keep the participants content and accepting of the ET. As a form of compensation.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  The main goal of the RES-Drechtsteden project was to assess and specifically incorporate the ET-synergies in the local RES-policy. To have a clear blueprint how to effectively implement them later.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  In the early analysis phase this has not been identified as a problem. But in the implementation phase a more thorough analysis will be performed. However, with the municipalities all on board, this will probably not be a major obstacle.

**Score: 0.7**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  Many different locations were identified: ditches, parking lots, sewage treatment plants, next to a train track, next to a pond and on the property of a fire department.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  No problems were identified with the amount of wiring in the soil in the early investigations.

**Score: 0.7**

## Case 2: Zonnedijk Moerdijk

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Minor dike repair<br>○ Two years<br>○ Solar energy |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Regional water authority<br>○ Regional water authority<br>○ Port management |
| Financial | ○ Percentual investment synergy | ○ Large (>30%) of total |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • The solar panel integration was successfully implemented. |
| **Delays related to synergy** | +0 | • There was severe delay caused by a high number of required safety investigations and related permits. Building on a dike is still in an infant state. |
| **Achieved ET-potential** | +0.4 | • After the delays with the right permits and safety checks, the result was a very effective ET synergy implemented within a dike renovation. |
| | | |
| **Total outcome score** | 0.7 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The regional water authority formed a collaboration with the port-management to incorporate the ET with the flood defence network. This collaboration had many contacts within the local relevant parties like the provincial government, nature organisations and Staatsbosbeheer. These main parties were selected based on their legislative power and were then involved in the early project process.
  **Score: 0.3**

Related conditions:

- **How were the participants determined?**
  There were only limited participants involved and no real involvement process was utilized.

- **How were the criteria for selection determined?**
  The main participants were involved based on their legislative power, not particularly to utilize synergies.

- **Why were the government/locals excluded?**
  To improve the project efficiency at the orientational phase, focussing solely on getting solar panels placed during the dyke renovation.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**

There was a clear management team that were the daily supervisors for the project and ensured the rest of the synergies were added to the main project of solar energy placement on the primary flood defences. This team consisted of a special energy-transition team within the regional water authority. It was a rigid composition, but it worked relatively efficient with the realisation of synergies as the regional water authority only asked the involved parties to invest and superficially guide the design process.

**Score: 0.3**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  A combination of both commercial and societal investors.

- **How stable is the commitment of the local governments for the integral energy transition?**
  N.N.

- **Which party is the initiator of the overarching project?**
  The regional water authority

- **Which party is the initiator of the potential synergy?**
  The regional water authority

- **Who is the final user of the overarching project?**
  Regional water authority

- **Who is the final user of the synergy?**
  The port management combined with the regional water authority

- **In retrospect, who else should have been involved to make the process easier?**
  Potentially the local companies and inhabitants, or the municipality. Mainly to identify more synergies.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The regional water authority and yes.

- **Who were the supervising legal coordinators of the project?**
  N.N.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  Very early on with the renovation of the dike, the synergy with solar energy was cemented into the main project (The solar energy become the main project). Other synergies like mobility and nature related objectives were also added very only on to the project objectives (when the other relevant parties were involved). However, after this initial orientation phase, the scope was rigid, not allowing other potential synergies with the local population or other nature synergies to be incorporated to maintain the project process efficient.
  **Score: 0.3**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  N.N.

- **How are potential synergies determined and incorporated in the overarching project?**
  A very brief identification phase at the very start of the project with Staatsbosbeheer, the Port management and the regional government.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The private organisations in the port were interested in integral ET-solutions to obtain the green energy. However, the regional water authority themselves where not that eager to further complicate the dike strengthening project. They wanted to make it as simple as possible which in the end did not hamper the implementation of the solar panel synergy (as the business case and physical environment was highly supportive), but the project was not freely allowed to look for all ET-synergies.
  **Score: 0.3**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  N.N.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  While the regional water authority was keen on exploiting the dike for the production of sustainable energy. The main reason for this was the ideal conditions for the solar panels on the dike (large distance between the dike and the river, and a very high dyke).

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  While the regional water authority had an efficient system how decision was made, basically a relatively one-side daily management by the regional water authority

itself and a management team by the port-regional water authority collaboration. However, it showed that even while this should work in theory, in the organisation of the regional water authority itself there was opposition to the integral approach. Departments where the opinion was focussed on flood defence and were opposed to the added complexity and potential increased flood risk.
**Score: 0.3**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.

- **What is the application period of the required permits?**
  Relatively long, as even within the regional water authority itself there
- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  Numerous safety investigations had to be performed to see if the solar panels did not affect the safety in any way.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  Safety regulations for the dyke

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Hierarchical with the regional water authority making the daily management decisions, with the port management below and then the other main parties (provincial government, Staatsbosbeheer) followed by the nature organisations.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  Different departments within the regional water authority were involved.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  Only limited amounts of information were shared and not all local parties received this information. Because the regional water authority aimed to minimize complexity to keep the project efficient. The local population and companies were only scarcely informed. Even the parties that were involved, Staatsbosbeheer, the provincial government and nature organisations received limited info to keep up with the quick project schedule.
  **Score: 0.3**

Related conditions:

- **Which technical risks are associated with the synergy?**
  All safety risks were investigated thoroughly, as was required for a dyke construction.

- **Which societal risks are associated with the synergy?**

The local population was scarcely involved to voice their opinion on local solar panels. Their opposition can grow later on during the project.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  An extra road to the port main centre, several nature improvements and of course the main project in the form of the solar panels.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  N.N.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  Local inhabitants and companies have received very little information until now. Only the regional water authority and to some extentthe port management have sufficient info.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The main synergy, namely the solar panels (ET) was calculated thoroughly, and the two main collaborators (water authority and port management) were content with the profitability of the synergy. The other synergies were calculated less thoroughly, and additional analysis had to be performed by the initiators of the synergies themselves. The potential costs of these other synergies were also fully allocated to these initiators (mainly the provincial government).
  **Score: 1**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  The regional water authority and the port management.

- **What is the societal added value of the synergy?**
  Increasing the percentage of sustainable produced and used by the parties. Also, a slight improvement to the local nature.

- **What impact does the synergy have on the local environment?**
  More space for nature to grow and flourish around the dyke.

- **Were all participants in agreement on the costs and benefits of the project?**
  The solar panels proofed to be profitable, and the other synergies were paid for separately.

- **Who and how were the costs/benefits assessed?**
  The solar panels were assessed with multiple business cases by the regional water authority and the port management. The other synergies were assessed invidually by the respective party (mainly the provincial government).

- **How were the cost/benefits distributed between the involved parties?**
  Similar to how they were assessed.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  Not highly against the project, but also too little involved.
- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  The regional water authority changed their policies to allow the solar panels to potentially be built upon the dike.
- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  It would be used locally, so no.
  **Score: 0.7**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  Flood protection, a road and agricultural land.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  No, instead, the location was perfect for the ET-synergy, as the dike itself had the perfect characteristics for the placement of solar panels.
  **Score: 1**

## Case 3: Rijnkade Arnhem

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Canal renovation<br>○ Two years<br>○ Varying ecological synergies |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Regional water authority<br>○ Regional water authority<br>○ The municipality |
| Financial | ○ Percentual investment synergy | ○ Substantial (>20%) of total |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0 | • No ET-synergy was realized |
| **Delays related to synergy** | +0 | • There was a difficulty findings investor, but not a lot of time and effort was spent into the ET-synergies |
| **Achieved ET-potential** | +0 | • No ET-synergy was realized |
| | | |
| **Total outcome score** | 0 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**

Many different parties were involved at the start of the project, from local neighbourhood-groups to Staatsbosbeheer. Even energy producers and nature organisations, there was a lot of effort put into the participation. This resulted in 42 specific synergy-ideas from all kinds of backgrounds and objectives that could be combined with the renovation of the canal wall.

**Score: 1**

Related conditions:

- **How were the participants determined?**
  There was a team dedicated to finding as many parties as possible that could potentially provide input, it was mainly based on their experience how parties were contacted. But all parties who wanted to provide input were incorporated.

- **How were the criteria for selection determined?**
  Experience of the stakeholder management team.

- **Why were the government/locals excluded?**
  None of these parties were excluded.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**

There was an interesting position rule in this project were all parties, no matter how small could provide ideas how synergies could be utilized. In a sense every party could participate in the design phase of the project. Additionally, there were two major parties involved that funded the project, on one side the regional water authority that funded the renovation of the walls themselves and fully management that component of the project and on the other side the municipality that funded and even partly managed the implementation of the synergies.

**Score: 0.7**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Mainly societal.

- **How stable is the commitment of the local governments for the integral energy transition?**
  Eager to develop their local energy transition aspects.

- **Which party is the initiator of the overarching project?**
  The regional water authority.

- **Which party is the initiator of the potential synergy?**
  The municipality combined with the regional water authority.

- **Who is the final user of the overarching project?**
  The regional water authority.

- **Who is the final user of the synergy?**
  Locals and the municipality.

- **In retrospect, who else should have been involved to make the process easier?**
  The regional water authority should put more pressure on the parties actually making the decision to invest and utilize the identified ideas.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The regional water authority managed project, but the synergies were investigated apart from the main project team initially.

- **Who were the supervising legal coordinators of the project?**
  The provincial government, the municipality and the regional water authority itself.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The scope of Rijnkade Arnhem was really flexible, with the regional water authority just putting the green light on any synergy that could find suitable investors and people willing to partly manage it. This meant that the objective could be expanded to also involve education or social welfare. While this meant that all possible synergies were assessed, it also resulted in a relatively inefficient and especially complex project management with many delays.
  **Score: 1**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  N.N.
- **How are potential synergies determined and incorporated in the overarching project?**
  It was very flexible what kind of synergies could be incorporated, if there was an investor the regional water authority would incorporate it into the management planning.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**

The facilitating and accepting role the regional water authority bestowed upon themselves had a very interesting effect on the project that encouraged the utilization of synergies. While this open and flexible project management focussing on synergy utilization has merits, in hindsight the regional water authority mentions to be slightly less flexible and select a few synergies early on and push the related parties to invest and partly manage the synergies. In the current project, many synergies were not utilized because the respective parties did not find enough funding or related personnel. This means that while the initiating party was very eager to incorporate synergies, it was too broadly looking for synergies and had to be more specific on certain synergy opportunities.

**Scope: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  All three.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**

The regional water authority had a high standard for the energy transition, however, the most important standard was that the organisation was actively trying to improve the well-being of all citizens.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  Only the main project was fully managed by the regional water authority, all synergies were a combined effort. While this benefitted the permit-processes as the provincial government and especially the municipality were heavily involved themselves, it had a negative effect on the daily management of the synergies. The many different parties resulted in a very complex project management situation.
  **Scope: 0.3**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.
- **What is the application period of the required permits?**
  N.N.
- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  When there is no real pressure behind the synergy, most organisations are not eager to quickly come to the decision to invest and prefer to wait it out.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  No, the renovation would happen regardless.
- **Were there any requirements or challenges before certain subsidies could be requested?**
  N.N.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Hierarchical for the renovation of the canal wall, but relatively level for the implementation of the synergies. The regional water authority was working really close with the other main investor (the municipality) the implement the synergies.
- **Did the decision-making structure differ for strategic vs everyday decisions?**
  N.N.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  The information distribution was initially really good, with many different parties receiving all information about the canal wall renovation. However, with the flexible project management and the very individual approach to each synergy it meant that each synergy was handled individually by the initiator party. This had negative consequences for the information spread between all involved parties, not all relevant parties were 100% up to the date with the developments of each individual synergy.
  **Score: 0.3**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Aquathermy solution incorporated into the canal wall and several nature related projects.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  It was uncertain when the hard deadlines would take place and who would invest in what synergy.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  Because many different parties were simultaneously working on potential synergies, the info would develop which synergy became fuzzy in the later phases.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The costs of each ET-synergy were analysed on a very individual basis by the initiating party themselves. The costs and benefits were, similarly, also distributed amongst the parties that put the idea of the synergy forward. This very spread-out strategy of cost distribution did ensure that each party had their own personal synergy-project with their own budget. But it also led to the majority of possible synergies not finding sufficient investors in time.
  **Score: 0**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  All stakeholders could freely invest in the synergy they wanted to be implemented.

- **What is the societal added value of the synergy?**
  In the end an ecological wall and local nature preservation area were the two synergies that would be utilized with the renovation of the canal wall.

- **What impact does the synergy have on the local environment?**
  Increases the amount of space for the local nature.

- **Were all participants in agreement on the costs and benefits of the project?**
  Because of the separation between the main project and the synergies, financial wise, there was little conflict.

- **Who and how were the costs/benefits assessed?**
  On an individual base per synergy.

- **How were the cost/benefits distributed between the involved parties?**

On an individual base per synergy per initiator.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  They were welcoming for any nature-related project; however, they were not keen on investing themselves. Which hampered the aquathermy synergy.
- **Are the possibilities for synergies incorporated in local policies, regional strategies, and local construction plans?**
  No.
- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  Transportation and the corresponding related network were too expensive for the ET synergy. ‘

**Score: 0.3**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  N.N. (varying)

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  Somewhat yes, it made the ET synergy more expensive.

**Score: 0.3**

## Case 4: Lauwersmeerdijk Renovatie

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Dike strengthening and renovation<br>○ Eight years<br>○ Mobility and ecological synergies |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Regional water authority<br>○ Regional water authority<br>○ Port management, municipality, provincial government and Rijkswaterstaat. |
| Financial | ○ Percentual investment synergy | ○ Minor (<10%) of total |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0 | • All three identified ET-synergies were deemed unfeasible. |
| **Delays related to synergy** | +0 | • Investigating the potential feasibility of the synergies required many scans and info-meetings with all the participants |
| **Achieved ET-potential** | +0 | • No ET-contribution was achieved. |
| | | |
| **Total outcome score** | 0 | |

| **Criteria** | **Rating of ET synergies** | **Rating of non-ET synergies** |
|---|---|---|
| **Holistic cost-benefit of the project** | **0** | **1** |
| | | |
| Added complexity (1 = no added complexity) | 0.7 | 0.7 |
| Increase project duration (1 = no increased duration) | 0.3 | 0.7 |
| Financial costs related to the synergies (1 = no added financial costs for each party) | 0 | 1 |
| Societal benefits related to the synergies (1 = optimal number of societal benefits) | 0.3 | 1 |
| Financial benefits related to the synergies (1 = optimal number of financial benefits) | 0.3 | 1 |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The most relevant parties were actively asked to be involved in the project process from a very early stage. However, only parties with sufficient funding and the ambition to improve society as a concept were invited (Provincial government, Rijkswaterstaat and the

municipality) by the regional water authority. While this boundary rules were relatively rigid and narrow, the early timing and exceptional persuasion meant that all three parties were sufficiently involved in the project since the start.
**Score: 0.7**

Related conditions:

- **How were the participants determined?**
  The regional water authority had close ties with many large public organisations which were instantly contacted after announcing the project.
- **How were the criteria for selection determined?**
  Based on previous integral collaboration and the ability to fund synergies.
- **Why were the government/locals excluded?**
  Increase project efficiency by excluding locals as much as possible, as they already received sufficient synergy ideas via the participants who were already participating.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**

Lauwersmeerdijk was the perfect example of a very determinant and managing main party (de kartrekker) in the form of the regional water authority. When the synergies were identified at the start and the funding was obtained from the involved parties, the regional water authority was both the daily and strategy manager of the project. The municipality, Rijkswaterstaat and the regional government were all given an investor role without any managing function.

**Score: 1**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Societal predominantly.
- **How stable is the commitment of the local governments for the integral energy transition?**
  The provincial government and the regional water authority have been working together on ET projects for more than a decade.

- **Which party is the initiator of the overarching project?**
  The regional water authority.

- **Which party is the initiator of the potential synergy?**
  The regional water authority.

- **Who is the final user of the overarching project?**
  The regional water authority.

- **Who is the final user of the synergy?**
  The local citizens.

- **In retrospect, who else should have been involved to make the process easier?**
  Not perse easier, but more synergies could have been identified if the local companies and inhabitants were involved.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The regional water authority.

- **Who were the supervising legal coordinators of the project?**
  The main parties who were also closely involved by the regional water authority.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  While there were 7 specific synergies utilized with the renovation of the dyke, the scope was actually relatively narrow. All objectives could be synergized with the renovation project, but they had to come from one of the three investor-role parties. As there was no funding from the regional water authority themselves. Other parties were also not directly involved. However, that only the three parties were heavily involve did not lead to a reduced number of utilized synergies, on the contrary actually.
  **Scope: 0.7**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  Dyke renovations are long-term and large-scale projects, which means that all synergies are compatible.

- **How are potential synergies determined and incorporated in the overarching project?**
  The regional water authority persuaded the three main parties to provide synergy ideas with the dike renovation.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  Heavily involving the three investor-parties' years before the orientation phase of the project had even started resulted in the situation that there already were 20+ synergy ideas before the project even commenced. Additionally, the objectives set by the regional water authority were aimed at improving the lives of all citizens in a broad aspect, not just water related. This initiating party was one of the more active and eager parties to identify and incorporate synergies.
  **Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**

They were the initiator and the (really active) facilitator of the energy transition.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  They were actively trying to better the local environment, socially, energy-wise and ecological.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  The decision-making was extremely efficient as only the regional water authority was making the daily decisions. And even within the regional water authority itself all departments were in favour of synergies and the integral approach. Moreover, the regional water authority had very close contacts within the three partners, which initially led to the heavy involvement but later on in the project meant that permits were obtained with incredible efficiency.
  **Score: 1**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  Permits from both the municipality, the provincial government and from within the regional water authority themselves were required.

- **What is the application period of the required permits?**
  Permits were obtained with near perfect efficiency as the communication with the legal supervision organisations was really effective.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  N.N.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.
- **Were there any requirements or challenges before certain subsidies could be requested?**
  Effective communication network between the main parties ensured that subsidies were obtained efficiently.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Hierarchal, the regional water authority team managed all decisions, and fully incorporated all synergies into their own project management structure.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  Large strategic decisions regarding the synergies were made in collaboration with the respective investor, but all other decisions were made by the regional water authority.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  Before the project begun, all three parties obtained all required information about the dyke renovation. However, after the project began the information flow was less comprehensive and only involved the required information for the respective synergy for each party. Other parties also did not receive much information. This was possible due to the dominant managing role of the regional water authority. As a result, the project was managed efficiently, and the complexity was restricted.
  **Score: 0.7**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Ecological, mobility and ET related synergies

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  N.N.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  N.N.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**

  All the financial costs of the synergies were for the party that initiated the idea (who were also the party that benefitted the most from the synergy). All managerial costs were taken up by the regional water authority. However, as everything was weighed individually, it meant that nearly all ET-synergies did not find suitable investors. While other more societal focussed synergies did find interested in the three parties.

  **Score: 0**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  Each of the three main parties invested in the synergy they preferred.

- **What is the societal added value of the synergy?**
  Mainly better mobility and an improved liveability of the neighbourhood around the dike.

- **What impact does the synergy have on the local environment?**
  An increase in the amount of space for nature, and overall improvement.

- **Were all participants in agreement on the costs and benefits of the project?**
  N.N.

- **Who and how were the costs/benefits assessed?**
  Individually per synergy type.

- **How were the cost/benefits distributed between the involved parties?**
  Individually per synergy type per investor.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  The local population was severely against the placement of any type of wind turbine and were also not happy with solar panels.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  Synergies were actively incorporated in the project process of the regional water authority. They are an example in the Netherlands of how to involve the regional authorities with their projects and how to manage projects with an integral approach. They have the experience and the expertise present in the regional water authority teams to integrate projects.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  The dike was not close enough to sufficient energy demand for the business case to be viable for solar panels.

**Score: 0.7**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  Around the dike is agricultural land. On the dike is a road.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  N.N.

**Score: 0.7**

## Case 5: Helmond gekoppeld

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Dike strengthening and renovation<br>○ Four to twelve years<br>○ Energy source synergies |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Municipality & energy producers<br>○ Municipality & energy producers<br>○ Energy network operator and energy provider. |
| Financial | ○ Percentual investment synergy | ○ Minor (<10%) of total |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • The aquathermy-solar farm solution will be fully implemented in a few years' time |
| **Delays related to synergy** | +0 | • There was severe delay caused by a high number of required permits to connect a solar farm to an aquathermy system. |
| **Achieved ET-potential** | +0 | • In the upcoming years the aquathermy solution will be powered by fossil fuels due to a problem with the permit and subsidies. |
| | | |
| **Total outcome score** | 0.3 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  While the number of participants was relatively conventional, the type of participants collaborating this project was unique. With an aquathermy company working together with a solar energy producer and a large energy distributor. Using the power of the local stream with the electricity provided by the solar farm to replace the existing energy network. Combining energy sources (even experimental ones) was a new and interesting concept. However, other synergies were not actively sought in this project.
  **Score: 0.7**

Related conditions:

- **How were the participants determined?**
  The municipality promoted the possibility for commercial parties to involve themselves in the city heating project All potential heating ideas were analysed and discussed.

- **How were the criteria for selection determined?**
  By the municipality, but in the initial selection, all parties were considered.

- **Why were the government/locals excluded?**
  Local parties were only involved after an initial project plan was formed, by then the initial big synergy ideas were already utilized.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**

Position-wise the project in Helmond did not offer anything special or unconventional. The municipality needed to replace the heat source for 6500 houses, and they wanted the energy company ENnatuurlijk to manage this project. The project management team was relatively similar to many other conventional projects.

**Score: 0.3**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Commercial.

- **How stable is the commitment of the local governments for the integral energy transition?**
  N.N.

- **Which party is the initiator of the overarching project?**
  The municipality

- **Which party is the initiator of the potential synergy?**
  The consulting partners in collaboration with the energy producers: the commercial parties.

- **Who is the final user of the overarching project?**
  The local inhabitants

- **Who is the final user of the synergy?**
  The energy producers

- **In retrospect, who else should have been involved to make the process easier?**
  The national government (het Rijk), to enable the subsidies for the project without delays.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The municipality and no, they did not.

- **Who were the supervising legal coordinators of the project?**
  The municipality mainly, with the ministry of energy involved with the subsidy complications.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The scope of this project was limited to just three potential solutions, which is limited. However, the 3 solutions were identified as the three most promising possibilities by a feasibility scan performed years earlier by another consultancy. So there was merit to it, but strictly for this project was tight as a result.
  **Score: 0.3**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  All energy production facilities have a long-term lifetime and a designed as such.

- **How are potential synergies determined and incorporated in the overarching project?**
  Geothermy, leftover industrial heat and aquathermy were all considered, then solar energy was added to that list. But other than energy related synergies, no societal or ecological synergies were identified.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The choice made to first of all even allow looking into ''new'' energy sources and even look into the potential to combine aquathermy with a solar powered heat pump (and also combine it with a solar farm located on the property of the conventional energy production plant, partly placed on its roof) was interesting. However, the initiating party was not especially eager for integral solutions, but was more looking for a financial gain.
  **Score: 0.7**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  The municipality was both initiating and investing in this project. They were also the party who eventually decided which alternative energy source(s) were select.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  They were very strict that they would achieve the set emission and natural gas standards set for 2030.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  The project of Helmond is still not finalized, and the synergies have not been implemented properly. This is due to the problems it is facing with the subsidy-

regulations. The current energy system is using leftover energy (from conventional energy sources) and as such is in practice more polluting than a fully sustainable one (with the aquathermy – solar energy integration). But due to its relative effectiveness and subsidy regulations from the 1990's it is impossible to switch to the aquathermy source on the short-term. First the solar farm needs to be completely finished and working, then the energy provided by the farm needs to be physically and legally connected to the heatpump. Only then the aquathermy source can be used without the risk of losing the energy subsidy. But his procedure delays the project several years.

**Score: 0**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  The required permits to build an aquathemry installation combined with the construction of a solar farm both required a large number of municipal permits.

- **What is the application period of the required permits?**
  This initial set of permits takes years (estimated: 2 years) to obtain fully, but this was not a bottleneck for the project as the subsidy regulations proved to be more of a blocking aspect.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  The project was not able to be started as a result of the synergy, because of the new composition of the energy sources, it was impossible to obtain a similar amount (compared to the current situation) of subsides for the project. Resulting in a negative business case.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  In some ways, as the initial identification of the possible energy synergies made a very positive business case possible with minimal damaging emissions.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  Yes, as the new composition of the energy sources led to a situation where the old energy subsidy could not be requested as the old heat buffer was really efficient and the new aquathermy system would require normal electricity to work initially.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined? '**
  In the end it was the municipality that decided what would happen with the heating system, however they were heavily informed by numerous commercial (and non-commercial) parties on what would be the best course of action.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  The daily decisions in the project were made mainly by the project team, consisting of people from all commercial parties, consultancies and the municipality. Strategic decisions were made by the municipality.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  The information distribution was severely restricted by the scope of this project. As only energy was taken into account as an objective, the only information distributed was focussed on sustainable energy. And even within the topic of energy there was little focus on sufficient energy distribution, as the main potential parties (the energy producers and distributors) were discussing and analysing collaboratively already.
  **Score: 0.3**

Related conditions:

- **Which technical risks are associated with the synergy?**
  As the synergy was a new field of energy combinations, there were certain uncertainties involved with the project that required deeper analysis.

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Different types of energy combinations were assessed, but only energy related synergies were considered.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  Because of uncertainties of the subsidies, parties were unwilling to invest heavily or commit a lot of resources on the required investigations and location research. This in turn led to several more situations with a lack of information as not all parties were actively contributing to the project process.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  The potential risk with the subsidies were actively shared with all involved parties.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The business cases analysed for this project actually show that for each partner in the project the synergy is beneficial. The solar farm, the aquathermy source and the energy distributor all receive a positive financial gain from the project if it could happen as planned in the business cases. Even the municipality would be content that they would achieve their goals for 2025. However, due to the subsidy-regulation problem, the energy distributor would lose millions if the project continued.
  **Score: 1**

**Related conditions:**

- Which stakeholders invest in the project and the synergy and how is this distributed
  Each energy producer (aquathermy and solar energy) invests together with the municipality.

- **What is the societal added value of the synergy?**
  N.N.

- **What impact does the synergy have on the local environment?**
  Temperature of the local stream is reduced by 1-degree Celsius maximum.

- **Were all participants in agreement on the costs and benefits of the project?**
  Excluding the problems with the subsidies, yes.

- **Who and how were the costs/benefits assessed?**
  Multiple, research-based, thorough business cases were conducted and analysed.

- **How were the cost/benefits distributed between the involved parties?**
  Each party obtained the costs and benefits for their own respective part of the energy circle.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  They were against large scale solar farms and wanted to place all the solar panels on the roofs of buildings. Wind turbines were also not an option.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  No.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  Yes, as there was no spare room for the solar farm to normally be added to the network. But with the synergy with the aquathermy installation there suddenly was extra demand. Additionally, the municipality pushed for the energy provider to transition towards more sustainable energy (reducing the amount of fossil-fuel energy and increase the amount of sustainable energy).

**Score: 0.3**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  The location where the solar farm will be placed is currently an agricultural field close to the city. The location of the aquathermy installation is in a heavily urbanized neighbourhood.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  Yes, and while this indeed increases the cost of the aquathermy heating installation and reducing the feasibility of solutions as both below and above the ground the space was limited.

**Score: 0.3**

## Case 6: Landtong Roozenburg

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Minor dike repair<br>○ 2.5 years<br>○ Wind energy |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Regional water authority<br>○ Energy producer<br>○ Rijkswaterstaat and the municipality combined with the network operator and energy provider. |
| Financial | ○ Percentual investment synergy | ○ Major (>40%) of investment |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • The wind turbine integration was successfully implemented (11 built). |
| **Delays related to synergy** | +0 | • There was severe delay caused by a high number of required safety investigations and related permits. Building on a dike is still in an infant state. |
| **Achieved ET-potential** | +0.4 | • After the delays with the right permits and safety checks, the result was a very effective ET synergy implemented within a dike renovation. |
| | | |
| **Total outcome score** | 0.7 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The boundaries were very rigid and only energy related parties could participate actively in the project process. Local parties were only superficially involved and invited. Parties with legal supervision like Rijkswaterstaat and the regional water authority itself were only involved for the provision of permits and not for significant input.
  **Score: 0.3**

Related conditions:

- **How were the participants determined?**
  Beforehand (before the orientation phase a plan was already made) and by the energy production company.

- **How were the criteria for selection determined?**
  Based on their relevance to the feasibility of the problem, if their money, expertise or legal supervision was required, they were invited.

- **Why were the government/locals excluded?**
  To decrease the amount of costs (both timewise and financially) for the project.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**

Relevant parties were determined based on the presence in the energy sector, producers, network operators, distributors and the port (user) were involved actively in the process. Additionally, legislative/authority organisations were also involved (municipality, Rijkswaterstaat). But other parties were not actively involved. For the management itself the regional water authority was working close with the energy distributor and Rijkswaterstaat. The legislative/authority parties had a supervising role to ensure no damage was done to the dykes and the environment while the energy distributor wanted to maximize output of the turbines.

**Score: 0.7**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Commercial, the energy producers themselves.

- **How stable is the commitment of the local governments for the integral energy transition?**
  The regional Rijkswaterstaat and the regional water authority are both experienced with combining the energy transition with their water defence network. This was the catalyst for the possibility for the ET to be synergizing with dike projects.

- **Which party is the initiator of the overarching project?**
  The regional water authority.

- **Which party is the initiator of the potential synergy?**
  The regional water authority.

- **Who is the final user of the overarching project?**
  The regional water authority.

- **Who is the final user of the synergy?**
  The energy producer.

- **In retrospect, who else should have been involved to make the process easier?**
  If more synergies were to be utilized, the municipality, the provincial government and more local parties should be involved to identify synergies.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The energy producers were making the daily decisions, but the regional water authority was mainly tasked with the strategy decisions.

- **Who were the supervising legal coordinators of the project?**
  Rijkswaterstaat, the municipality and the regional water authority itself.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The scope of the project was simple and straight-forward, just how the energy distributor wants it. It was focussed on combining a small dyke renovation with a relatively large wind turbine project. No other objectives were connected to the project as it already was a regulative complex process. As a result, no other synergies were identified or utilized except the wind turbines.
  **Score: 0.3**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  **N.N.**

- **How are potential synergies determined and incorporated in the overarching project?**
  Only energy related synergies were assessed and only energy production numbers were used for the objectives of this project.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The choice of the regional water authority to work so closely with the energy distributor and even change the spatial planning to allow energy production on the primary and secondary flood defence systems was relatively unconventional. Both greatly benefitting the possibility to synergize dike renovation with the energy transition and showing the willingness of the regional water authority to synergize with the ET. However, the main objective was always financial related and broad ET-integration was not encouraged.
  **Score: 0.7**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  The regional water authority promoted the possibility to invest in sustainable energy on that particular dike, and they facilitated the whole project while the energy producers were active with the daily decisions making.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  They are very active (both the regional water authority as Rijkswaterstaat West Nederland) for achieving all nationally set environmental standards.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  The aggregation rules posed a large obstacle for the project, as both the regional water authority as Rijkswaterstaat had to provide permits. To do this the safety and potential impact of the wind turbines had to be thoroughly analysed. However, the experience with the permits of both the legislative parties as the energy distributor ensured that this went relatively smoothly (still took multiple years to complete all required investigations).
  **Score: 0.7**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  The ''omgevingsvergunning'' from the local municipality and the ''watervergunning'' from both the regional water authority itself for the secondary dikes and the ''watervergunning'' from Rijkswaterstaat for the primary dikes.

- **What is the application period of the required permits?**
  Varying between 1 to 2 years for both the ''watervergunningen''. The permit from the municipality was less than a year.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  Acquiring the ''watervergunningen'' was difficult as all safety checks had to be investigated thoroughly to ensure the safety of the dikes. Without the synergy there would only be a minor routine repair project for the dike.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  The energy producers had lots of experience with the required and potential subsidies

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Levelled in a way that both the energy producers and the local governments all had a say in the project management (however, the government parties were more focussed on the legislative and legal parts, while the energy producers were busy with the practical aspects.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  Yes, as can be read in the question above.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**

The energy related parties and the governmental parties both had plenty of experience and shared information sufficiently, however all other parties, even local ones were left relatively in the dark with the developments of this project. While it did benefit the project duration and complexity, combined with the narrow scope it led to missing out on potential other synergies.
**Score: 0.7**

Related conditions:

- **Which technical risks are associated with the synergy?**
  The structural integrity of the dike can be compromised as a result of the wind turbines.

- **Which societal risks are associated with the synergy?**
  Decrease in flood safety paired with less aesthetically pleasing dikes.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Only wind energy was considered.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  The participants did not know when (and if) all the required permits would be provided. Because there were only a small number of active participants, they all had similar info.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  Yes.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The energy producer and distributor had a clear distribution of the cost, all parties were content with the related costs and benefits. The governmental parties were achieving their standards while the energy related parties were realising a financially healthy project.
  **Score: 1**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  The energy producer predominantly.

- **What is the societal added value of the synergy?**
  More sustainable energy.

- **What impact does the synergy have on the local environment?**
  Large wind turbines on the dike environment (aesthetically damaging) but no significant impact on the ecological life.

- **Were all participants in agreement on the costs and benefits of the project?**
  N.N.

- **Who and how were the costs/benefits assessed?**
  Based on multiple business cases supported by evidence from comparable projects, the project is profitable for the investing energy producer.

- **How were the cost/benefits distributed between the involved parties?**
  N.N.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  They already had experience with wind turbines on the dikes, so they were not as opposed to the project as other regions would be.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  Yes, the regional water authority specifically ensured that the wind turbines could be integrated with the dike.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  No.

**Score: 1**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  A flood defence structure covered with grass and old outdated wind turbines.

- **Is the soil of the project location already *full* of other wires, tubes, and networks?**
  Nothing significantly damaging for the project.

**Score: 1**

## Case 7: Port of Rotterdam – Port of Amsterdam | Vision for the future

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Strategic spatial planning port area (of two ports)<br>○ 2 years planning for 30 years in the future<br>○ Sustainable energy broad |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Port management<br>○ Port management and the municipality<br>○ The surrounding municipalities |
| Financial | ○ Percentual investment synergy | ○ No implementation yet |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • There is now sufficient space for ET-synergies in the future due to the new spatial plans for both ports |
| **Delays related to synergy** | +0 | • Investigating the required space and implementing that in the new spatial designs required a lot of time for both port managements. |
| **Achieved ET-potential** | +0.4 | • The potential benefits this new spatial planning brings to the harbour is enormous as without it, there would not be sufficient space for ET-solutions. |
| | | |
| **Total outcome score** | 0.7 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The port management of each region was specifically focussed on their own land, work and future. As they are thoroughly intertwined with their respective municipality, they were naturally involved as well. But other than the municipality and the port management, no other parties were involved in the project process. While this is explicable, as the scope of the project was for the long-term robustness of the port areas, it is still very limiting to have only two major parties involved.
  **Score: 0**

Related conditions:

- **How were the participants determined?**
  The two only parties that were involved were determined based on their involvement with the port area (the municipality owns a large portion of the respective ports and the port management is the main regulative branch of the port area).

- **How were the criteria for selection determined?**
  N.N.

- **Why were the government/locals excluded?**
  To streamline the efficiency of the project, as the scope of the project was severely long-term that local parties were required to provide input. Additionally, the objective of the project was to design a resilient plan for the energy production and storage of the port in the future, not to actually implement it.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  The port management was the main decision-maker in this project, with legal supervision and supportive input from the municipality. Because of the rigid and limiting boundary rules, the position rules are also limited as well, as there is basically one big single organisational entity that organises the whole project.

**Score: 0.3**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Combination of both as the municipality and the port management were both investing.

- **How stable is the commitment of the local governments for the integral energy transition?**
  As the port management and the municipality are already making an integral strategic vision for 2030 – 2050 of the port, their commitment to the integral energy transition is exemplary.

- **Which party is the initiator of the overarching project?**
  The port management.

- **Which party is the initiator of the potential synergy?**
  The port management.

- **Who is the final user of the overarching project?**
  The port management.

- **Who is the final user of the synergy?**
  The port management.

- **In retrospect, who else should have been involved to make the process easier?**
  Easier not perse, but involving more local parties, energy related organisations and other stakeholders could lead to a more integral strategic vision. However, this would also lead to a less efficient project.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**

The port management in combination with some involvement of the municipality did both the daily as well as the strategic decision-making.

- **Who were the supervising legal coordinators of the project?**
  The municipality who was already sufficiently involved in the project.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  While the scope itself, focussing solely on the spatial planning of energy production and energy storage in the future, isn't broad or effective on its own. But the fact that the port region wants to develop and maintain their resilience (sustainability-wise) in the long-run, shows how broad and effective the objectives of the port management are.
  **Score: 0.7**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  Finding the synergies with energy production and storage on the area of the port was the main goal of the project, so there is no real overarching project to speak off.

- **How are potential synergies determined and incorporated in the overarching project?**
  By the appointed ET spatial planning team of the port – municipality project team.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The dedication of the port to be as robust and resilient as possible regarding the energy transition ensures that potential synergies are identified early on. This in turn will contributes to more synergies being feasible and more synergies being utilized in the upcoming two decades. Many other, smaller, ports do not have this dedication (and more importantly the resources) to manage such long-term projects.
  **Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  The municipality ensures the port regions have sufficient space to expand and develop themselves regarding the energy transition. They are highly facilitating

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  The port management has set themselves the objective to become a staple region in the Netherlands in the fields of the sustainable industry. Because of the large scale, immense

capacity of the ports, they want to become an example for the rest of the industries in the Netherlands.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  Because of the limited number of parties involved and the very close ties with the respective municipality, decision-making is relatively efficient in the project. Only components of the strategic vision that affect other municipalities cannot be effectively assessed as these parties are not as involved.
  **Score: 0.7**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.

- **What is the application period of the required permits?**
  N.N.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  It proved to be relatively difficult to estimate the potential growth, importance and required space for sustainable energy for 20+ years in the future. But that was the main objective of the project.

- **Did the overarching project become feasible because of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  Because of the close ties between the ports and the respective municipalities, this was not an issue.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Hierarchal, because the port management team was the main decision-maker for the whole port region. No single company had significant power in this project. Only the municipality was significantly involved.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  N.N.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  As the number of active participants was severely limited, the spread of information was consequently relatively efficient. Because of the inherent

entanglement between the municipality and the port management, there was an efficient system in place that ensured both parties had sufficient information about the planning, objectives and capacity of each party.
**Score: 0.7**

Related conditions:

- **Which technical risks are associated with the synergy?**
  The reason why the port management was so active in designing the port for the long-term was that the energy transition requires a lot of space to be stored and produced. Especially when hydrogen and other energy-carriers become more prominent, the required space to ensure safe storage gets significantly large. These technical safety risks determine a great part of the port spatial planning.

- **Which societal risks are associated with the synergy?**
  It is unknown for the port management how exactly the global energy transition will develop in the upcoming three decades. A potential quick shift in the societal approach to the energy transition could completely nullify the plans made for the energy transition in the port area.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Combining hydrogen productions plants with leftover energy, solar panels and wind turbines. Integrating the energy transition in private spatial planning, in the long-term.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  The parties were uncertain about the expected development in the ET sector in the upcoming three decades, making it difficult to estimate how the ET should be integrated in the area.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  Yes, because of the low-number but high-collaborative parties involved.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  All costs were covered by the port management itself. As part of their sustainability budget is derived from direct subsidies by the respective municipality, the municipality was also indirectly involved. There was not any special or particular system in place for the costs, as this project only involved designing a long-term resilient spatial planning for the port area and did not involve any direct construction.
  **Score: 0.7**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  N.N.

- **What is the societal added value of the synergy?**
  N.N.

- **What impact does the synergy have on the local environment?**
  N.N.

- **Were all participants in agreement on the costs and benefits of the project?**
  N.N.

- **Who and how were the costs/benefits assessed?**
  N.N.

- **How were the cost/benefits distributed between the involved parties?**
  N.N.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  While the local population, both companies and inhabitants are somewhat pro sustainable development, they are opposed to any of their lands being taken by the port management for their spatial planning.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  This project is actively trying to incorporate the energy transition in the spatial planning of the port area. Luckily, the ports of Amsterdam and especially Rotterdam have the required capacity to make a spatial plan for the development in the long-term (>20 years). Other smaller industrial areas do not have the adequate capacity for such projects.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  Yes, as the current spatial planning of the port does not allow for the required space for the production and storage of sustainable energy. That was one of the main instigators of the project for the port management.
  **Score: 0.7**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  The lands in question are occupied by the local port companies and the people living around the port area. So, both an industrial and housing function with an high urbanization grade.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  Yes, especially with the current energy transportation systems like the natural gas transport network. Taking into account how much this will develop in the upcoming decades and how it would affect the available space in the soil was a vital component of the project objective.
  **Score: 0.3**

## Case 8: STAIN Zwolle

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Integral spatial planning<br>○ 2 years<br>○ Sustainable energy, climate adaptation and nature |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Park manager industrial area<br>○ Municipality, park management and private companies<br>○ All local companies |
| Financial | ○ Percentual investment synergy | ○ Large >30% of total investment |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • Multiple ET-synergies were identified (both small and large) and implemented in the planning |
| **Delays related to synergy** | +0 | • All companies were invited which required lots of planning, time and effort. |
| **Achieved ET-potential** | +0 | • Only very small ET synergies have been realized so far, as the larger ET-synergies require a clear cost-distribution which has not yet been established. |
| | | |
| **Total outcome score** | 0.3 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The STAIN-approach ensures that all private parties are involved in the integral development of their respective region. Key component of STAIN is that all local parties in an area are invited to discuss the potential synergies and ideas together, the essential part here: ALL parties. Because of this broad selection of relevant parties, all the area in a certain area is covered by the parties present. This in turn leads to the situation where property-ascending projects can be undertaken. Moreover, this strategy also greatly boosts the potential public-private collaboration as all commercial parties are connected with the municipality (and potential the provincial government) at the same time.
  **Score: 1**

Related conditions:

- How were the participants determined?
  They were selected based on their presence in the project area and based on their organisation-type. In the case of the Zwolle project, only companies were invited based on the project location, not local inhabitants, or other organisations. (The municipality was ofcourse also heavily involved).

- **How were the criteria for selection determined?**

The criteria were determined by the consultants using the STAIN tool, and the goal of the criteria was to involve all companies from the project location.

- **Why were the government/locals excluded?**
  The local population was excluded because the first objective of the project (it is still going on as of the time of writing), was to ensure all commercial parties (the landowners) were on-board with the project and the potential synergies. Making sure the companies were actively trying to identify and utilize the potential synergies as a collective in collaboration with the municipality. Only after this has been achieved and specific synergy-ideas have been formed, will the local population be involved heavily.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  The park manager of the industrial park (the project location) was the initiator of the project, but he is not the only decision-making party in this project. A core-aspect of the use of STAIN is to assess and combine the input of all involved parties and form a plan based on the input of everyone. In the end the park manager will have to decide if he accepts the strategies and plans proposed by STAIN, but the strategy itself is based upon the ideas of the collective. This system where all involved parties have an equal say in the project process ensures that smaller companies can provide synergy-ideas, but also leads to a situation where indecisiveness or a conflict between the involved companies can fester.
  **Score: 0.7**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Mainly commercial parties based in the industrial park (and the municipality).

- **How stable is the commitment of the local governments for the integral energy transition?**
  The municipality is actively trying to facilitate any sustainable spatial development project but is encountering problems to effectively do this on private grounds (public property is only 30% of the urban area in Zwolle).

- **Which party is the initiator of the overarching project?**
  The park manager.

- **Which party is the initiator of the potential synergy?**
  All involved parties, the park manager, the municipality and the local companies.

- **Who is the final user of the overarching project?**
  The local environment of the industrial park, which in turn benefits the companies, the inhabitants and the municipality.

- **Who is the final user of the synergy?**
  N.N.

- **In retrospect, who else should have been involved to make the process easier?**
  It might show that during the design phase when the ideas obtained from all the companies are being developed, that certain synergies are impossible because of the local population or other relevant organisations. As all non-local company parties have not been involved actively so far. However, this was deliberately chosen by the project team to ensure the feasibility and efficiency of the project.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The STAIN-project team in collaboration with the park manager (with additional involvement of the municipality).

- **Who were the supervising legal coordinators of the project?**
  The municipality.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The scope was very flexible and broad throughout the project so far, if for example an idea with an educational goal came up as a potential synergy, it is possible to broaden the scope and incorporate it into the integral spatial development plans. This flexible scope is inherent to the STAIN-tool as it enables the involved parties to show potential synergies via an interactive map, without inhibiting them to a certain pre-set scope. When the involved parties see an opportunity to integrate the expansion of a factory with the placement of a wind turbine, then that's facilitated.
  **Score: 1**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  N.N.

- **How are potential synergies determined and incorporated in the overarching project?**
  The synergies are determined by multiple group-discussion via an interactive map with all parties involved. Ensuring a list of tens, potentially hundreds of synergy-ideas are initially formed. Afterwards the discussion is aimed to find which ideas are possible and are beneficial for all involved parties. This is also done via group-discussion led by the consulting party. The aim of these discussions is to obtain a small list of synergies that can be utilized to develop the industrial park, with all involved parties agreeing with the implementation.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The willingness of the involved local companies (and especially the park manager!) to invest in an integral, sustainable development of their surroundings to achieve all

environmental standards greatly helped with the achieved of synergies (or at least the identification of the synergies). Additionally, the appointment of a park manager with a relatively strong political position ensured that the industrial park as a whole can initiate sustainable projects instead of small parts of it. Moreover, the usage of the STAIN-tool in the identification of potential synergies with the sustainable spatial development of the region ensured that more synergies were identified and possible. These aspects are all positive, but the choices made within this project are not particularly unique and noteworthy.
**Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  The municipality was extremely facilitating and willing to work together with the industrial park to ensure the location was developed effectively.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  The park manager was trying to ensure the park area achieved the national emission standards, but also strived to do this as efficiently as possible. Actively connecting different neighbouring companies to increase the scale of the local sustainable projects.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  The decision-making structure was, as a result of the broad boundary rules and levelled positions, fairly time-consuming. All parties could contribute to the discussion and the opinion, wishes and demands of each party was incorporated in the final recommendation for the development of the area. While this was beneficial for the identification of synergies, the efficiency of the project process and respective decision-making suffered.
  **Score: 0.3**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.

- **What is the application period of the required permits?**
  N.N.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  Companies had to connect with each other to combine their individual efforts of sustainable development into integrated collective efforts. Which proofed difficult initially.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  N.N.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  The daily decision-making and design options were done in an extremely levelled way, with an end-decision in a hierarchical way by the park manager.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  Yes, as the daily decision-making was performed by the collective of all involved parties, and the strategic decision were made by the park manager in collaboration with the municipality.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  Providing all involved parties with sufficient and an equal amount of information was one of the core strengths of the STAIN-tool. By making sure all parties have all the information they need to provide input, identify synergies and utilize potential integration of the ideas and efforts of multiple companies, the project as a whole becomes more efficient. The information itself was obtained by multiple discussions with all involved parties and then shared via workshops, group-discussions and an online inter-active map.
  **Score: 1**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  There were many ideas, but the most prominent ideas involved increasing the presence of nature in the region, the (re)usage of the water to generate power and reduce consumption and to collectivise ET development like constructing wind turbines, placing solar panels and using leftover energy (and doing all of this region-wide instead of per company).

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  The biggest uncertainty was a result of the current phase of the project, as its still in a very early stadium. This meant that many of the synergy ideas were only identified and it is still unsure if they were actually going to be utilized and implemented (in the short term). This led to many parties being unsure how to respond to the varying synergy ideas.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**

Yes, sharing this information is a vital part of the way STAIN is used.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  While STAIN is a helpful tool in identifying synergies, it is no tool to help distribute or assess potential costs. The collaborative, broad approach meant that most parties were content with the potential benefits of the synergies. They were all happy that the local environment would be developed more effectively. However, for a large part of the distribution of the costs they looked towards the municipality and even the provincial government. The public governments in turn looked at the companies and so a form of stalemate was created in the project process. This discussion is still ongoing as of the time of writing.
  **Score: 0,3**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed?**
  The commercial parties and the public authorities will both invest in the identified synergies, but the distribution is still uncertain.

- **What is the societal added value of the synergy?**
  More nature and bigger and more efficient climate adaptation and energy transition development in the industrial park.

- **What impact does the synergy have on the local environment?**
  More space for nature, more resilient environment for precipitation and other climate occurrences, and potentially more sustainable energy production systems.

- **Were all participants in agreement on the costs and benefits of the project?**
  No, there is still a heavy discussion how the costs should be distributed (ongoing).

- **Who and how were the costs/benefits assessed?**
  Assessment is still ongoing**.**

- **How were the cost/benefits distributed between the involved parties?**
  Assessment is still ongoing**.**

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  All involved companies were remarkably eager to participate and contribute to the sustainable spatial development of their industrial park. The local population and other organisations, however, were not yet actively involved.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**

Not yet, but through usage of the STAIN tool, the involved parties all agree with the current plans on how to synergize the ET, climate adaptation and other societal objectives in their area.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  N.N.
  **Score: 0.7**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  The project location consists of a heavily urbanized industrial area.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  The land, both below and above the ground is fairly crowded according to early investigations.
  **Score: 0.3**

## Case 9: Schoteroog energie plas

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ ET integrated in spatial rural development<br>○ 4 years<br>○ Solar panels (floating), wind turbines, nature development, recreational development and an old dumpsite. |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Municipality<br>○ Municipality, energy producer<br>○ Local inhabitants, the provincial government, Schiphol and cultural, natural and historic organisations. |
| Financial | ○ Percentual investment synergy | ○ Large (>30%) of investment |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • A small ET-synergy was implemented |
| **Delays related to synergy** | +0 | • There was a lot of opposition (nature, recreational and local inhabitants) which all delayed the ET-implementation and the whole spatial development project. |
| **Achieved ET-potential** | +0 | • In the end only a small field of solar panels was implemented instead of the large field and multiple wind turbines |
| | | |
| **Total outcome score** | 0.3 | |

| **Criteria** | **Rating of ET synergies** | **Rating of non-ET synergies** |
|---|---|---|
| **Holistic cost-benefit of the project** | **0.3** | **0.7** |
| | | |
| Added complexity (1 = no added complexity) | 0 | 0.7 |
| Increase project duration (1 = no increased duration) | 0 | 0.7 |
| Financial costs related to the synergies (1 = no added financial costs for each party) | 0.7 | 0.3 |
| Societal benefits related to the synergies (1 = optimal number of societal benefits) | 0.7 | 0.7 |
| Financial benefits related to the synergies (1 = optimal number of financial benefits) | 0.3 | 0.7 |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  Most of the parties were involved in the project process based on their legislative power in the context of the project. The nature, historic and cultural organisations, the provincial government and Schiphol were all involved because they had to provide a permit or a form of approval before the project could continue. Even the local inhabitants who were involved were contacted to see if they would oppose the plans and what would need to be added for them to accept the plans. This situation in no way contributed to the utilization of synergies, and in many ways opposed it. However, the involvement of all these legislatively involved d
  **Score: 0**

Related conditions:

- **How were the participants determined?**
  They were selected by the project team from the municipality based on their previous experience with spatial development.

- **How were the criteria for selection determined?**
  The main criteria were based on the potential opposition to the ET-synergies and their legal power. There were many parties who were heavily against the placement of solar panels and wind turbines. Especially all the parties who had legal power who were against the placement were selected.

- **Why were the government/locals excluded?**
  N.N.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  The municipality was the main managing factor with this project, they were both the initiator as well as facilitator. The other parties were only superficially involved: all parties that were against any ET placement were only involved with the aspects there were opposing. They did not have any decision-making or managing function within the project. Even the party that was content with the project, the energy producer, was only involved in a commercial way and did not actively contribute to other project aspects. While the municipality did correctly assess where the problems and potential resources in the region were located, and correctly shouldered the responsibility, they were only a single organisation. This limited the amount of beneficial input from other organisations, simultaneously limiting the potential for synergy utilization.
  **Score: 0.3**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Both commercial and societal. (The commercial investor focussed solely on the energy production, and the rest covered by the municipality)

- **How stable is the commitment of the local governments for the integral energy transition?**
  The municipality has a background in trying to find

- **Which party is the initiator of the overarching project?**
  The municipality.

- **Which party is the initiator of the potential synergy?**
  The municipality.

- **Who is the final user of the overarching project?**
  The municipality, the local inhabitants, recreational visitors and the energy producer.

- **Who is the final user of the synergy?**
  The municipality, the local inhabitants, recreational visitors and the energy producer.

- **In retrospect, who else should have been involved to make the process easier?**
  Involve the selected parties in an earlier phase or in a different approach to allow them to provide more beneficial input instead of limiting input. However, it could also be the case that this was impossible due to the fixed negative stance of all the involved parties.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The municipality and yes.

- **Who were the supervising legal coordinators of the project?**
  The municipality, the nature, historic and cultural organisations, the provincial government, and Schiphol.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The scope of the potential synergies was determined solely by the municipality, but it was not limited to a set number of possibilities and was flexible throughout the initial orientation and design phases. This meant that even though there was a lot of opposition, there was still a lot of potential implementable synergies. When the floating solar panels were received negatively, the municipality combined the solar panels with a financial gain for the local inhabitants, an ecological route and only used the space from an old dump site. This flexibility of the objectives ensured that even though the opposition was significant, there was always a potential solution by incorporating another societal objective.
  **Score: 1**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  The overarching project was to connect the development of sustainable energy production with the integral development of one of three locations. These locations were aimed to not

be changed significantly in the upcoming decades so the ET systems could function throughout their estimated lifetime.

- **How are potential synergies determined and incorporated in the overarching project?**
  They were, quite effectively, identified and assessed by the ET team of the municipality.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The willingness of the municipality to develop the sustainable energy production in a spatial multi-purpose way and continue with the project even after setbacks, delays and opposition is remarkable. Moreover, the decision to look for potential integration of the ET in the spatial development of three separate regions greatly benefitted the feasibility of synergies. Even the flexibility and general role of the managing party, the municipality was noteworthy. When a nature-historic organisation opposed the placement of solar panels to close to an historic site, the municipality worked around it by placing ecological objects close to the site and solar panels around it.
  **Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  The municipality assumed all roles, investor, facilitator, initiator and daily manager. The provincial government was only a legislative power (providing permits).

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  The municipality was active with achieving the environmental standards, but the most noteworthy aspect is their experience and willingness to apply the integral approach for their spatial development. The municipality is very keen on utilizing multi-purpose spatial development.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  The decision-making process itself was fairly efficient, as the decision was made by the municipality first and foremost. However, because of the many opposing parties involved in the project process, it became much more complex. Obtaining a permit or an agreement from the opposing parties was a significant component of the flow of the project. Many delays and complications were a direct result of the requirement before a final decision could be made.
  **Score: 0.3**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.

- **What is the application period of the required permits?**
  With the complications, misunderstandings and conflicts that occurred the process for all permits required more than 20 months.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  Local parties did not want any industrial looking object in their pond or forest and historic organisation were opposed to any construction close to any historic site. Schiphol was against any construction of tall objects and the recreational parties were against any floating objects on the pond. All in all, there was a lot of opposition created by the wish to integrate the spatial development of the locations with the energy transition.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  In some ways yes, as for the final placement of the solar panels and a potential small wind turbine, the construction of an ecological route with improved nature aspects around the locations were required. Only by constructing these environment-improving objects the opposing parties would accept the synergies.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  All parties first had to agree with the proposed plans before any subsidy could be requested.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  N.N.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  N.N.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  There were many different organisations providing vital information for the feasibly of the whole project, but these organisations were all only superficially involved. First obtaining all required information from these parties and then sharing it with all involved parties was an extremely complex endeavour. In practice, this complexity led to many requirements and details being misunderstood, being delayed or being changed during the project itself. The positive component of the information subset was that the municipality had sufficient information about the three locations and was well aware of potential solutions because of it.
  **Score: 0.3**

Related conditions:

- **Which technical risks are associated with the synergy?**
  The solar panels should not affect the local environment (not while floating and not while conventionally built) and the wind turbine should not endanger any planes (should be less than 150 meters tall).

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Floating solar panels, combining an ecological route with solar panels (nature and recreation in general with the ET), combining a financial gain of the ET with the local population, and the utilization of an old dumpsite for solar panels.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  It was very uncertain for the involved parties what would eventually happen as there were three separate locations and even the potential synergies were also numerous and varying.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  The municipality somewhat attempted to do this, but the large amount of superficially involved parties made doing this effectively very complex.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The costs were mainly shouldered by the municipality and only the costs directly related to the placement of the energy production systems were partly distributed to the energy producer. This ensured that there was little resistance in the distribution and assessment of the costs and benefits, only the municipality had to assess all possibility thoroughly as there were a large number of potential project variations. In the end the project team settled on a smaller solar panels field combined with potentially one wind turbine. Both having a somewhat positive business case, as the smaller size of the production facilities reduced the profitability. Moreover, the nature and recreational aspects integrated with these developments were all individually assessed and funded by the municipality.
  **Score: 0.7**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  Only the energy production systems themselves were partly funded by the energy producer; the rest was funded by the municipality.

- **What is the societal added value of the synergy?**
  A better recreational environment.

- **What impact does the synergy have on the local environment?**
  More room for high quality nature around the solar panels.

- **Were all participants in agreement on the costs and benefits of the project?**
  Yes.

- **Who and how were the costs/benefits assessed?**
  On an individual basis for each synergy, each aspect of the project and then funded when deemed acceptable (by the municipality).

- **How were the cost/benefits distributed between the involved parties?**
  Only the energy production systems themselves were partly funded by the energy producer; the rest was funded by the municipality.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  The local parties were all heavily against placing anything ET related close to their valuable natural- historic – cultural sites. Both the organisations and the local population,

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  Yes, their strategy specifically mentions the usage of multi-purpose spatial development.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  N.N.
  **Score: 0.3**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  Mainly nature, but a large part of the designated locations was also designated as preservation for nature – historic or cultural reasons.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  N.N.
  **Score: 0.3**

## Case 10: Maasvlakte II: Windturbines

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Large scale wind turbine integration with a dike system<br>○ 10+ years<br>○ Wind turbines and small dike renovation |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Rijkswaterstaat<br>○ Energy producer<br>○ Local municipality, national government, provincial government, regional water authority. |
| Financial | ○ Percentual investment synergy | ○ Primarily synergy focussed (~50%) |

| Outcome indicator | Score | Argumentation |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • A number of wind turbines were realized in the planning of the dike renovation |
| **Delays related to synergy** | +0 | • There was a lot of opposition and required safety scans for permits. It was never done on this scale before, so it required a lot of time. |
| **Achieved ET-potential** | +0.4 | • While it has not been realized yet, it is quite certain that a high number (>12) of turbines will be placed. |
| | | |
| **Total outcome score** | 0.7 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  Because the project was one of the first large scale wind turbine – dike integrations, there were a lot of parties involved who wanted to ensure all legal regulations and safety requirements were met. It also meant that the full focus of these involved parties was analysing the feasibility of the wind turbine placement, and not on finding additional synergies. Another result contributed to the large scale of the project was that only large scale, legal supervising, parties were involved in the process. Smaller organisations and groups were left out to increase the efficiency (and the feasibility!) of the project.
  **Score: 0.3**

Related conditions:

- **How were the participants determined?**
  They were invited by the initiator Rijkswaterstaat to supervise the project or be selected as the main investor (for the commercial energy producers).

- **How were the criteria for selection determined?**
  The investor was selected based on the promised costs, safety, project duration and general project score. The other participants were invited based on their legal and legislative power related to the project.

- **Why were the government/locals excluded?**
  Most of the government was involved, however, smaller municipalities and the local inhabitants were only superficially involved to ensure the feasibility of the project (it already takes 10+ years).

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  When dealing with projects of this scale (national level), it is important to have clear functions for all parties involved. As already the project duration was immense due to the legislative opposition on building so many wind turbines on a water defence structure (safety and aesthetic concerns). This project is going towards the construction phase however, because of the clearly defined role for the energy producer to manage and design the wind turbines on the dike. The other parties involved were only tasked with checking the safety and other legislative concerns. Another, less efficient structure could have potentially led to an unfeasible project. However, the conservative stance of all public organisations combined with the absence of any party specifically looking for synergies, meant that other than the wind turbines, no other objectives were sought after.
  **Score: 0.7**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Commercial with heavy societal subsidies.

- **How stable is the commitment of the local governments for the integral energy transition?**
  While they were all in favour of investing in the ET, they had a relatively unstable commitment to the Maasvlakte II project itself.

- **Which party is the initiator of the overarching project?**
  Rijkswaterstaat**.**

- **Which party is the initiator of the potential synergy?**
  Rijkswaterstaat.

- **Who is the final user of the overarching project?**
  The energy producer.

- **Who is the final user of the synergy?**
  The energy producer.

- **In retrospect, who else should have been involved to make the process easier?**

Involving more parties would in the case of this project only lead to an even more complex project structure. In its current state there already was a lot of delays and required discussions before any progress could be made.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  Energy producer hired project team.

- **Who were the supervising legal coordinators of the project?**
  All non-energy producing participants involved.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The main objective of the project was the produce energy on top of the dike. While because of the large scale of the project, this already was an ambitious undertaking, it meant that all other potential objectives were relatively neglected to ensure the feasibility of the main project. Because it would have already been quite the achievement to realise such a integrated wind turbine farm, there was little interested in expanding upon this achievement by expanding the scope of objective.
  **Score: 0.3**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  Yes, the dike is scheduled for renovation after the breakeven period of the wind turbines.

- **How are potential synergies determined and incorporated in the overarching project?**
  N.N.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The feat of constructing such a large-scale ET project integrated with the water defence network was ambitious. All legislative power was in favour of the integration, this was very noteworthy for these types of projects. The initial decision to even look for the opportunity to generate sustainable energy can become an example for many other locations. However, because of the unknown and complex components of this large-scale spatial development, the initiating parties were not 100% sure on their decision and willingness to actively implement ET-synergies.
  **Score: 0.7**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  They initiated and facilitated the project, ensuring that the best potential energy producer got the project. Afterwards they ensured that the project complied to all legislative and safety requirements.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  Rijkswaterstaat West is more inclined towards innovative dike-ET solutions due to its limited size and high number of dikes. But it upholds similar standards.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  The size of the project can be an asset in generating large amounts of sustainable energy using a multi-purpose spatial designation. However, it also led to the situation where multiple government-types had to discuss and accept components of the projects. As there was no main public entity providing the legislative supervision, all parties were working simultaneously which in turn led to managerial conflicts. This severely delayed any decision making in the project. Leading to a project who has been on the project table for decades. However, it is the first one of it's kind to actually move towards the final design phases, which in turn means that the managing project team did manage to go through with certain essential decision in the long run.
  **Score: 0.3**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  Permits from the regional water authority, Rijkswaterstaat and from the municipality. But also, the provincial government and the national government had to accept the plans.

- **What is the application period of the required permits?**
  In practice it got delayed for multiple years due to communication issues and managerial conflicts.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  Many types of government had to be involved as a result of this ambitious undertaking. It meant that instead of creating a conventional wind turbine field in 4 – 6 years, it took 10+ years to move towards the design phase.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  All public parties had to agree with the plans.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Every public party had its own legislative bubble, which made it relatively levelled but in turn made it also relatively chaotic and conflicting.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  In a sense yes, because most daily decisions were made by the energy producer led project team while the major decisions had to be accepted by the involved public parties.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  Because the project involved an innovative integration of a flood defence structure and a wind turbine farm, a variety of analyses were requirement before any decisions or designs could be made. If the project had to go through with the plans, all legislative supervision parties had to agree with the plans, which in turn meant that all parties had to receive a sufficient amount of information and safety reports before the designing could commence. The project did get accepted which means that all parties received sufficient information, even in the special case of Maasvlakte II where a new large-scale integration was undertaken.
  **Score: 1**

Related conditions:

- **Which technical risks are associated with the synergy?**
  Building on dikes frequently comes with a lot of internal safety issues.

- **Which societal risks are associated with the synergy?**
  It's the first large scale dike-ET integration, people need to be content with the outcome to ensure more dike-location can be developed.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  N.N.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  When and if the project will transition into the final design phase. As it was for a long time unclear when all parties would agree with the plans.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  With all active participants (As mentioned in the Boundary Ruleset), yes.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**

The Maasvlakte II offers a great location for power generation as there are few civilians nearby but an industrial area is closeby. Combined with the windy and spatially unused location of the wind turbines, the project offered a profitable investment location for the energy producer. So Rijkswaterstaat contributed to the development of sustainable energy production, and the energy producer itself had a sound business case. All parties were in the end, after the safety and legislative discussion, content with the project prospects.
**Score: 0.7**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  The energy producer, and via subsidies partly the governmental parties.

- **What is the societal added value of the synergy?**
  Large scale sustainable energy production on an innovative location.

- **What impact does the synergy have on the local environment?**
  More artificial structures (who can hurt wildlife) near the coastline.

- **Were all participants in agreement on the costs and benefits of the project?**
  N.N.

- **Who and how were the costs/benefits assessed?**
  By the energy producer itself.
- **How were the cost/benefits distributed between the involved parties?**
  The costs where mainly shouldered by the energy producer with subsidy regulations supported the finances.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  The local population were not significantly impactful.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  Rijkswaterstaat is developing these policies, but they are not yet fully integrated.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  Nothing out of the ordinary with an energy project of this 110 MW scale. But the energy demand was relatively close by near the harbour.
  **Score: 0.7**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**

Only a relatively sparsely planted dike with a highway on it.

- **Is the soil of the project location already full of other wires, tubes and networks?**

The soil was not leading to any significant complication.

**Score: 0.7**

## Case 11: Raalte RAS – RES integration

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Combining the maintenance of infrastructure with climate adaptation and heat networks.<br>○ 2 years (only design and policy)<br>○ Construction work within a neighbourhood (for example with sewers, heat networks, water drainage. |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Municipality<br>○ Municipality<br>○ Local inhabitants, local companies, 5+ municipal departments |
| Financial | ○ Percentual investment synergy | ○ Substantial (>20%) of investment |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • The ET solution was integrated in the spatial development of the neighbourhoods |
| **Delays related to synergy** | +0 | • It did require a lot of information sessions and planning to connect multiple spatial objectives |
| **Achieved ET-potential** | +0.4 | • A significant part of Raalte has now developed ET-synergies together with climate adaptation solutions |
| | | |
| **Total outcome score** | 0.7 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  For all planned construction and development work in a neighbourhood to be integrated, it is important for all relevant parties to be able to discuss their own upcoming objectives. Based on the experience of municipality Raalte, this was done relatively good with all infrastructure parties invited and 5 municipal departments involved (Health, ecological, water, energy, housing!). However, as the project is still in a very early orientational phase, not all local parties could be fully involved as there were no specific dates scheduled yet.
  **Score: 0.7**

Related conditions:

- **How were the participants determined?**
  The municipality had experience with what parties were involved and interested in the developments in the neighbourhoods. They were all incorporated based on this experience.
- **How were the criteria for selection determined?**

Interested and potential input for the project based on the experience of the project team members from the municipality.

- **Why were the government/locals excluded?**
  All required local parties and municipal parties were involved in this project.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  The municipality had a strong managerial position, connecting the right parties at the right time to ensure synergies could be identified. There was a clear role for the municipality to lead this as a large part of the project team consisted of the municipal departments and the municipality already performed the required initial analyses in the region to have the data required to find synergies. While there was no real flexibility to speak of, a municipality that is the main driving force behind integral spatial development of neighbourhoods is vital for it's success.
  **Score: 1**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Societal investor, the municipality.

- **How stable is the commitment of the local governments for the integral energy transition?**
  The municipality was actively trying to become more sustainable each year and already had much experience with integrating these sustainable objectives for a decade.

- **Which party is the initiator of the overarching project?**
  The municipality.

- **Which party is the initiator of the potential synergy?**
  The municipality.

- **Who is the final user of the overarching project?**
  The local inhabitants.

- **Who is the final user of the synergy?**
  The local inhabitants.

- **In retrospect, who else should have been involved to make the process easier?**
  The project has not gone into the implementation phase just yet, which means that potentially vital parties were missed in the orientation and planning phase.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  Mainly the municipality.

- **Who were the supervising legal coordinators of the project?**

The municipality.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The scope to connect multiple developments in the neighbourhood to decrease the total project duration and minimize construction costs is sufficient for the identification of synergies. However, solely looking a large development in the neighbourhood might lead to missing potential smaller integration opportunities. Luckily the Watt en Wanneer maps of RHDHV has somewhat reduced this issue for the municipality. Especially the collaboration between 5 different departments of the municipality, connecting those 5 objectives, shows great scope management by the municipality.

  **Score: 0.7**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  N.N.

- **How are potential synergies determined and incorporated in the overarching project?**
  The municipality connects relevant local parties to discuss their own upcoming objectives and RHDHV created a ''synergy'' map out of this input based also on the neighbourhood data from the municipality.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The municipality was fully committed into identifying and utilizing synergies in their projects. They were dedicated that their departments were focussed on collaborating together and they were actively looking to make clear plans and policies that incorporate synergies in the future (0 – 20 years for upcoming developments). These all greatly benefitted the possibility to identify synergies, but so far there has not been a clear decision what synergy to actually implement and utilize. They have only been identified.
  **Score: 0.7**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  The assume an all-enveloping role where they are the initiator, investor and managing party.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**

They want to achieve all national environmental standards in time, but with the most efficient spatial planning as possible, thus by utilizing synergies.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  Because the municipality was the main decision-maker in the project, and the other parties were only providing information what objectives there were working on or planning to work on, it was relatively simple to make decisions. It was an efficient managerial structure that was used, but it was only possible because the municipality already had experience working closely together in an sector-exceeding way.
  **Score: 0.7**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.

- **What is the application period of the required permits?**
  **N.N.**

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  Timeframe issues between different projects and objectives.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  N.N.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Hierarchical, where the municipality had the final say in what happened.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  N.N.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  Because of the clear managerial position of the municipality in terms of decision-making, the other parties only had to receive sufficient information so that they could provide the info of their plans. The other parties only had to provide info about their scheduled projects, and not interfere that much in the project process itself. The municipality, with help from the RHDHV maps, would make the decisions

when synergies could potentially be utilized. As a result, this knowledge only had to be fully present with the municipality and RHDHV, which was achieved.
**Score: 0.7**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**
  Because of the long-term planning, a potential synergy that is feasible right now, can become obsolete in a single decade because of the rapid developments in the ET (heating) sector.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Combinations between ecological developments, water drainage projects, housing construction, heating network placement and sewage renovation.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  Planning for something that potentially happen 10 years in the future is always a great uncertainty. Not knowing if the current plans are feasible in a decade means that many participants were weary.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  Yes, as the parties had to be willing to utilize synergies in their project (even if the municipality managed the decisions itself).

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The project only involved a strategic mapping of potential synergies and did not involve the actual implementation. But, the small component of cost distribution involved, used the municipality as the main party to shoulder the costs. The municipality was content with this cost and the related cost reduction due to the synergies.
  **Score: 0.7**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  The municipality shouldered most of the costs.

- **What is the societal added value of the synergy?**
  A more efficient and faster sustainable transition in the multiple neighbourhoods of Raalte.

- **What impact does the synergy have on the local environment?**
  Faster and more ecological projects as they can be integrated with other large projects.

- **Were all participants in agreement on the costs and benefits of the project?**
  N.N.

- **Who and how were the costs/benefits assessed?**
  N.N.

- **How were the cost/benefits distributed between the involved parties?**
  N.N.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  The municipality had experience with keeping the local parties updated, informed and content with the sustainable developments.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  Yes, as this project was aimed in incorporating the synergies in the long-term neighbourhood planning.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  N.N.

  **Score: 1**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  The neighbourhoods are fully occupied with its current spatial functions, be it housing or nature. That's why an integral approach can be so valuable for Raalte.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  Yes, that is why any project should be synergizing with each other to help reduce the costs and complications.
  **Score: 0**

## Case 12: RWZI Land van Cuijk & Ooien RWZI

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Sewage treatment plant development with solar energy farm<br>○ 2 years<br>○ Combining a smaller sewage treatment plant with the area around it to create a large solar farm |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Regional water authority<br>○ Regional water authority, local inhabitants<br>○ Local inhabitants, the provincial government |
| Financial | ○ Percentual investment synergy | ○ Major (>30%) of investment |

| Outcome indicator | Score | Argumentation |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • The envisioned ET-solution was installed |
| **Delays related to synergy** | +0.4 | • While there was some minor opposition in the form of a single nature related demand, the total project duration was not altered significantly. |
| **Achieved ET-potential** | +0 | • In the end only a limited number of solar panels were realized due to spatial limitations and nature demands |
| | | |
| **Total outcome score** | 0.7 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The regional water authority actively involved ecological organisations, the provincial government and the municipality in the project process to attempt to find more synergies and ease legislative complications. However, these parties were mainly involved based on their legislative power and not based on their potential input for synergies. Moreover, the local inhabitants were actively involved, but due to the scarce population density in the area, only a small number of houses were involved in the project.
  **Score: 0.7**

Related conditions:

- **How were the participants determined?**
  The parties were selected based on the preference and established contacts of the regional water authority. Only the local inhabitants were selected based on regional analysis by the involved consultants.

- **How were the criteria for selection determined?**

Mainly legislative power.

- **Why were the government/locals excluded?**
  They were both included, though the local governments could be incorporated even more to potentially find more synergies.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  The regional water authority was the main managing force in the project, with the other parties only surveying the project to see if all legislative requirements were met. As the regional water authority was committed to using the synergy opportunity and pushed towards the realisation, it worked out in favour of the synergy. They even had a specific team incorporated in their organisation that looked for these energy synergy opportunities. However, this rigid nature and relative superficial positions for the other parties can lead to missing out on potential synergies.
  **Score: 0.7**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Societal, the regional water authority (for own usage).

- **How stable is the commitment of the local governments for the integral energy transition?**
  The regional water authority was one of the first of its type to actively seek to integrate solar panel fields (and more!) with all their sewage treatment plants. So far, they have three realised projects, with 4 more on the drawing board.

- **Which party is the initiator of the overarching project?**
  The regional water authority.

- **Which party is the initiator of the potential synergy?**
  The regional water authority.

- **Who is the final user of the overarching project?**
  The regional water authority.

- **Who is the final user of the synergy?**
  The regional water authority.

- **In retrospect, who else should have been involved to make the process easier?**
  Better contacts within the local municipality and provincial governments to ease the permit process.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The regional water authority.
- **Who were the supervising legal coordinators of the project?**
  The regional water authority, the municipality and the provincial government.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The regional water authority was actively looking to broaden their scope, they initially just had just spare land next to their sewage treatment plant. But after doing quick scans on the surrounding nature to find ecological opportunities, and a technical scan to see to what extent a solar field is possible, the scope broadened. In the end it included the wishes of the local population, it empowered the local wet nature, and it used unused farmland to increase the size of the solar field.
  **Score: 1**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  N.N.

- **How are potential synergies determined and incorporated in the overarching project?**
  Based on ecological and technical quick scans of the regions surrounding the sewage systems.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The regional water authority did 3 things that shows their eagerness to integrate ET-solutions in their projects:
  - The regional water authority was doing quick scans on all their properties to see if synergy opportunities were present.
  - They were willing to invest even more in the project to increase the feasibility (create ecological synergies and use unused fields for more panels).
  - The regional water authority assumed their role as a supporter of all Dutch citizens which means that doing all possible actions for the Dutch ET is part of the workload.

  **Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  They assumed all relevant roles to themselves.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  A similar standard as all regional water authorities, but they are actively trying to achieve it for the 2030 deadline.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  There are many requirements before a medium scale project as the one in Cuijk can commence, mainly due to the strict requirements set by the provincial government. There were many ecological legalities that hindered the project, but in the end, after some delays, the end product was very positive. The strict requirements were used to integrate a wet forest synergy into the project.
  The decision-making itself was mainly done by the regional water authority itself within their own dedicated team. This meant that this process was singular and efficient.
  **Score: 0.7**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  The provincial government had very strict regulations when structures can be built in nature or farmland.

- **What is the application period of the required permits?**
  1 year to 2 years depending on the communication effectiveness, it was a significant bottleneck.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  Nature had to be used as a form of compensation to ease the permit process, as building solar panels was not enjoyed environmentally speaking.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  Yes, in a way. The initial synergy in the form of the solar panels become feasible because it was integrated with a nature development project.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  The local environment must not suffer on an ecological or aesthetic level.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  There were parties with legislative supervision, and there was the main decision-making party. The regional water authority made all decisions in a hierarchical fashion but still had to comply to all set requirements.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  No.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  The relatively low number of participants ensured that the spread of information could be done relatively efficient. It was necessary that all parties involved, the municipality, the local inhabitants, the nature organisations and the provincial government all had the information from the various quick scans and the corresponding plans of the regional water authority. This was the case, and as a result the provincial government could agree (and to some extent provide guidance) how to develop the local environment in complementation with the solar panels.
  **Score: 0.7**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Ecological, participatory and multi-purpose spatial development (combining farmland, and the leftover land of the sewage treatment plant).

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  It was uncertain how

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  N.N.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The regional water authority used an interesting strategy regarding the costs of these projects. They requested the money for 7 of these types of projects with the freedom to spend the money how they please between these 7 projects. This enabled them to work simultaneously on 7 projects and invest initially in the projects that had to fastest progress. All costs and synergy opportunities were mainly covered by the regional water authority and this large budget. Even ecological synergies were paid for by the regional water authority to increase the feasibility of the project and to benefit the citizens in general.
  **Score: 1**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  Mainly the regional water authority with subsidies and such from the municipality and provincial government.

- **What is the societal added value of the synergy?**
  More nature, more sustainable energy.

- **What impact does the synergy have on the local environment?**
  A compensation between the placement of a wet forest, but also the construction of a large solar panel field.

- **Were all participants in agreement on the costs and benefits of the project?**
  N.N.

- **Who and how were the costs/benefits assessed?**
  By multiple business cases by the project team (mainly the regional water authority).

- **How were the cost/benefits distributed between the involved parties?**
  Mainly the regional water authority with subsidies and such from the municipality and provincial government.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  There was little only a very small community of local inhabitants who were not strictly against the project but wanted to get involved as well.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  Yes, the regional water authority had a special team that looks into ET synergy opportunities on their properties. They have been doing that for years already.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  No, it was all close by.
  **Score: 1**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**

Farmland, polder landscape, unused grassland. But the sewage treatment property was only limited in size.

- **Is the soil of the project location already full of other wires, tubes and networks?**

No.

**Score: 0.7**

## Case 13: Culumborgse Dijk

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Integrative dike strengthening<br>○ 8 years<br>○ Recreation, mobility, flood defence, nature, and solar panels |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Regional water authority<br>○ Regional water authority, municipality and provincial government<br>○ Local inhabitants, the provincial government, nature organisations, local inhabitants. |
| Financial | ○ Percentual investment synergy | ○ Minor component (~10%) of investment |

| Outcome indicator | Score | Argumentation |
|---|---|---|
| **ET-synergy implemented** | 0 | • No ET-synergy was realized |
| **Delays related to synergy** | +0 | • There was a difficulty findings investor, but not a lot of time and effort was spent into the ET-synergies |
| **Achieved ET-potential** | +0 | • No ET-synergy was realized |
| | | |
| **Total outcome score** | 0 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The regional water authority actively involved ecological organisations, local companies, local inhabitants, the provincial government and the municipality in the project process to attempt to find more synergies and incorporate them with the dike strengthening project. These parties were all heavily involved in the design process and could bring in as much ideas as they want.
  **Score: 1**

Related conditions:

- **How were the participants determined?**
  The parties were selected based on the preference and established contacts of the regional water authority.

- **How were the criteria for selection determined?**
  Interested and willingness to provide input for synergies based on previous experience.

- **Why were the government/locals excluded?**
  They were both included in a very thorough manner.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  The regional water authority was the main managing force in the project, with the other parties only providing ideas to the project to utilize potential synergies. As the regional water authority was committed to using the synergy opportunity and pushed towards the realisation, it worked out in favour of the synergy. They even had a specific team incorporated in their organisation that looked for these energy synergy opportunities. Interestingly, all parties that provided ideas for synergies were only assigned an investor role and would not actively partake in the project process.
  **Score: 0.7**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Societal, the regional water authority, the provincial government and the municipality.

- **How stable is the commitment of the local governments for the integral energy transition?**
  N.N.

- **Which party is the initiator of the overarching project?**
  The regional water authority.

- **Which party is the initiator of the potential synergy?**
  All involved public parties.

- **Who is the final user of the overarching project?**
  The regional water authority.

- **Who is the final user of the synergy?**
  All involved public parties.

- **In retrospect, who else should have been involved to make the process easier?**
  Better contacts within the local municipality and provincial governments to ease and streamline the distribution of the costs to implement more synergies in a quicker manner.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The regional water authority solely, yes.

- **Who were the supervising legal coordinators of the project?**
  The regional water authority, the municipality and the provincial government.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The regional water authority was actively looking to broaden their scope, the initial project of a dike renovation grew out to be a project where 30+ synergy ideas were tested. When there was a party willing to fund a feasibility analysis, the analysis would be incorporated in the project (and if they were also willing to fund the implementation). This meant that the objectives attached to the dike strengthening project were as flexible as there were willing investors. This was a great influence on the total number of identified and ready-to-utilize synergies.
  **Score: 1**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  Yes.

- **How are potential synergies determined and incorporated in the overarching project?**
  All parties could provide ideas based on their own preference, experience and upcoming projects.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The regional water authority was actively trying to support Dutch citizens in general as well as they logically could. Which meant involving other parties in their own projects as much as possible to utilize synergies. The decision to let every possible party contribute synergy ideas was very positive for the amount of synergy ideas, however, there was no real pressure from the regional water authority towards certain specific ET-synergies.
  **Score: 0.7**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  They assumed all relevant roles to themselves except synergy-investor.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  A similar standard as all regional water authorities, but they are actively trying to achieve it for the 2030 deadline. Moreover, they have an intrinsic focus to contribute as much as possible to society within the boundaries of their projects.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**

Interestingly, the decision-making process was very efficient and quick. But in the end many synergies were not utilized, even those with a very positive quick scan and business case. This was the result of the loose collaboration between all involved parties which led to a situation where no party was willing to take the next step and actually invest in the implementation (even after they invested in the initial quick scan). The permits and agreements itself posed no problem as all parties with legal supervision were already involved in the project.
**Score: 0.3**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.

- **What is the application period of the required permits?**
  N.N.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  Finding enough investors for the project in the short timespan before the dike strengthening project itself commenced proved difficult.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  N.N.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Fully hierarchical, all decisions were made by the regional water authority.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  N.N.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  It was necessary that all parties involved, the municipality, the local inhabitants, the nature organisations and the provincial government all had the information from the various quick scans planned and performed by the regional water authority. This was the case, and as a result all parties could effectively provide input on what synergies exist with the dike project. There were only some uncertainties as some parts of the dike had multiple synergies and for a major part of the project,
  **Score: 0.7**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Ecological, mobility (placement of a new road was analysed but cancelled), energy production (both solar panels and wind turbines were analysed but not deemed feasible).

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  It was uncertain what components would be realised on what part of the dike for most of the project duration.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  N.N.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The synergies were mostly aimed at non-commercial objectives like improving the local nature. This in turn led to the situations where a lot of synergies had the interest of the especially the provincial government and the municipality. But when the time came and the regional water authority started the dike strengthening process and asked what objectives should be integrated, only a handful of synergies were selected. The involved investor-role parties were not keen on investing large sums of money into a project that was not exceptionally urgent. On one hand it can be said that the expected benefits were not persuasive enough to cover all the costs, but it was mentioned that better communication, involvement and a little push to invest in the synergies could have resulted in a much more integrative result.
  **Score: 0**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  All public parties involved.

- **What is the societal added value of the synergy?**
  More nature, more sustainable energy.

- **What impact does the synergy have on the local environment?**
  Much more space for flood water and nature to grow.

- **Were all participants in agreement on the costs and benefits of the project?**
  Yes, as not all interesting synergies were utilized.

- **Who and how were the costs/benefits assessed?**
  By multiple business cases performed by the regional water authority.

- **How were the cost/benefits distributed between the involved parties?**
  Each party paid for their own synergy.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  N.N.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  N.N.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  N.N.
  **Score: 0.3**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  Farmland, polder landscape, unused grassland.
- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  No.
  **Score: 0.7**

## Case 14: Den Bosch RWZI

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Sewage treatment plant development with solar energy farm and biogas production<br>○ 2.5 years<br>○ Combining a renovation of the sewage treatment plant with the area around it to create a large solar farm and a biogas production plant |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Regional water authority<br>○ Regional water authority<br>○ Local inhabitants, the municipality |
| Financial | ○ Percentual investment synergy | ○ Substantial (>30%) of investment |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • The envisioned ET-solutions were installed |
| **Delays related to synergy** | +0.4 | • There was little opposition and no delays were recorded in the system development of the sewage treatment plant |
| **Achieved ET-potential** | +0.3 | • In the end all identified solutions were realized (limited by the available space), both the biogas and the solar panels were achieved! |
| | | |
| **Total outcome score** | 1 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The regional water authority involved the provincial government and the municipality in the project process to attempt to ease legislative complications. These parties were mainly involved based on their legislative power and not based on their potential input for synergies. The main inflow for synergies come from a collaboration between a group of energy consultants and the energy experts from the regional water authority itself. These two groups were selected based on their expertise in identifying ET synergies and their involvement greatly helped. While it worked out for this particular scenario as there were not that many synergy options due to the urban constraints of the sewage treatment plant, it was still very lacking in the number of participants involved and the selection method used.
  **Score: 0.3**

Related conditions:

- **How were the participants determined?**
  The regional water authority contacted the required legislative parties and corresponding experts on their own plans and ambition.

- **How were the criteria for selection determined?**
  The parties were selected based on their legislative power (public organisations) and their expertise (energy consultants).

- **Why were the government/locals excluded?**
  They were mainly included to agree with the plans and not create any opposition, they were not included to have a prominent role in finding synergies.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  The regional water authority was the main managing force in the project, with the other parties only surveying the project to see if all legislative requirements were met or providing input and data to the regional water authority. As the regional water authority was committed to using the synergy opportunities and pushed towards its realisation, it worked out in favour of the synergy. They even had a specific team incorporated in their organisation that looked for these energy synergy opportunities. However, this rigid nature and relative superficial positions for the other parties can lead to missing out on potential synergies outside of the vision of the regional water authority themselves.
  **Score: 0.7**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Societal, the regional water authority (for own usage mostly).

- **How stable is the commitment of the local governments for the integral energy transition?**
  The regional water authority was one of the first of its type to actively seek to integrate solar panel fields (and biogas production) with all their sewage treatment plants. So far, they have three realised projects, with 4 more on the drawing board.

- **Which party is the initiator of the overarching project?**
  The regional water authority.

- **Which party is the initiator of the potential synergy?**
  The regional water authority.

- **Who is the final user of the overarching project?**
  The regional water authority.

- **Who is the final user of the synergy?**
  The regional water authority.

- **In retrospect, who else should have been involved to make the process easier?**
  Better contacts within the local municipality and provincial governments to ease the permit process.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The regional water authority.

- **Who were the supervising legal coordinators of the project?**
  The regional water authority, the municipality, and the provincial government.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The regional water authority was looking to increase the spatial utilization of their sewage treatment plants, this in itself was a broadening of the initial scope of sewage treatment plant renovation projects. However, the limiting biophysical conditions combined with the limited number of active participants meant that the scope was fully determined by the regional water authority who was fully inclined to focus on energy production. Energy production as a broad concept, yes, but the project was not actively looking into ecological, social or mobility-oriented synergies.
  **Score: 0.3**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  N.N.

- **How are potential synergies determined and incorporated in the overarching project?**
  Based on business cases of different systems that could be added on the soil surrouding the sewage systems.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The regional water authority did 3 things that shows their eagerness to integrate ET-solutions in their projects:
  - The regional water authority was doing quick scans on all their properties to see if synergy opportunities were present.
  - They were willing to invest even more in the project to increase the feasibility (create ecological synergies and use unused fields for more panels).
  - The regional water authority assumed their role as a supporter of all Dutch citizens which means that doing all possible actions for the Dutch ET is part of the workload.

  **Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  They assumed all relevant roles to themselves, even energy producer and consumer.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  A similar standard as all regional water authorities, but they are actively trying to achieve it for the 2030 deadline.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  There are many requirements before a medium scale project as the one in Den Bosch can commence, mainly due to the strict requirements set by the municipality and the provincial government. Constructing new energy production systems in a relatively urban area (both solar panels and biogas creation) meant that a lot of processes were required before the permits could be provided. The decision-making itself was mainly done by the regional water authority itself within their own dedicated team. This meant that this process was singular and efficient.
  **Score: 0.7**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  The municipality had very strict regulations when structures can be built in relative urban area.

- **What is the application period of the required permits?**
  2 years depending on the communication effectiveness, it was a significant bottleneck.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  Delays as a result of the permit process.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  N.N.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  There were parties with legislative supervision, and there was the main decision-making party. The regional water authority made all decisions in a hierarchical fashion but still had to comply to all set requirements.

- **Did the decision-making structure differ for strategic vs everyday decisions?**

No.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  The relatively low number of participants ensured that the spread of information could be done relatively efficient. It was necessary to effectively assess all potential energy systems on their effectiveness that especially the regional water authority and the energy experts has sufficient information. This was the case and both parties could effectively inventory multiple business cases before coming to the final synergy types where the sewage treatment plant renovation was combined with a large biogas plant and a solar farm. The legislative parties received sufficient information as well, but this was not specifically noteworthy.
  **Score: 1**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Different energy sources and energy consumption reduction systems that could be integrated within the land surrounding the sewage treatment plants.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  N.N.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  N.N.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The regional water authority used an interesting strategy regarding the costs of these projects. They requested the money for 7 of these types of projects with the freedom to spend the money how they please between these 7 projects. This enabled them to work simultaneously on 7 projects and invest initially in the projects that had to fastest progress. All costs and synergy opportunities were mainly covered by the regional water authority and this large budget. For Den Bosch it was interesting as it was mainly focussed on energy related synergies, which meant that the business cases were decisive in the project process. The selected synergies all had clear-cut positive business cases.

**Score: 1**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  Mainly the regional water authority with subsidies and such from the municipality and provincial government.

- **What is the societal added value of the synergy?**
  More sustainable energy without more spatial usage.

- **What impact does the synergy have on the local environment?**
  N.N.

- **Were all participants in agreement on the costs and benefits of the project?**
  N.N.

- **Who and how were the costs/benefits assessed?**
  By multiple business cases by the project team.

- **How were the cost/benefits distributed between the involved parties?**
  Mainly the regional water authority with subsidies and such from the municipality and provincial government.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  The local inhabitants were not strictly against the project as it involved only the soil upon which a sewage treatment plant was already built.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  Yes, the regional water authority had a special team that looks into ET synergy opportunities on their properties. They have been doing that for years already. The municipality and provincial government were not that experienced with the utilization of synergies, however.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  No, it was all close by.
  **Score: 0.7**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  The area was fully occupied by the previous larger sewage treatment plant, so it was an urban industrial area where there was little opposition to an ET-development.
- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  Not on the sewage treatment ground itself, which was where the ET was generated and the energy predominantly utilized.
  **Score: 1**

## Case 15: Den Haag kademuren renovatie

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Canal wall renovation<br>○ 1.5 years<br>○ Heat network integration |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Municipality<br>○ Municipality, local inhabitants<br>○ Local energy consumers |
| Financial | ○ Percentual investment synergy | ○ Minor (<20%) of investment |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0 | • The three aquathermy solutions were all not implemented. |
| **Delays related to synergy** | +0 | • There were a multitude of prior investigations required for the ET-synergies to be potentially implemented. Only for the consumers themselves to block the development. |
| **Achieved ET-potential** | +0 | • No ET-generation or saving was realized. |
| | | |
| **Total outcome score** | 0 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The municipality involved multiple energy experts with the project, they were aiming to renovate the canal wall and they needed the expertise of RHDHV. However, other potential partners were not involved and only these energy experts were tasked to calculate the feasibility of the ambition of the municipality. There was no real participant selection process that in any way helped the identification of synergies. Only the involvement of the energy transition expert team to calculate the already designed synergies.
  **Score: 0**

Related conditions:

- **How were the participants determined?**
  They were involved by the municipality to help determine if their ambition were feasible.

- **How were the criteria for selection determined?**
  Based on their experience and expertise with aquathermy projects.

- **Why were the government/locals excluded?**
  The locals were excluded to increase the project efficiency and only focus on the feasibility (both technical and financial). However, this backfired greatly as the locals were the ones who cancelled the synergies with a positive business case in the end.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  The energy experts determined the feasibility of the aquathermy ambitions of the municipality and provided a recommendation for this. All other decisions were made by the municipality, as they had created a special ET-team within their departments to tackle these problems.
  **Score: 0.7**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Societal (municipality) with help of local inhabitants

- **How stable is the commitment of the local governments for the integral energy transition?**
  Actually, the commitment was really stable as the municipality has quite an abundance of experience with (innovative) ET projects within the municipality.

- **Which party is the initiator of the overarching project?**
  The municipality was renovating the canal walls.

- **Which party is the initiator of the potential synergy?**
  The municipality.

- **Who is the final user of the overarching project?**
  The municipality and the regional water authority.

- **Who is the final user of the synergy?**
  Local energy consumers.

- **In retrospect, who else should have been involved to make the process easier?**
  The local energy consumers should have been actively involved! And potentially nature preservation-oriented organisations.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The municipality and yes.

- **Who were the supervising legal coordinators of the project?**
  The municipality

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The municipality was looking to utilize as much potential energy production in their region as feasible, preferably integrated with other municipal projects. This in itself was a broadening of the initial scope of canal wall renovation. However, the limited number of active participants meant that the scope was fully determined by the municipality who was fully inclined to focus on energy production. The project was not actively looking into ecological, social or mobility-oriented synergies, which, based on other canal wall renovation projects, are relatively feasible.
  **Score: 0.3**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  N.N.

- **How are potential synergies determined and incorporated in the overarching project?**
  Based on business cases of different aquathermy systems calculated by the energy experts.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The municipality was ambitious and innovative when it came to energy related projects. They were constantly pushing and analysing new energy production systems themselves. This combined with the drive to find synergies and integrate multiple objectives into their projects ensured that from a municipal standpoint they were actively striving towards sustainable development. However, it also meant that most projects were already pre-determined by the municipality's own standpoints, objectives and vision. Reducing the possibility to find even more synergies (and even reducing the chance to implement the initial synergy). But the willingness and eagerness to integrate ET-solutions was visibly present.
  **Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  They assumed all relevant roles to themselves, only the consulting and energy consuming roles were not part of the municipality's roles.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  A similar standard as all regional water authorities, but they are actively trying to achieve it for the 2030 deadline.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  The relatively small number of involved parties (only one real managing party) meant that making internal decisions became relatively efficient. But in turn it made taking decisions where other parties had a say (decisions involving local inhabitants, the regional water authority or the provincial government) more complex. However, the latter two did not pose any significant issues in the project process.
  **Score: 0.7**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.
- **What is the application period of the required permits?**
  N.N.
- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  The energy consumers had to agree with the plan, as they had to partly pay for the system and have their housing adjusted. Making them agree with the plan was the biggest bottleneck the project encountered.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.
- **Were there any requirements or challenges before certain subsidies could be requested?**
  N.N.
- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  The municipality made all decisions in a hierarchical fashion but still had to persuade the local inhabitants to accept the new aquathermy heating network.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  No.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  The low number of participants ensured that the spread of information could be done relatively efficient. It was necessary for effectively assessing all potential energy systems on their effectiveness that especially the municipality and the energy experts has sufficient information. This was the case and both parties could effectively inventory multiple business cases before coming to the final synergy types (three aquathermy systems). The legislative parties received sufficient information as well, but this was not specifically noteworthy. However, there was one party who did not receive any information at all throughout the whole project.
  **Score: 0.3**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**
  The risk that the energy consumers themselves were not convinced about the benefits of the aquathermy project, which would mean that the whole system would have no purpose.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Different energy sources and energy consumption reduction systems that could be integrated within the canal wall which was being renovated.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  The major uncertainties were twofold: first the municipality did not know if the aquathermy synergy would be profitable, and two, the municipality did not fully know if the local inhabitants were willing to switch to the aquathermy network.
  But the biggest uncertainty was that the local inhabitants themselves were not even participants in the project, they had little to no information before being asked to switch to aquathermy energy for 30.000 euro. This severely hampered their willingness to cooperate.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  N.N.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The municipality was striving for more ET developments and was willing to partly invest in these projects. From the initial analyses, 3 aquathermy variants were selected. Two out of these three were deemed not fully profitable in the long run and were not selected. However, one was deemed profitable and could be implemented in a small-scale system next to the canal wall. The costs were manageable by the municipality and a small fee for the consumers themselves, and the benefits would be a fully aquathermy heated housing section next to the canal. The costs and benefits were, strictly financially speaking, sound for this variant. And for the other aspects the municipality was also content. But the local inhabitants themselves were not fully happy, but it was not mainly cost and benefit based, but also as a result of a lack of involvement and information.
  **Score: 0.7**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  The municipality and the local inhabitants who would get an aquathermy connection.

- **What is the societal added value of the synergy?**
  More sustainable energy without more spatial usage.

- **What impact does the synergy have on the local environment?**
  N.N.

- **Were all participants in agreement on the costs and benefits of the project?**
  No, they were not willing to suddenly invest in a system that would change their house without proper consulting and involvement.

- **Who and how were the costs/benefits assessed?**
  By multiple business cases by the project team (and the local inhabitants did their own subjective analysis as a result of the lack of involvement).

- **How were the cost/benefits distributed between the involved parties?**
  Each household had to pay 30.000 euro to connect to the aquathermy network while the municipality covered the rest of the costs.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  The local inhabitants were strictly against any project that would greatly affects their households without proper involvement. They completely blocked any project that would involve their houses.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  The municipality actually had quite a track record of ET related innovative project. So, while it was not specifically stated in the policies, their ET team did have sufficient experience with trying to look for synergies in their project.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  Transporting the heat of the water to somewhere else is costly which meant that only consumers living very close to the water were suitable.
  **Score: 0**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  Urbanized land with housing, offices and roads.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  Yes, as is expected in the urbanized landscape in the west of the Netherlands. Increasing the costs of any construction plans and synergy related costs.
  **Score: 0**

## Case 16: RWZI Beverwijk & RWZI Echten aquathermie

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Canal wall renovation<br>○ 1.5 years<br>○ Heat network integration |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Municipality<br>○ Municipality, local inhabitants<br>○ Local energy consumers |
| Financial | ○ Percentual investment synergy | ○ Minor (<20%) of investment |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • The envisioned ET-solution was installed |
| **Delays related to synergy** | +0 | • The required investigations into the required safety regulations and potential energy generation did delay the development of the sewage treatment plant |
| **Achieved ET-potential** | +0.4 | • The most optimal solution was realized in terms of ET-contribution. |
| | | |
| **Total outcome score** | 0.7 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The regional water authority involved multiple energy experts with the project, they were aiming to renovate the sewage treatment plant and they needed the expertise of RHDHV. However, other potential partners were not involved and only these energy experts were tasked to calculate the feasibility of the ambition of the regional water authority. There was no real participant selection process that in any way helped the identification of more synergies. Only the involvement of the energy transition expert team to calculate the already identified set of possible synergies.
  **Score: 0.3**

Related conditions:

- **How were the participants determined?**
  They were involved by the municipality to help determine if their ambition was feasible.

- **How were the criteria for selection determined?**
  Based on their experience and expertise with aquathermy projects.

- **Why were the government/locals excluded?**
  The locals were excluded to increase the project efficiency and only focus on the feasibility (both technical and financial). As it was only located on the property of the regional water authority, government involvement was low.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  The energy experts determined the feasibility of the aquathermy ambitions of the municipality and provided a recommendation for this. All other decisions were made by the municipality, as they had created a special ET-team within their departments to tackle these problems.
  **Score: 0.7**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Societal (regional water authority)

- **How stable is the commitment of the local governments for the integral energy transition?**
  N.N.

- **Which party is the initiator of the overarching project?**
  The regional water authority was developing its sewage treatments plant (in both cases).

- **Which party is the initiator of the potential synergy?**
  The regional water authority

- **Who is the final user of the overarching project?**
  The regional water authority

- **Who is the final user of the synergy?**
  The regional water authority

- **In retrospect, who else should have been involved to make the process easier?**
  Local inhabitants, the municipality and the provincial government if the surrounding area should also be incorporated in the synergy assessment.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The regional water authority and no.

- **Who were the supervising legal coordinators of the project?**
  The regional water authority

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The regional water authority was striving towards their full energy neutrality in as short a time span as possible. This ambition greatly helped with their initial analysis that potentially the sewage treatment plant renovation could be integrated with an aquathermy system. However, the limited number of active participants meant that the scope was fully determined by the regional water authority who was fully inclined to focus on energy production. The project was not actively looking into ecological, social or mobility-oriented synergies, which, based on other sewage treatment renovation projects, are relatively feasible.
  **Score: 0.3**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  N.N.

- **How are potential synergies determined and incorporated in the overarching project?**
  Based on business cases of different aquathermy systems calculated by the energy experts.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The regional water authority was actively striving to become an energy-neutral organisation. This ambition translated in the organisation attracting multiple energy consultants to support them in integrating an aquathermy system with their sewage treatment plant. It meant that pre-analyses were performed by the regional water authority and a budget was already reserved. They were willing to take risks to help develop the Dutch ET and it showed in the success of the projects.
  **Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  They assumed all relevant roles to themselves, only the consulting roles was not part of the regional water authority's roles.

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  A similar standard as all regional water authorities, but they are actively trying to achieve it for the 2030 deadline. They are not afraid to look into innovative technologies to achieve it.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  The relatively small number of involved parties (only one real managing party) meant that making internal decisions became relatively efficient. There were no real noteworthy aspects to this, as all decision affected, and were made by only the regional water authority. On the other hand, it also didn't support the identification and utilization of synergies in any way.
  **Score: 0.7**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.

- **What is the application period of the required permits?**
  N.N.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  N.N.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  N.N.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  N.N.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  N.N.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  The low number of participants ensured that the spread of information could be done relatively efficient. It was necessary for effectively assessing all potential energy systems on their effectiveness that especially the regional water authority itself and the energy experts had sufficient information. This was the case and both parties could effectively inventory multiple business cases before coming to the final synergy types (two aquathermy systems).
  **Score: 1**

Related conditions:

- **Which technical risks are associated with the synergy?**
  Aquathermy is a relative novelle heating system and all technical aspects had to be calculated thoroughly.

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  N.N.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  How much energy would be generated and if it would be an profitable investment.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  N.N.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The regional water authority was striving for more ET developments and was willing to partly invest in these projects. From the initial analyses, 2 aquathermy variants were selected. Both were deemed profitable in the long run and the most promising system was selected. There is not much noteworthy to say about this aspect as well as the cost- benefit analysis was the main component of the project. And the different business cases all showed a sound investment for the regional water authority. Decreasing their fossil energy usage while not costing them an unreasonable amount of funds.
  **Score: 1**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  The regional water authority.
- **What is the societal added value of the synergy?**
  More sustainable energy without more spatial usage.
- **What impact does the synergy have on the local environment?**
  N.N.
- **Were all participants in agreement on the costs and benefits of the project?**
  Yes.
- **Who and how were the costs/benefits assessed?**
  By multiple business cases by the project team.
- **How were the cost/benefits distributed between the involved parties?**
  N.N.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**

The local inhabitants showed no problem as it was solely on the property of an already urbanized sewage treatment plant.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  No, but the regional water authority was actively seeking ways to further develop their personal ET.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  Not at all, the location actually suited itself quite well for an aquathermy system as the energy demand was the sewage treatment plant itself.
  **Score: 1**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  Only the sewage treatment plant was analysed in the project.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  No.
  **Score: 1**

## Case 17: Grebbedijk integrale gebiedsontwikkeling

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Integrated spatial development with dike strengthening<br>○ 9 years<br>○ Solar panels (floating), wind turbines, nature development, recreational development and an old dumpsite. |
| Stakeholders | ○ Identity initiator<br>○ Identity investor overarching project<br>○ Involved relevant stakeholders | ○ Municipality<br>○ Municipality, energy producer<br>○ Local inhabitants, the provincial government, Schiphol and cultural, natural and historic organisations. |
| Financial | ○ Percentual investment synergy | ○ Minor (<10%) of investment |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • A small ET-synergy was implemented |
| **Delays related to synergy** | +0 | • There were many scans and investigations into multiple ET-synergies, but in the end, they were all deemed unfeasible except a small aquathermy solution. All these studies required additional time to process. |
| **Achieved ET-potential** | +0 | • There were many scans and investigations into multiple ET-synergies, but in the end, they were all deemed unfeasible except a small aquathermy solution. All solar panel and wind turbine solutions were not realized. |
| | | |
| **Total outcome score** | 0.3 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  The regional water authority announced the dike strengthening project and contacted all relevant public parties whom they have prior contact with, these included Rijkswaterstaat, the provincial government and the municipality. In addition, they invited any local companies, recreational organisations and local inhabitants as well. They wanted everyone who could provide input to how the dike should look like in the future to get involved in the project. This broad playground ensured that from all backgrounds parties joined to provide input on how to best identify and utilize potential synergies.
  **Score: 1**

Related conditions:

- **How were the participants determined?**
  They were freely invited by the regional water authority the moment the dike strengthening project was announced.

- **How were the criteria for selection determined?**
  If the party had an opinion on the utilization of the dike, they were contacted. This included a large number of local parties.

- **Why were the government/locals excluded?**
  They were all involved.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  There was a clear distinction of roles, the regional water authority did the managing and the daily decisions. The other involved parties could at first provide ideas and input to the project, and after the synergies were selected could provide recommendations and demand what the end-result should be. This division between daily management, which was done by the regional water authority, and the creative decision-making, which was done in unison with the many participants, was highly effective in actually utilizing the potential synergies.
  **Score: 1**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Societal mostly (with minor commercial investments for solitary synergies).

- **How stable is the commitment of the local governments for the integral energy transition?**
  Very stable as they have a great track record of integrative spatial development within the regional water authority project team.

- **Which party is the initiator of the overarching project?**
  The regional water authority, a dike renovation.

- **Which party is the initiator of the potential synergy?**
  The regional water authority in collaboration with all involved parties.

- **Who is the final user of the overarching project?**
  The regional water authority.

- **Who is the final user of the synergy?**
  The variety of involved parties.

- **In retrospect, who else should have been involved to make the process easier?**
  N.N.
- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  The regional water authority and yes.

- **Who were the supervising legal coordinators of the project?**
  The regional water authority in collaboration with Staatsbosbeheer, the provincial government and the municipality. But they were all heavily involved which made the process relatively easy.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  The scope was remarkably broad and flexible. The regional water authority led project team looked into ET synergies, mobility synergies, recreational synergies, ecological synergies, room-for-the-river-type synergies, and even culture-historical synergies. In the end most of these types will even be implemented during the dike strengthening project itself (which is planned between until 2025). This extreme flexibility that all sectors could provide objectives which were added to the main-project-objective of strengthening the dike meant that many synergies were utilized. Moreover, the scope was this flexible and broad since the announcement of the project (the immediate start).
  **Score: 1**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  Yes.

- **How are potential synergies determined and incorporated in the overarching project?**
  Every involved participant could provide the regional water authority with ideas and preferred objectives.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The regional water authority was driven to integrate as many benefits for society in the project as possible. This intrinsic drive was present in the whole project team and ensured that synergies were actively sought after. From this drive the other positive aspects of the integral approach of this project followed. As it allowed for more focus on the synergy-aspect of the project.
  **Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  All roles were assumed by the main project team led by the regional water authority: facilitating, initiating, daily management. Only the investing role was split up between all parties (though the regional water authority paid for >90% of the total expenses of the whole project).

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  They actively strive to improve the general conditions of all Dutch citizens, in addition to the main tasks of a regional water authority. This includes improving the local nature aspects but also the ET.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  The regional water authority had very close ties with the municipality, Staatsbosbeheer and especially the provincial government. This combined with their heavy involvement in the project allowed for a very smooth permit-process. The regional water authority, due to their experience, could effectively led the many discussions between all the involved (smaller) parties. Allowing them to participate in the decision-making process in an effective way without delaying the main project of the dike strengthening. All this combined with the clear managerial role the regional water authority assumed for themselves meant that decision making was remarkably efficient.
  **Score: 1**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.
- **What is the application period of the required permits?**
  Several months, very short relatively speaking.

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  N.N.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  No.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  N.N.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Everyone could provide input, and every investor could make the strategic level decision, but the daily decision making was fully done by the regional water authority in a hierarchical way.

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  Every investor could make the strategic level decision, but the daily decision making was fully done by the regional water authority.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  With so many participants, it is difficult to provide everyone with adequate information about the project. But via a lot of discussion session and (interactive) maps this was sufficiently achieved. All parties were able to provide synergies-ideas for the project based on their own objectives and when there was a potential misunderstanding the regional water authority scheduled an individual meeting with the participant. This strategy was made possible by the already close ties the regional water authority had with most of the participants combined with their experience on how to manage it.
  **Score: 1**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Ecological (multiple nature related synergies), aquathermy, culture-historical, mobility (failed because of monetary reasons), solar panels (failed because of monetary and aesthetic reasons), recreational (failed because of lack of funding) and wind turbines (failed because of time frame mismatch)

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  N.N.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  N.N.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  While the dike strengthening project was 90% of the total costs of the final project, there was no budget within the regional water authority to actively invest in any synergies. Only synergies that were closely tied to the dike, like a widened floodplain could be funded by this budget, all other synergies fully required funding from the participants. This was the only significant aspect that hindered the synergies in the project. The participants themselves (while urged by the regional water authority) had to find the corresponding funding for the synergies in the timespan set by the dike project. This sometimes led to synergies not being developed further (especially the smaller synergies, not connected to Staatsbosbeheer, the provincial government or the municipality). Interestingly as well, most ET-related synergies were also deemed unprofitable. The business case of solar panels was deemed unacceptable (while a wind turbine was deemed

impossible due to mismatching timeframes). However, aquathemry was deemed profitable and a municipality invested in the project.
**Score: 0.3**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  The regional water authority, Staatsbosbeheer, the provincial government and the municipality.
- **What is the societal added value of the synergy?**
  More nature, more biodiversity, more space for water, more sustainable energy and a better conserved historical site.
- **What impact does the synergy have on the local environment?**
  More nature, more biodiversity, more space for water
- **Were all participants in agreement on the costs and benefits of the project?**
  Yes, after dropping many synergies.
- **Who and how were the costs/benefits assessed?**
  Individually by the parties who provided the ideas.
- **How were the cost/benefits distributed between the involved parties?**
  Individually for each synergy.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  While against large scale solar panel farms on a dike, they were not heavily opposed to most proposed integral solutions. They were however a large conflict between recreational rowers and nature preservation organisations.
- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  No, but the regional water authority had an abundance of experience with integral spatial development projects.
- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  Yes, which reduced the cost-benefit score of the solar panels significantly.
  **Score: 0.7**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  Mostly nature, farmland and floodplain combined with a single road.
- **Is the soil of the project location already full of other wires, tubes and networks?**
  N.N.

**Score: 0.3**

## Case 18: Delfland wijkontwikkeling

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Strategic integral spatial development water systems<br>○ 4 years<br>○ Connecting work and objectives of regional water authority, drink water company and the municipality. |
| Stakeholders | ○ Identity initiator<br>○ Involved relevant stakeholders | ○ Regional water authority<br>○ Municipality and the drink water company |
| Financial | ○ Percentual investment synergy | ○ Large (>30%) of the investment |

| Outcome indicator | Score | Argumentation |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • An integral ET-solution was implemented in the planning |
| **Delays related to synergy** | +0 | • The close-contacts between the participants and the horizontal hierarchy meant that decisions were made in a relatively slow manner regarding the ET-synergies. Moreover, as drink water, climate adaptation and the energy transition all had to have matching timeframes, the ET-solution was implemented quite late. |
| **Achieved ET-potential** | +0.4 | • The close-contacts and the intertwined approach for drink water, CA and ET development did lead to a relative effective integration process. |
| | | |
| **Total outcome score** | 0.7 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  **Score:**
  There was actually only a relatively small circle of participants (participant types). With the Delfland Wijkaanpak project only municipality, the regional water authority and the drinkwater company were involved. This was relatively limited and rigid compared to other projects. By not involving more parties or public organisations a lot of synergies could not be identified. However, the current strategy of a tight boundary ruleset did lead to a more efficient project process where communication was more fluent and interactive. This enabled the other aspects which in turn led to a successful synergy identification process.
  **Score: 0.3**

Related conditions:

- **How were the participants determined?**
  They all invited prior to the beginning of the project as they were a vital part of the project itself, by the regional water authority.

- **How were the criteria for selection determined?**
  Based on their spatial projects involving water systems.

- **Why were the government/locals excluded?**
  The locals were excluded to fully focus on the private-public collaboration for project efficiency.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  The different functions were the most noteworthy aspect of the project, a special collaboration was formed where the daily management was shared between organisations of equal power. All three main parties were acting as the main managing organisation. While this slightly hampered decision-making efficiency, it enabled all parties to freely voice their opinions and ideas in regard to potential synergies. However, due to the defined scoring system used for this research, the score for the positions in this project is low, as all defining traits for optimal positions are not met within this project due to its uniqueness.
  **Score: 0.3**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Combination of both.

- **How stable is the commitment of the local governments for the integral energy transition?**
  All three main parties had been active in their approach to the integral energy transition for multiple years before this collaboration.

- **Which party is the initiator of the overarching project?**
  Regional water authority

- **Which party is the initiator of the potential synergy?**
  Regional water authority

- **Who is the final user of the overarching project?**
  Combination of all three parties.

- **Who is the final user of the synergy?**
  Combination of all three parties.

- **In retrospect, who else should have been involved to make the process easier?**
  N.N.

- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  Combination of all three parties.

- **Who were the supervising legal coordinators of the project?**
  The municipality and the regional water authority.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  At the start the project was already inclined to identify synergies within the water system plans of all three parties. While this enabled the collaboration to effectively assess construction-work that could be combined (for example sewage renovation and drink water system placement and a road renovation). It was also strictly focussed on these large-scale renovation and construction type projects. While effective in identifying these types of synergy, this sole vision on large scale opportunities might have resulted in missing out on small scale synergy opportunities.
  **Score: 0.7**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  There were comparing their planned projects for the upcoming two decades, trying to identify synergies that matched within their respective timeframes.

- **How are potential synergies determined and incorporated in the overarching project?**
  Via multiple discussion sessions between the main parties.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The initial decision to collaborate heavily in this levelled managing fashion to create a shared strategy for integration, a shared vision how to steer the spatial development in the region efficiently, greatly helped with synergy identification. The willingness to cooperate between the initiating organisation types meant that much more synergy-opportunities were selected to be incorporated in their policies. This project lays the foundation for a decade of synergy utilization in their neighbourhoods. However, the main focus of the initiating parties was to look for general synergies and the ET was a secondary objective.
  **Score: 0.7**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  The private-public collaboration of the three parties assumed all main roles (as no other participant was actively involved).

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  Both the private as well as the public participants have an above average motivation to develop in a sustainable fashion.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  While the efficiency of the decision-making was due to the levelled playing field (no hierarchy) sometimes lacking, it greatly benefitted the synergies. Because all involved parties were on equal footing, they were all actively participating in achieving synergies and making decisions to support potential synergies. It was a remarkable decision-making structure that was unique to the project, which did highly benefit the synergy identification as all parties had an equal say in what synergies were deemed valuable.
  **Score: 1**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.
- **What is the application period of the required permits?**
  **N.N.**
- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  The strategy forming itself did not encounter significant problems due to the smooth collaboration, but the first projects that formed out of the strategy encountered minor resistance from the local inhabitants.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  N.N.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Completely levelled, which was remarkable for successful integral projects. In all other projects it was clear that a strong managerial role had to be taken (preferably by the initiator).

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  N.N.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  Because of the tight collaboration between the small number of participants, the sharing of information was an effective and quick process. Allowing for all parties to effectively participate in the project and provide input and feedback. This was one of the great benefits of having three equally powerful participants, each managing party had sufficient information to actively identify synergy opportunities.
  **Score: 1**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**
  N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Combining construction and renovation projects in the living areas of the city, of the three main participants in the upcoming two decades.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  Knowing who will bear what part of the costs and which locations will benefit the most from the scheduled projects was the most significant uncertainty.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  It was available to all participants in a very clear fashion.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  The main goal of the collaboration was to reduce costs, increase the speed of the sustainable development projects and reduce the nuisance costs for local inhabitants. While so far, the collaboration seems to have somewhat succeeded in these objectives, there are still a lot of uncertainties regarding the respective costs and benefits of all scheduled projects. As potential delays caused by the implementation for synergies can lead to one-sided losses.
  **Score: 0.7**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**

Combination of all three involved main parties, the specific distribution is determined for each project individually.

- **What is the societal added value of the synergy?**
  Getting an integral spatial development strategy on paper to be implemented later that connects three major spatial development parties.

- **What impact does the synergy have on the local environment?**
  N.N.

- **Were all participants in agreement on the costs and benefits of the project?**
  Yes.

- **Who and how were the costs/benefits assessed?**
  N.N.

- **How were the cost/benefits distributed between the involved parties?**
  N.N.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  The local population was not involved as it was a strategic design to enable synergy identification between the three parties.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  After the completion of this policy-making project, it will, yes.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  N.N.
  **Score: 1**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  Urbanized living areas and semi-urbanized suburbs.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  Yes, the soil surrounding the housing areas are very full. The extra costs this brings to projects is one of the main reasons why any spatial development project in the area needs to innovate with multi-purpose public-private solutions. It was one of the drivers for the collaboration
  **Score: 0.3**

## Case 19: Best Bedrijvenvisie gebiedsontwikkeling

| Category | Characteristic | State of conditions |
|---|---|---|
| Project characteristics | ○ Project type<br>○ Project duration<br>○ Synergy type | ○ Strategic integral spatial development<br>○ 1 year (planned for the upcoming two decades)<br>○ How to connect private – public collaboration in integral ET developments (combining property) |
| Stakeholders | ○ Identity initiator<br>○ Involved relevant stakeholders | ○ Municipality together with the private organisations<br>○ All local companies |
| Financial | ○ Percentual investment synergy | ○ Unknown yet, but expected to be major investments in comparison to the total investment of the industrial area renovation (>40%) |

| **Outcome indicator** | **Score** | **Argumentation** |
|---|---|---|
| **ET-synergy implemented** | 0.3 | • Multiple ET-synergies were identified (both small and large) and some small synergies were implemented |
| **Delays related to synergy** | +0 | • All companies were invited which required lots of planning, time and effort. |
| **Achieved ET-potential** | +0 | • Only very small ET synergies have been realized so far, as the larger ET-synergies require a clear cost-distribution which has not yet been established. |
| | | |
| **Total outcome score** | 0.3 | |

**Boundary rules – determines the criteria for selecting participants and when they should enter/leave their positions.**

- **How is their involvement determined and by whom or what and how they assume/leave their positions? Do these boundary rules support or obstruct the pursuit of synergies?**
  **Score:**
  There was actually only a relatively small circle of participants (participant types). With Best Bedrijvenvisie, only the companies present on the industrial area and the municipality were involved. While this was relatively rigid, as only private parties were involved (and the municipality), the large number of involved local companies made sure that a broad collection of participants was involved in the identification process of the synergies.
  **Score: 0.7**

Related conditions:

- **How were the participants determined?**
  Invited by the industrial area manager and the municipality.
- **How were the criteria for selection determined?**
  The core part of the project was that all local companies were invited to strengthen the private – public collaboration.

- **Why were the government/locals excluded?**
  The locals were excluded to fully focus on the private-public collaboration for project efficiency.

**Position rules – concerns with which actors should be involved and their roles?**

- **Which stakeholder determines what part in the project (specifically focussing on responsibilities, resources, and interests)? Are positions flexible or rigid? Do certain position rules stand in the way of synergies (such as certain responsibilities and interests)?**
  There was a unique private-public collaboration present that allowed both sides to have an equal say in how spatial development would take place. This relatively levelled playing field between the privately owned private property and the publicly owned property allowed those synergies could be identified that transcended a single type of area. It has aspects that was also present in case 18, where there was no clear main managing position, as the main focus was to form a levelled project structure. While this slightly hampered decision-making efficiency, it enabled all parties to freely voice their opinions and ideas in regard to potential synergies. However, due to the defined scoring system used for this research, the score for the positions in this project is low, as all defining traits for optimal positions are not met within this project due to its uniqueness.
  **Score: 0.3**

Related conditions:

- **Which type of investors were involved with the synergy? (e.g., commercial/societal)**
  Combination of both.

- **How stable is the commitment of the local governments for the integral energy transition?**
  The local governments but also the local private sector show great interest in sustainable development.

- **Which party is the initiator of the overarching project?**
  The municipality.

- **Which party is the initiator of the potential synergy?**
  The municipality.

- **Who is the final user of the overarching project?**
  Combination of the public-private collaboration present in this project.

- **Who is the final user of the synergy?**
  Combination of the public-private collaboration present in this project.

- **In retrospect, who else should have been involved to make the process easier?**
  N.N.
- **Who acted as the daily coordinating team of the project? And did this team have a dedicated function-description for synergy implementation?**
  Combination of the public-private collaboration present in this project.

- **Who were the supervising legal coordinators of the project?**
  The municipality.

**Scope rules – determines the understanding that affect the outcomes**

- **How is the scope (desired outcome) of the project determined? At what stage? And is the determined scope flexible or rigid through realization? How does this process of scope specification influence the potential for synergy?**
  While initially focussed on the ET, it quickly also expanded to climate adaptation and other social issues because of the unique opportunity the public-private collaboration provided. This flexibility ensured these out-of-the-box synergies were also identified. The main objective transformed into obtaining as much valuable from the collaboration between public property and private property as efficiently possible.
  **Score: 1**

Related conditions

- **Is the projected lifetime of the synergy compatible with the overarching project?**
  N.N.
- **How are potential synergies determined and incorporated in the overarching project?**
  Via multiple discussion sessions between the main parties.

**Choice rules – focuses on allowing and prohibiting certain actions**

- **What sets of actions attributed to actors encourage synergy? Or what sets of actions hamper synergy?**
  The initial decision to collaborate heavily in this private-public style to create a shared strategy, a shared vision how to steer the integral spatial development in the region, greatly helped with synergy identification. The willingness to cooperate between the different organisation types meant that much more synergy-opportunities were possible in the region, both for the ET and in general.
  **Score: 1**

Related conditions

- **What role do the local governments assume for themselves in regard to the energy transition? (Facilitating, initiator, investor)**
  The private-public collaboration assumed all main roles (as no other participant was actively involved).

- **What environmental standard does the initiating organisation (for the synergy) set for himself?**
  Both the private as well as the public participants have an above average motivation to develop in a sustainable fashion.

**Aggregation rules – how the decisions are made?**

- **What is the process of decision making in projects that focus on synergy? Do the processes differ for important vs everyday decisions?**
  While the efficiency of the decision-making was due to the levelled playing field (no hierarchy) sometimes lacking, it greatly benefitted the synergies. Because all involved parties were on equal footing, they were all actively participating in achieving synergies and making decisions to support potential synergies. However, the large

number of private companies involved that each had their own individual interests made finding common ground for just the private-component of the decision-making already quite difficult.
**Score: 0.7**

Related conditions

- **Which type and how many permits were required for the realisation of the synergy?**
  N.N.

- **What is the application period of the required permits?**
  **N.N.**

- **Which challenges and complications were encountered during the project as a result of the realisation of the synergy?**
  For Best Bedrijvenvisie, problems arose with the many different companies that were involved in the project.

- **Did the overarching project become feasible as a result of the benefits of the synergy?**
  N.N.

- **Were there any requirements or challenges before certain subsidies could be requested?**
  N.N.

- **How was the decision making structured (hierarchical vs levelled)? If hierarchical, how was the hierarchy determined?**
  Somewhat levelled between the industrial area manager and the municipality, which was remarkable for these both final projects. In all other projects it was clear that a strong managerial role had to be taken (preferably by the initiator).

- **Did the decision-making structure differ for strategic vs everyday decisions?**
  N.N.

**Information rules – what information is available, necessary, inaccessible to participants?**

- **Was the amount of information/knowledge about the project adequate for all participants? Did participants willingly share project related information?**
  Because of the tight collaboration between the participants, the sharing of information was a relatively simple process. Allowing for all parties to effectively participate in the project and provide input and feedback. However, the large number of private companies involved made it relatively time-consuming process to make sure all parties had sufficient information about the potential synergies.
  **Score: 0.7**

Related conditions:

- **Which technical risks are associated with the synergy?**
  N.N.

- **Which societal risks are associated with the synergy?**

N.N.

- **Which potential synergy types were recognized and analysed for the overarching project?**
  Combining properties to create larger fields of green, solar panels or create enough space for a wind turbine. Or create a leftover energy network between the companies. There was a list of 50+ ideas in the strategic vision that will potentially be implemented.

- **What were the major uncertainties for the participants? Did the perception of uncertainties vary between the participants?**
  Knowing who will bear what part of the costs and which locations will benefit the most from the plans was the most significant uncertainty.

- **Was information about the project progress (risks, benefits) available/shared with all the participants?**
  It was available to all participants, at least that was attempted by the industrial area manager.

**Payoff rules- distribution of costs and benefits**

- **How were the costs and benefits assessed and distributed?**
  While the project was great at identifying integral solutions, getting sufficient funding for it proofed to be more difficult so far. As the many different individual companies do not want to have an equal share of the costs compared to the received benefits. While on the other hand the municipality does not want to be the main contributor to a project aimed to spatially develop the lands around the companies in a sustainable manner. This had led to minor conflicts, but as the project is still in an early stage, the hope is that with enough discussions and planning it is possible to find a suitable cost- and benefit distribution that is acceptable for all individual parties.
  **Score: 0.3**

**Related conditions:**

- **Which stakeholders invest in the project and the synergy and how is this distributed**
  Combination of both the municipality and the local companies.

- **What is the societal added value of the synergy?**
  Getting a private-public integral spatial development strategy on paper to be implemented later.

- **What impact does the synergy have on the local environment?**
  N.N.

- **Were all participants in agreement on the costs and benefits of the project?**
  Yes.

- **Who and how were the costs/benefits assessed?**
  N.N.

- **How were the cost/benefits distributed between the involved parties?**

N.N.

**Attributes of community:**

- **What is the stance of the local population on the synergy and the overarching project?**
  The local population was not involved as it was a strategic design that will hopefully be implemented later on the future. Local companies were very positive of the potential integration opportunities, however.

- **Are the possibilities for synergies incorporated in local policies, regional strategies and local construction plans?**
  After the completion of this project, it will, yes.

- **Were there any complications regarding the storage and transportation of the energy in the local environment of the project?**
  N.N.
  **Score: 1**

**Biophysical condition:**

- **Which spatial function is currently in place at the project location? (e.g., nature, industry)**
  Urbanized industrial areas.

- **Is the soil of the project location already *full* of other wires, tubes and networks?**
  Yes, the soil surrounding the industrial areas are very full. One of the main reasons why the spatial development needs to innovate with multi-purpose public-private solutions. It was one of the drivers for the collaboration
  **Score: 0.3**

## C.6 Scoring system

### 6.1 Outcome scoring system

*Table 18 Outcome template: ET synergy criteria for each case*

| Criteria | Explanation |
|---|---|
| **ET synergy score** | **ET synergy effectiveness based on the criteria listed below** |
| ET synergy realized | 'Is the identified ET-solution integrated into the overarching project in any way or form?' based on crisp true/false logic |
| Increase project duration | The impact on the total project duration compared to a similar project without the synergy utilization |
| Utilized ET potential | The achieved potential of energy generation (or saving) compared to the identified maximum potential |

#### *Outcome scoring system example*

To show the working of this outcome scoring system, an example case will be rated. A project where a very small ET-synergy was realized after lengthy feasibility scans and safety investigations which delayed the main project. In this case most ET-opportunities have not been realized in the end.

Step 1 consists of a check whether an ET-synergy (regardless of size and effectiveness) is realized, the presence of the small ET-synergy in our example case sets the minimum score of the outcome to 0,3.

Step 2 is dependent on the delays caused by the integration, because the required scans and investigations delayed the main project, the impact of the synergy was significantly negative. The outcome score does not go up to 0,7 and remains on 0,3.

Step 3 looks at the achieved ET-contribution, in this project many possible synergies were identified but only a small ET-synergy was realized. This means that only the achieved potential is low, and this results in the outcome scoring not increasing to 0,7 and thus it remains on 0,3.

Using the score system on this example project context, the outcome score would have been set on 0,3.

## 6.2 Condition scoring system

*Table 11 Condition scoring system*

| Ruleset | Score = 0 | Score = 0.3 | Score = 0.7 | Score = 1 |
|---|---|---|---|---|
| **Boundary rules** | The boundaries are tight and rigid, only sectoral stakeholder-types are involved during the design process | The boundaries are tight but flexible, a variety of relevant stakeholder-types are requested to provide input for synergy ideas | The boundaries are broad but rigid, a huge array of different stakeholder-types is involved in the process towards synergy realisation | The boundaries are broad and flexible, all potentially relevant stakeholder-types can provide input for synergy ideas |
| **Position rules** | No clear role distinction is made which party is managing what part of the project | Clear function distinction has only been made for functions concerning the overarching project | A role distribution is made within the project team dedicated to identifying and utilizing synergies | There is a designated team within the project team that manages the incorporation of the synergies efficiently |
| **Scope rules** | No clear scope was set for ET-synergies, only when the ET-synergy actively *collided* with the main project through analyses or stakeholders associated with the main project, would the ET-synergy be incorporated. | Only a single type of ET-synergy was identified and potentially incorporated. All other types of ET-synergies were not analysed until it *collided* with the main project. | Actively identifying and incorporating synergies is part of the project process since the orientation phase, this has resulted in most of the possible synergies being in the scope of the project. | Actively identifying and incorporating synergies is part of the project process since the pre-orientation phase in a flexible and broad fashion, this has resulted in all possible synergies being placed in the scope of the project. |
| **Choice rules** | The decision-makers (and other relevant parties) involved are limited in their actions | The decision-makers (and other relevant parties) are given freedom to accept and facilitate any possible synergistic-ideas | The decision-makers (and other relevant parties) are free to pursue other societal goals in addition to the main project objectives | The decision-makers (and other relevant parties) involved have unbounded freedom and are intrinsically driven to support the society at a higher level |
| **Aggregation rules** | The managing parties have no prior contact with legal supervisors and has a complex and inefficient internal management structure | The managing parties have little contact with legal supervisors and experience minor conflicts in their internal decision-making processes | The managing parties have close contact with the legal supervisors and utilize a clear decision-making structure that efficiently incorporates the synergies | People from the legal supervisors are incorporated in the project team and it has a near optimal internal management structure |
| **Information rules** | Relevant participants (parties with a significant amount of power or interest) are not informed about the project and there is no knowledge about utilizing synergies in the project team | Relevant participants are provided a notice about the project and the project team has little knowledge how to incorporate the synergies | Relevant participants are informed about the project and the project team has adequate knowledge regarding the utilization of the potential synergies | Relevant participants are informed sufficiently to allow them to provide input and the project team has thorough knowledge of all aspects of the possible synergies |
| **Payoff rules** | The identified ET-synergies did not find a suitable investor during the relevant project stages, no costs were distributed, or the costs were distributed too late for any ET-integration to occur. | The identified ET-synergies found investors on time only for some parts of the ET-synergies. A major part of the ET-synergies did not see an accepted cost-distribution in an early project stage. | The identified ET-synergies found investors relatively early in project. The synergies obtained a party who was willing to fund the ET-solution during the starting period of the design phase of the main project. | All identified ET-synergies found investors during the starting phases of the project, ensuring a party was willing to fund the synergy throughout the project phases. |
| **Community** | The community is actively working against the utilization of synergies; there is no room on the local energy network, the policies are working against the synergies and the local parties are heavily opposed. | The community is actively working against large intrusions in their neighbourhood. There is only little network-room, policies are limiting the utilization of synergies, and the local parties are unhappy. | The community is open for synergies, with some space in the network, policies unaffecting the implementation and the local parties creating no opposition. | The community is actively seeking the implementation of synergies, creating space on the network, having policies that advocate for synergies and local parties are actively promoting the synergies. |
| **Biophysical conditions** | The project location is physically limiting the placement of the ET-synergies due to space requirements and there is no ET demand on and around the location | A part of the project location is physically limiting the placement of the ET-synergies due to space requirements and there is little ET demand on and around the location | The project location is publicly owned open area with a lot of spare space both above and below the ground and there is demand for ET-developments | The project location is owned by the initiating organisation with surrounding lands owned publicly, the location has a lot of spare space both above and below the ground and the area is already industrialized with demand for ET |

### *Condition scoring system example*

The usage of a fuzzy scoring set combined with descriptive ratings is bound to create ambiguity in the scores. To provide a clear example on how the scoring system is applied, the boundary condition can be used as an example.

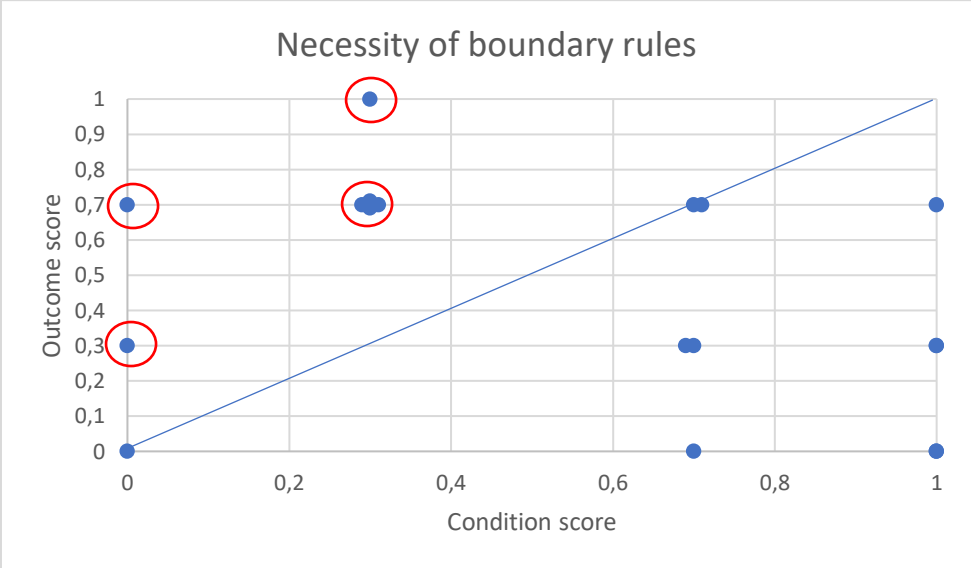
For a perfect 1 score, the project needs to have a very flexible and broad boundary. In practice this can be achieved by involving every potentially relevant stakeholder in the project process: local inhabitants, neighboring public authorities, surrounding companies and organizations. In addition, the project needs to involve these participants using a flexible and effective selection and involvement process. No participants were left out in the project processes and no unnecessary complexity or delays were added related to this involvement process.

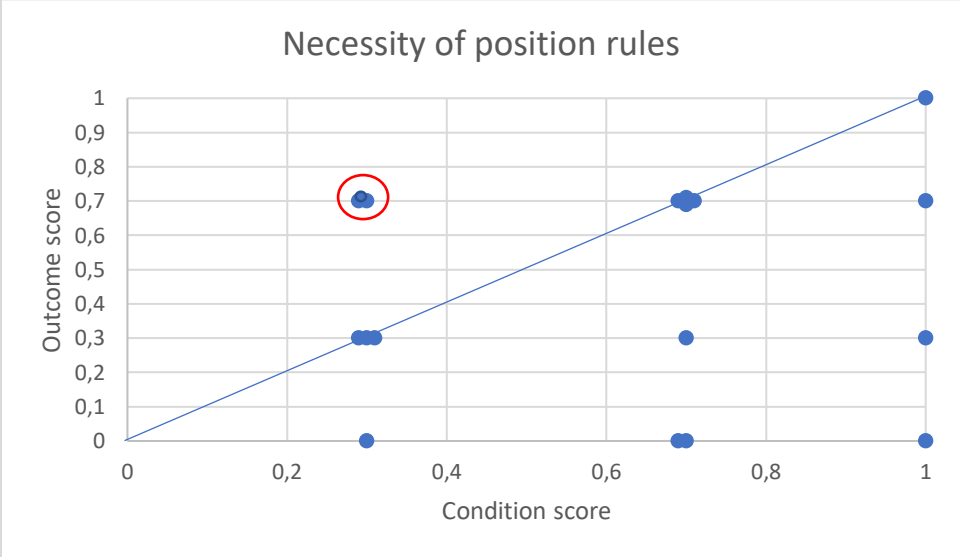
For a score of 0.7, the boundary of the project is also flexible and broad. However, not all relevant participants were involved and/or the selection and involvement process was slow or performed by a slightly biased single party. The difference lies between a case being in the theoretical top 15% (respective to other cases) regarding the state of the boundary and a case which has a boundary state slightly worse than the hypothetical optimal state.

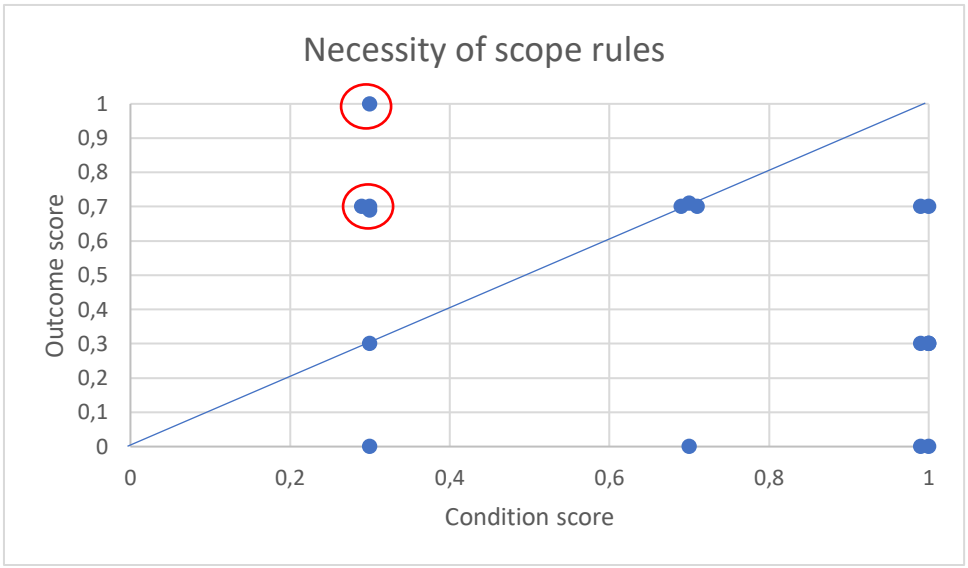
# Appendix D: Results and findings

## Appendix D.1 Outcome-condition plots of individual conditions

*Figures 16-24 showing necessity analysis of individual conditions using condition-outcome plots*




Necessity of scope rules
Outcome score
Condition score
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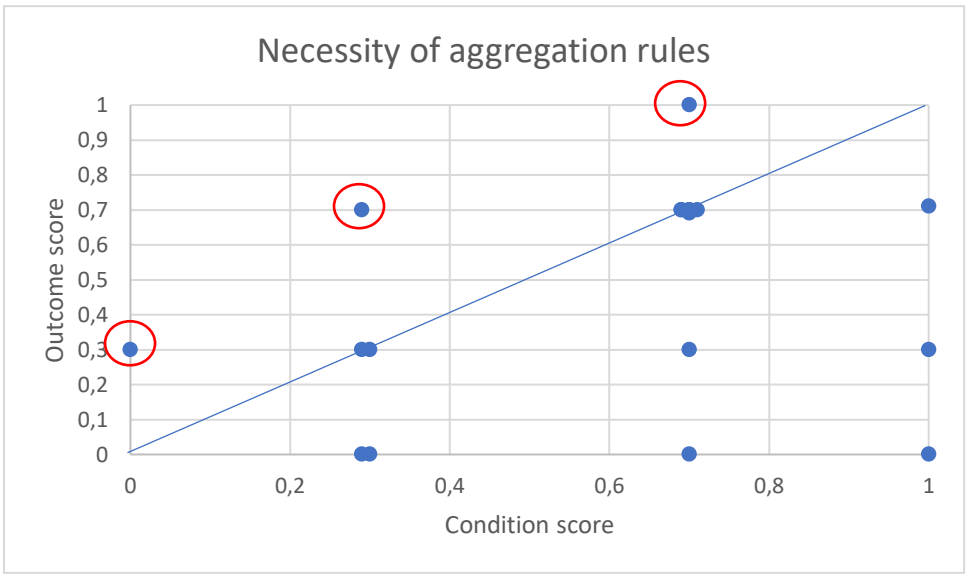
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1
0
0,2
0,4
0,6
0,8
1


Necessity of aggregation rules
Outcome score
Condition score
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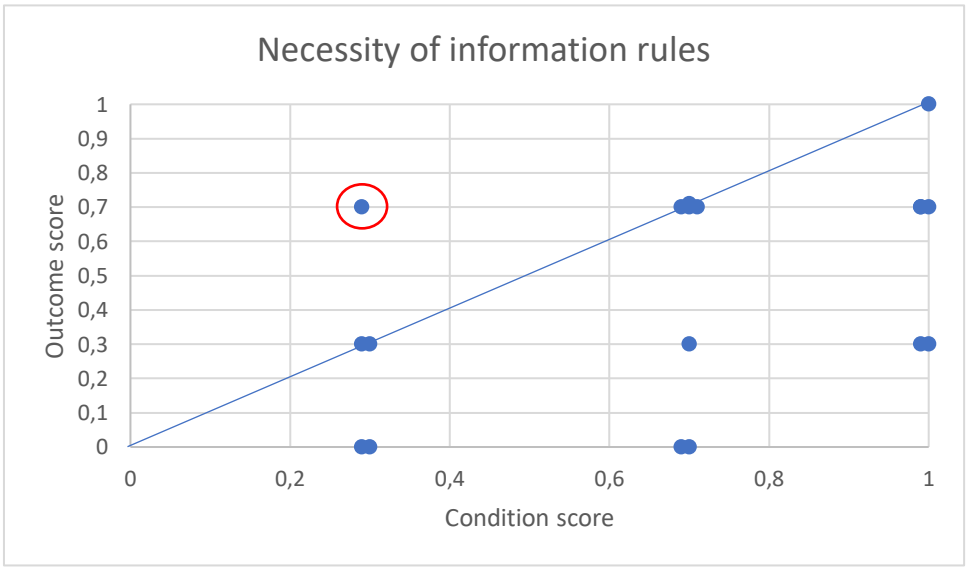
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1
0
0,2
0,4
0,6
0,8
1


Necessity of information rules
Outcome score
Condition score
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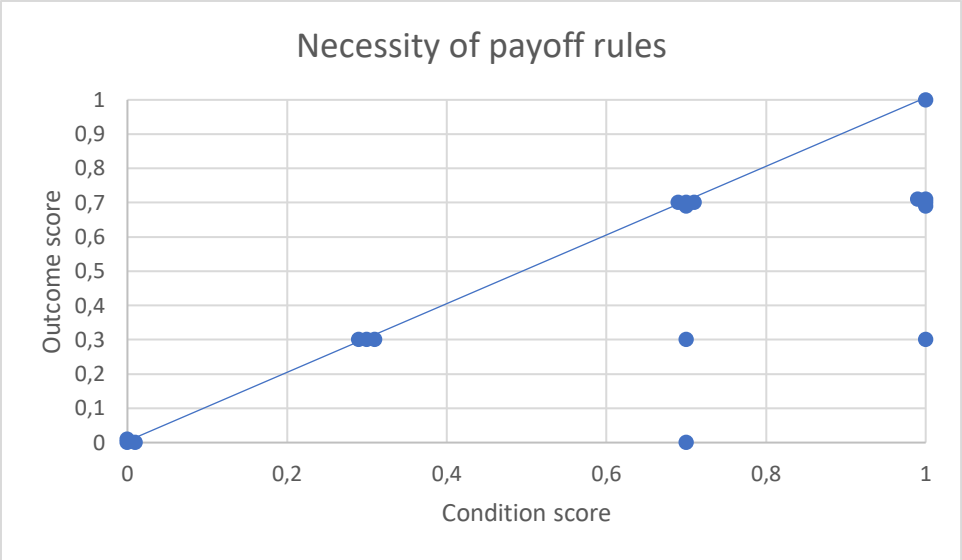
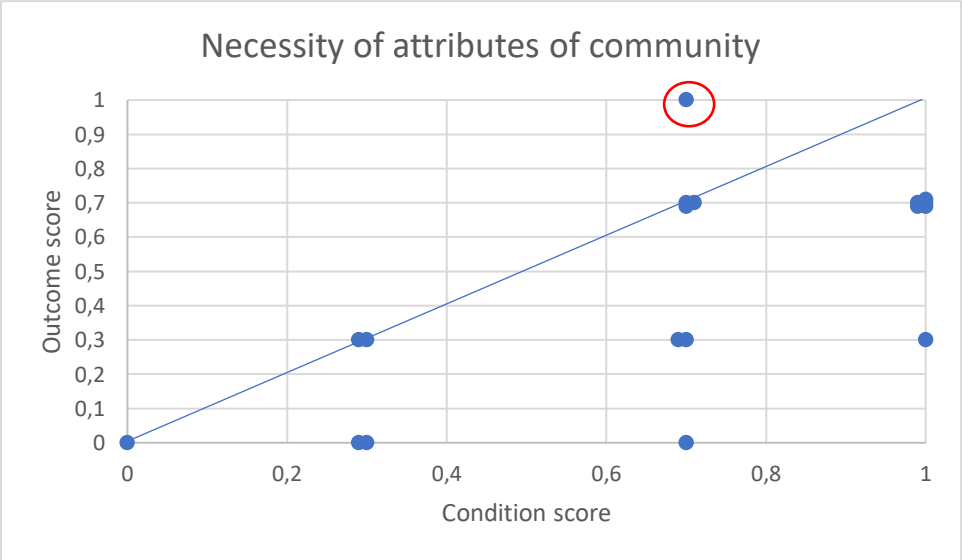
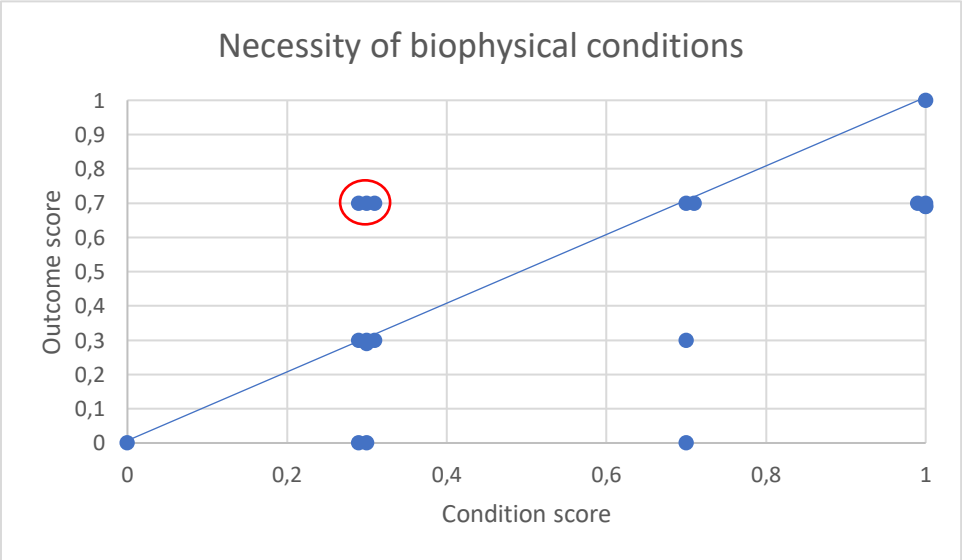
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1
0
0,2
0,4
0,6
0,8
1



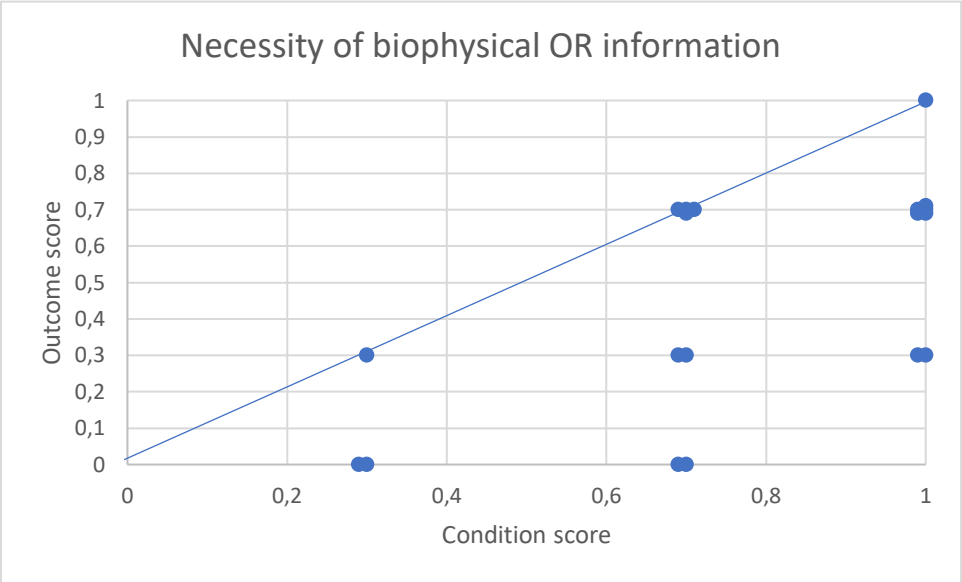

*External conditions*

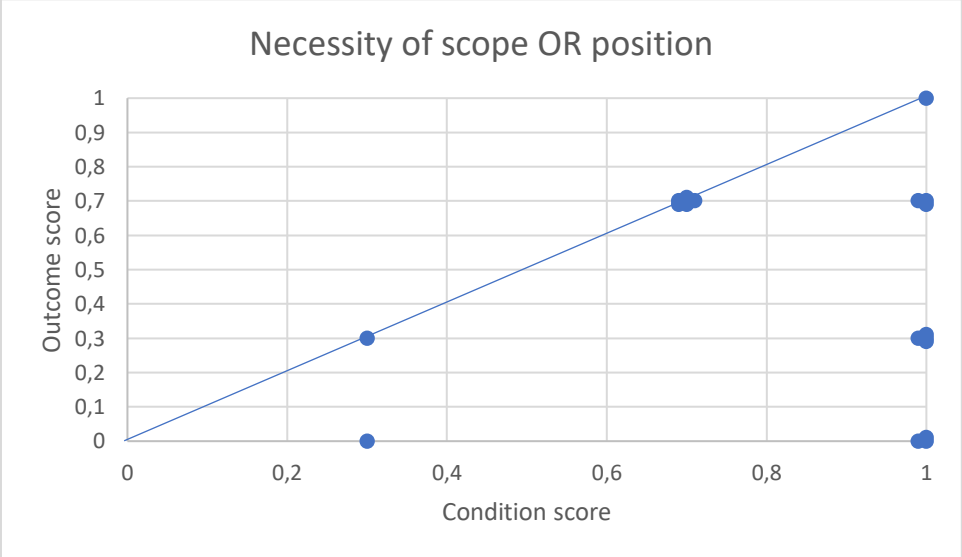


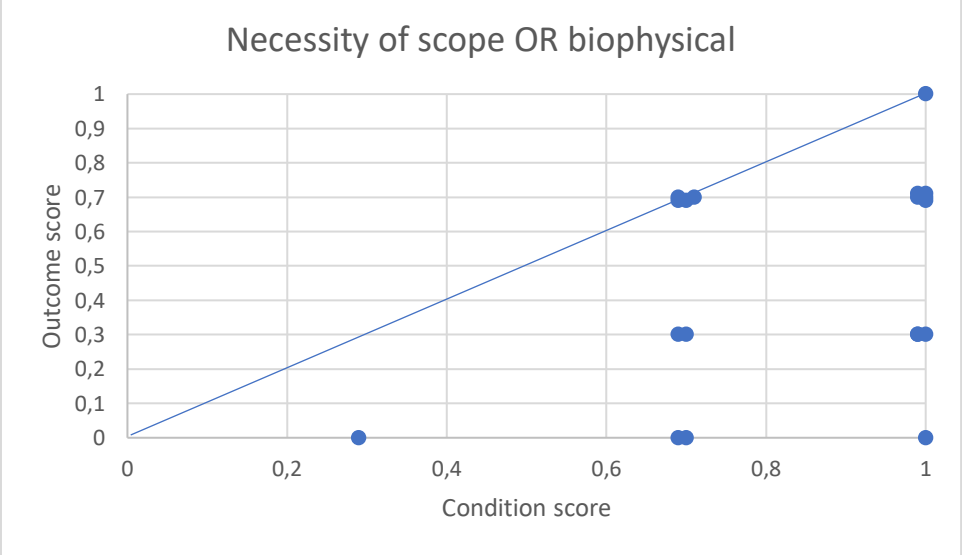



## Appendix D.2 Necessity analyses of Boolean combinations

*Figures 25-27 showing necessity analysis of combinations of conditions using condition-outcome plots*



## Appendix D.3 Sufficiency analysis

*Table 20 List of remaining relevant cases excluding those without a supportive payoff*

| Case nr. | Case ID | Project name | Project type | Potentially relevant conditions | | | | | | | | | Outcome |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Boundary | Position | Scope | Choice | Aggregation | Information | Payoff | Community | Biophysical | |
| 1 | 1 | RES Drechtsteden implementatie | Solar energy<br>Spatial development<br>Aqauthermy | 1 | 0,7 | 1 | 1 | 0,7 | 0,7 | 1 | 0,7 | 0,7 | 0,7 |
| 2 | 6 | Landtong Roozenburg | Solar energy<br>Dike strenghening | 0,3 | 0,7 | 0,3 | 0,7 | 0,7 | 0,7 | 1 | 1 | 1 | 0,7 |
| 3 | 7 | Port of Rotterdam – Amsterdam | Spatial planning<br>Required space for future ET-synergies | 0 | 0,3 | 0,7 | 1 | 0,7 | 0,7 | 0,7 | 0,7 | 0,3 | 0,7 |
| 4 | 9 | Schoteroog energy lake | Solar + wind energy<br>Spatial development | 0 | 0,3 | 1 | 1 | 0,3 | 0,3 | 0,7 | 0,3 | 0,3 | 0,3 |
| 5 | 10 | Maasvlakte II | Solar energy<br>Dike strenghening | 0,3 | 0,7 | 0,3 | 0,7 | 0,3 | 1 | 0,7 | 0,7 | 0,7 | 0,7 |
| 6 | 11 | Raalte RAS – RES-adaptatie | ET-solutions<br>Climate adaptation | 0,7 | 1 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 1 | 0 | 0,7 |
| 7 | 12 | RWZI Land van Cuijk & RWZI ooien | Sewage treatment plant renovation<br>Solar energy | 0,7 | 0,7 | 1 | 1 | 0,7 | 0,7 | 1 | 1 | 1 | 0,7 |
| 8 | 14 | Den Bosch RWZI | Sewage treatment plant renovation<br>Solar energy + biogas | 0,3 | 1 | 0,3 | 1 | 0,7 | 1 | 1 | 0,7 | 1 | 1 |
| 9 | 15 | Den Haag kademuren | Aquathermy<br>Canal renovation | 0 | 0,3 | 0,3 | 1 | 0,7 | 0,3 | 0,7 | 0 | 0 | 0 |
| 10 | 16 | RWZI Beverwijk & RWZI Echten | Sewage treatment plant renovation<br>Aqauthermy | 0,3 | 0,7 | 0,3 | 1 | 0,7 | 1 | 1 | 1 | 1 | 0,7 |
| 11 | 18 | Waterketen Delfland Wijkaanpak | Aquathermy<br>Solar energy<br>Underground spatial development | 0,3 | 0,3 | 0,7 | 0,7 | 1 | 1 | 0,7 | 1 | 0,3 | 0,7 |

## Crisp set of remaining cases

In green: selected sufficient solution and which cases are explained by the pathway.

*Table 21 Sufficient pathway consisting of supportive payoff and biophysical conditions*

| Case ID | Project name | Boundary | Position | Scope | Aggregation | Informaiton | Payoff | Community | Biohysical | | Outcome |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RES Drechtsteden implementatie | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 |
| 2 | Zonnedijk Moerdijk | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | | 1 |
| 5 | Helmond gekoppeld | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | | 0 |
| 6 | Landtong Roozenburg | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | | 1 |
| 7 | Port of Rotterdam – Amsterdam | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | | 1 |
| 9 | Schoteroog energy lake | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | | 0 |
| 10 | Maasvlakte II | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | | 1 |
| 11 | Raalte RAS – RES-adaptatie | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | | 1 |
| 12 | RWZI Land van Cuijk & RWZI ooien | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 |
| 14 | Den Bosch RWZI | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | | 1 |
| 15 | Den Haag kademuren | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | | 0 |
| 16 | RWZI Beverwijk & RWZI Echten | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | | 1 |
| 18 | Waterketen Delfland Wijkaanpak | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | | 1 |

*Table 22 Pathway consisting of supportive aggregation, information, payoff and community*

| Case ID | Project name | Boundary | Position | Scope | Aggregation | Informaiton | Payoff | Community | Biohysical | | Outcome |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | RES Drechtsteden implementatie | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 |
| 2 | Zonnedijk Moerdijk | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | | 1 |
| 5 | Helmond gekoppeld | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | | 0 |
| 6 | Landtong Roozenburg | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | | 1 |
| 7 | Port of Rotterdam – Amsterdam | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | | 1 |
| 9 | Schoteroog energy lake | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | | 0 |
| 10 | Maasvlakte II | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | | 1 |
| 11 | Raalte RAS – RES-adaptatie | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | | 1 |
| 12 | RWZI Land van Cuijk & RWZI ooien | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 |
| 14 | Den Bosch RWZI | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | | 1 |
| 15 | Den Haag kademuren | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | | 0 |
| 16 | RWZI Beverwijk & RWZI Echten | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | | 1 |
| 18 | Waterketen Delfland Wijkaanpak | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | | 1 |

## Appendix D.4 Conditions producing low outcome scores

*Explanation of low outcome scores by necessary conditions (and combinations thereof).*

*Table 23 Cases with low outcome scores selected from the data matrix*

| Case nr. | Potentially relevant conditions | | | | | | | | | Outcome of interest |
|---|---|---|---|---|---|---|---|---|---|---|
| | Boundary | Position | Scope | *Choice* | Aggregation | Information | Payoff | Community | Biophysical | |
| 3 | 1 | 0,7 | 1 | *1* | 0,3 | 0,3 | 0 | 0,3 | 0,3 | 0 |
| 4 | 0,7 | 1 | 0,7 | *1* | 1 | 0,7 | 0 | 0,7 | 0,3 | 0 |
| 5 | 0,7 | 0,3 | 0,7 | *0,7* | 0 | 0,3 | 1 | 0,3 | 0,7 | 0,3 |
| 8 | 1 | 0,7 | 1 | *1* | 0,3 | 1 | 0,3 | 0,7 | 0,3 | 0,3 |
| 9 | 0 | 0,3 | 0,7 | *1* | 0,3 | 0,3 | 0,7 | 0,3 | 0,3 | 0,3 |
| 13 | 1 | 0,7 | 1 | *0,7* | 0,3 | 0,7 | 0 | 0,3 | 0,7 | 0 |
| 15 | 0 | 0,3 | 0,3 | *1* | 0,7 | 0,3 | 0,7 | 0 | 0 | 0 |
| 17 | 1 | 1 | 1 | *1* | 1 | 1 | 0,3 | 0,7 | 0,3 | 0,3 |
| 19 | 1 | 0,3 | 1 | *1* | 0,7 | 0,7 | 0,3 | 1 | 0,3 | 0,3 |

*Analysis of boundary scores of cases with low outcome scores using binary sets.*

*Table 24 Binary set of low outcome scores and linked boundary scores*

| Case nr. | Case ID | Project name | Project type | Outcome of interest | |
|---|---|---|---|---|---|
| | | | | Boundary | |
| 1 | 3 | Rijnkade Arnhem | Aquathermy<br>Canal renovation | 1 | 0 |
| 2 | 4 | Lauwersmeerdijk renovatie | Solar energy<br>Dike strenghening | 1 | 0 |
| 3 | 5 | Helmond gekoppeld | Solar energy<br>Aqauthermy | 1 | 0 |
| 4 | 8 | STAIN Zwolle | ET-solutions<br>Spatial development | 1 | 0 |
| 5 | 9 | Helmond gekoppeld | Solar energy & Aquathermy Renovation heat network | 0 | 0 |
| 6 | 13 | Culumborgse Dijk ontwikkeling | Solar energy<br>Dike strenghening | 1 | 0 |
| 7 | 15 | Den Haag kademuren | Aquathermy Canal renovation | 0 | 0 |
| 8 | 17 | Grebbedijk integrale gebieds-ontwikkeling | Solar energy<br>Wind energy<br>Aquathermy<br>Dike strenghening | 1 | 0 |
| 9 | 19 | Best Bedrijven visie | Solar energy<br>Various ET-solutions | 1 | 0 |

## Appendix D.5 Pathway explanations

*Table 25 Relevant pathways for each case explained qualitative based on interviews*

| Case ID. | Outcome of interest | Relevant pathway | Qualitative explanation of case pathway |
|---|---|---|---|
| 1 | 0,7 | Presence of supportive: AGG, IFM, PO, CMT | Case 1 followed the sufficient configuration of conditions. Based on the interview transcripts, the open community and interactive information sharing methods were identified as the main benefactors. |
| 2 | 0,7 | Presence of supportive: Payoff and biophysical | Case 2 was unique in its project conditions. The positive outcome score was linked solely to the supportive payoff conditions paired with the supportive biophysical conditions. All other internal conditions seemed to be in an unsupportive state. |
| 3 | 0 | Absence of supportive: Payoff | Case 3 failed to realise any type of ET-synergy because of the absence of any investor-identification (low payoff), no costs related to the synergy were distributed during any phase of the project. |
| 4 | 0 | Absence of supportive: Payoff | Case 4 failed to realise any type of ET-synergy because of the absence of any investor-identification (low payoff), no costs related to the synergy were distributed during any phase of the project. |
| 5 | 0,3 | Absence of: Position, scope and biophysical conditions. | Case 5 realized a moderately low scoring ET-synergy because there was no strong manager present and the scope was too narrowly focussed on only 3 possible synergies. When the selected two synergies encountered problems and no manager was present to switch or push other solutions, the ET-synergy was limited. |
| 6 | 0,7 | Presence of supportive: AGG, IFM, PO, CMT | Case 6 followed the sufficient configuration of conditions. This case was surrounded by industrial area and had plenty of space to place the wind turbines. Resulting in high scores for the sufficient selection of conditions (and the biophysical conditions). |
| 7 | 0,7 | Presence of supportive: AGG, IFM, PO, CMT | Case 7 followed the sufficient configuration of conditions. This case was surrounded by industrial area and had plenty of funds and available experts to plan for any type of synergy. Resulting in high scores for the sufficient selection of conditions. |
| 8 | 0,3 | Absence of supportive: Payoff | Case 8 realized a moderately low scoring ET-synergy because of the absence (at the time of the interview) of any investor-identification (low payoff), no costs related to the synergy were distributed just yet. In the future this is still a possibility. |
| 9 | 0,3 | *Unexplained by pathways* | Case 9 can to an extent be explained by an absence of the sufficient selection of conditions. But in this particular case, four conditions were specifically mentioned in the transcripts as main causes for the delays and small implementation. In addition to three of the four conditions of the sufficient configuration, the lack of proper boundaries was identified. |
| 10 | 0,7 | Presence of supportive: Payoff and biophysical | Case 10 can be explained by the shortest sufficient configuration. Specific for this project is that it was a long-term project spanning 20+ years. The moderately high score is explained by the well-suited location between large energy demanding companies and the fact that many investors were willing to fund the synergy from the start |
| 11 | 0,7 | Presence of supportive: AGG, IFM, PO, CMT | Case 11 followed the sufficient configuration of conditions. Based on the transcripts all conditions states were at least in a moderately supportive state, except for the project location itself. |
| 12 | 0,7 | Presence of supportive: AGG, IFM, PO, CMT | Case 12 followed the sufficient configuration of conditions. Based on the transcripts all conditions states were at least in a moderately supportive state. This project in particular encountered opposition from nature-preservation organisations. |
| 13 | 0 | Absence of supportive: Payoff | Case 13 failed to realise any type of ET-synergy because of the absence of any investor-identification (low payoff), no costs related to the synergy were distributed during any phase of the project. |
| 14 | 1 | Presence of supportive: Payoff and biophysical | Case 14 realized an effective ET-synergy, scoring a 1 for the outcome. This can be explained by the sufficient configuration of conditions (payoff and biophysical scored a 1) but based on the transcripts the strong manager and a perfectly suited location contributed significant to the good result as well. |
| 15 | 0 | Absence of supportive: Payoff | Case 15 failed to realise any type of ET-synergy because of the absence of a strong manager and the presence of a narrow scope and badly suited project location. |
| 16 | 0,7 | Presence of: AGG, IFM, PO, CMT, BP | Case 12 followed the sufficient configuration of conditions. Based on the transcripts all conditions states of this configuration were at least in a moderately supportive state. This project in particular had low scores for the boundary and scope rulesets, but without a significant negative impact on the outcome score. |
| 17 | 0,3 | Absence of supportive: Payoff | Case 17 failed to realise any type of ET-synergy because of the absence of any investor-identification (low payoff), no costs related to the synergy were distributed during any phase of the project. With this case in particular, the low pay off was attributed to the low scoring biophysical conditions, based on the transcripts. |
| 18 | 0,7 | Presence of: AGG, IFM, PO, CMT | Case 18 followed the sufficient configuration of conditions. All relevant conditions were at least in a moderately supportive state. This case in particular challenged the hypothesis for the position rule, as this project was led by a fully horizontal hierarchy between the main stakeholders. According to the transcripts this role-distribution was the main reason the ET-synergy was realized. |
| 19 | 0,3 | Absence of supportive: Payoff | Case 19 realized a moderately low scoring ET-synergy because of the absence (at the time of the interview) of any investor-identification (low payoff), no costs related to the synergy were distributed just yet. In the future this is still a possibility. |