Expansion of biogas plant in Spørring, Denmark

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Is the project a case of…:

☒ State-initiated co-creation

☐ Entrepreneur-driven co-creation

☐ Grassroots-based co-creation*

**For an elaboration of the typology, please consult the GOGREEN theoretical framework p. 25.*

Integrated case analysis

Before proceeding to the scoring of the GFs, please provide a *3–5 page case analysis* in which you describe the background, history, and national, regional, and local contexts of the case, the problems and goals addressed by the local collaboration, the participating actors and their relationships, the unfolding of the co-creation process, the most important governance factors (this may include factors other than those in focus in this project), and the generated outputs and outcomes. The conclusion may specify a few lessons learned from the case study.

1) Background, history, and national, regional, and local contexts of the case

Aarhus, Denmark's second-largest city, is a municipality located on the east coast of Jutland. The municipality has set an ambitious goal of achieving climate neutrality by 2030 and has already made significant efforts in reducing its CO2 emissions over the past decade. Aarhus municipality's climate action plan, "Go Green with Aarhus", guides the city's efforts from 2021 to 2024 in pursuit of this goal. Central to this plan is the focus on holistic land use, referring to the integration of land-use plans with the broader urban development plans of the municipality. Many of the green transition projects in Aarhus, such as biogas plants and solar cells, are often located in the same areas, and the municipality sees it necessary to ensure holistic land use and planning that merge different concerns and interests in these areas. In this way, the municipality is rethinking its previous planning practice where initiatives such as the establishment of solar cell parks, expansion of biogas plants, etc. have worked been developed as isolated project initiatives, that is, through bureaucratic silos without any regard for their overall integration and compatibility with the broader developmental visions of the municipality. In its new planning practice, Aarhus municipality takes measures to merge concerns related to climate adaptation, biodiversity, social sustainability, groundwater protection, city development, sustainable energy solutions, CO2 reductions, security of supply and optimal land use in the same locations, so that it ensures holistic planning of areas that house many green transition projects. According to the municipality, holistic land use projects in Aarhus should also enable collaboration between administrative units in the municipality and involve co-creation of green transition projects with local citizens. The project thereby also foregrounds the democratic potential of retrieving approval and inputs from citizens

in the planning and development of such green transition projects, in anticipation that they would consequently command greater community-level support.

Our case study is situated in the village/district of Spørring, located north of Aarhus city. With just over 1000 inhabitants, the villagers form a small part of the total population in Aarhus municipality, which as of 2023 tallies 367.000 inhabitants. Several green transition projects are currently under implementation in Spørring, including the establishment of a new solar park and the expansion of the local biogas plant, Bånlev Biogas, which has existed in Spørring since the early 1990s. Due to extensive involvement in green transition initiatives and projects, Spørring has become designated as a pilot site for implementing the part of Aarhus' climate strategy concerned with holistic land use. Aarhus municipality will use the experiences from their efforts to conduct holistic planning and co-creating with local citizens in this pilot for future holistic land use projects. Moreover, the learnings from citizen co-creation in the Spørring project will feed into the development of a new Aarhus model for citizen engagement. We have chosen to focus on one specific initiative in the holistic planning of Spørring: the expansion of the local biogas plant, Bånlev Biogas, which is owned by the energy company Nature Energy. Bånlev Biogas was established in Spørring in the early 1990s, during which it was owned and operated by Aarhus municipality, and the biogas plant has since shifted hands multiple times between the municipality and different energy companies. Today, Bånlev Biogas is owned by the energy company Nature Energy, which specializes in biogas and is a wholly owned subsidiary of Shell plc.

Press photo of Bånlev Biogas by Nature Energy.

2) The aims of the project and the sustainability problems that it seeks to address

One of the initiatives of Aarhus municipality's climate action plan to achieve CO2 neutrality by 2030 is the transition away from natural gas in Aarhus municipality's industry and an increased production of renewable natural gas (RNG). To meet the increasing gas needs of the industry, Nature Energy requested permission from Aarhus municipality to expand Bånlev Biogas in 2020. It was estimated that the expansion of the biogas plant would enable Nature Energy to increase its biogas production by almost 200%. In this way, the expanded Bånlev Biogas would be able to increase its contribution to Aarhus municipality's climate goals significantly.

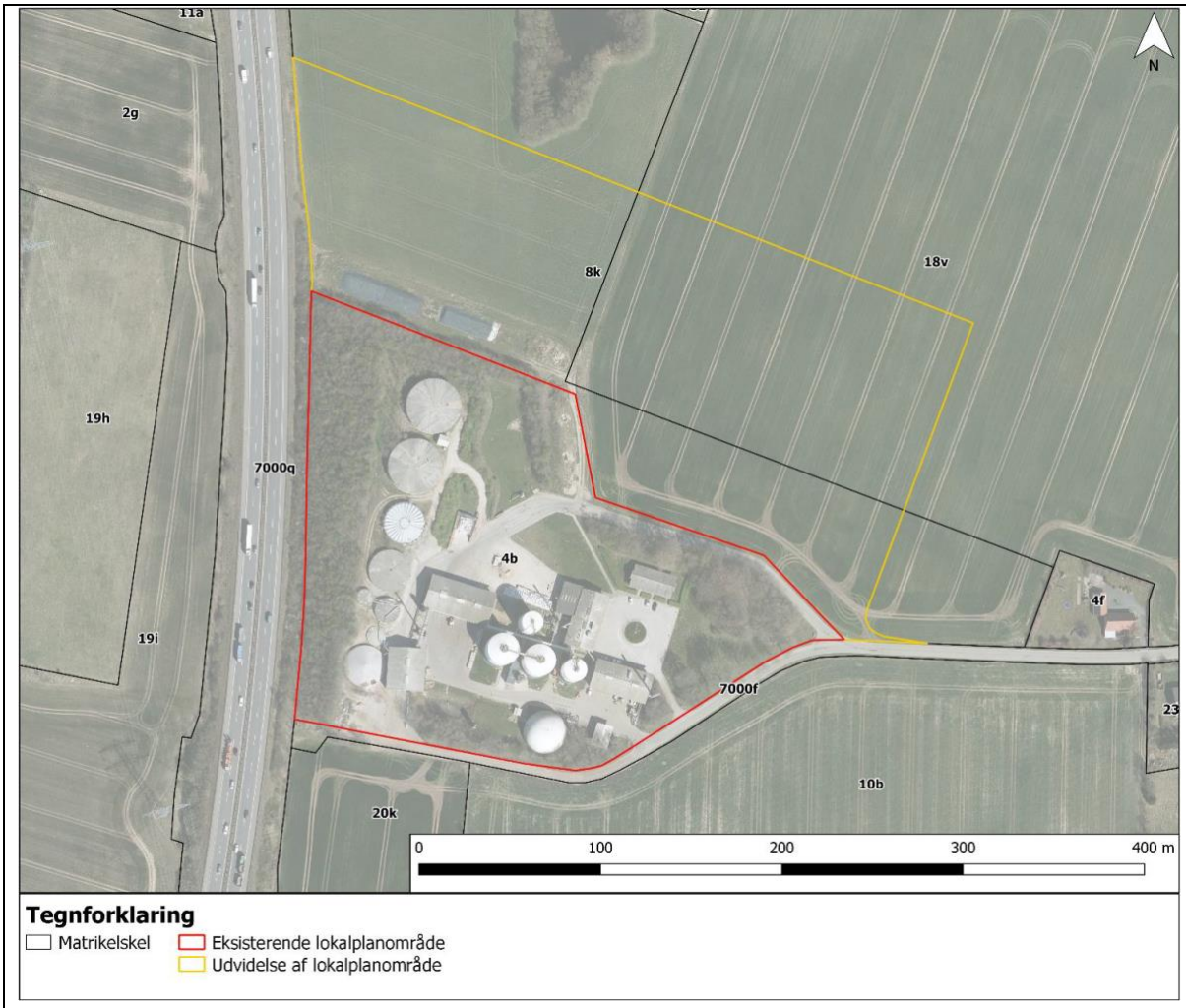

Photo of the existing (old) biogas plant and illustration of its area of expansion by Nature Energy.

The proposition to expand the biogas plant was not uncontroversial. Local citizens were initially skeptical of the expansion, as they feared it would generate more traffic on the local highway and increase odors from the biogas plant, which in its current state is known to discernibly emit pungent odors in its vicinity. The locals have also previously felt overlooked by the municipality in decision-making processes about the establishment of green transition projects in Spørring, which has further exacerbated the backlash to the new proposed expansion of the biogas plant. In parallel to the biogas plant, Aarhus municipality's plan for holistic land use has also entailed the prospect of a 50-hectare solar cell plant and a gravel pit in Spørring, which has been met with similar skepticism in view of its potential consequences for the value of the local neighborhood and the potential loss of pastoral landscape.

The combination of these factors spurred an air of dissatisfaction in the local community. This was picked up by Aarhus municipality, who took measures to improve their collaboration and communication with local citizens. Previously, the primary representative of Aarhus municipality that was in contact with Spørring citizens had been an urban planner, who regularly conducted public hearings in relation to the development of the local district plan. The Danish planning act provides the legal framework for the work of the urban planner, requiring them to send the proposed district plan out in a public hearing twice before its final

adoption. However, Spørring citizens sensed a frustration regarding their limited level of influence over the district planning of Spørring, in response to which Aarhus municipality chose to engage a team of dedicated "citizen involvers" from their citizen engagement department to improve the collaboration between Aarhus municipality and the locals of Spørring.

Illustration of the expanded biogas plant by Nature Energy.

3) The participants and their interaction and communication in and between meetings

The participants in the project were Aarhus municipality's Technical and Environmental administration (consisting of its planning, climate, and citizen involvement sub-departments), Nature Energy, and local citizens in Spørring. Representatives from different departments of Aarhus municipality's Technical and Environmental administration were engaged in the project, including the citizen engagement department, the climate department, and the planning department. These municipality representatives are considered the project facilitators of the project. Project participants include Nature Energy, primarily represented by the operations manager of Bånlev Biogas, who oversees the day-to-day activities of the biogas plant and regularly updates Spørring citizens about its operations. The central office of Nature Energy was also involved in communication with Spørring citizens to some degree. The citizens of Spørring were also project participants, partially represented through Spørring citizen association, which communicated news about the urban planning of Spørring as well as the operations of Bånlev Biogas to Spørring citizens. This

communication took place through the local newspaper, the Spørring Post, as well as informal conversations between the chairperson of the citizen association and local citizens.

4) How often do they meet, and do they communicate between meetings?

Interactions between the different actor groups in the project took different forms and took place both regularly and ad hoc. The planning department of Aarhus municipality interacted mostly with local citizens through one legally mandated public hearing meeting. The other representatives of Aarhus municipality, including the climate department representatives and citizen engagement department representatives, arranged an additional meeting in the local village hall in Spørring to inquire about citizens' preferences to the expanded biogas plants. In parallel with this, the operations manager of Bånlev Biogas continuously communicated with the Spørring citizen association about the operations of the biogas plant, temporary augmented odor problems from the plant's operations, and other changes in the plant's operations that would affect the local community. The operations manager also continuously responded to inquiries from local citizens about the operations of the biogas plant. Finally, the operations manager was present at Spørring's yearly village fair together with a communications officer from Nature Energy, where citizens could meet them and ask questions about the expansion of Bånlev Biogas.

5) The role and forms of knowledge sharing, coordination and joint problem-solving

Different forms of knowledge sharing took place in the project. In the village of Spørring, the operations manager at Bånlev biogas regularly shared information about the day-to-day operations of the biogas plant with the citizen association of Spørring, which disseminated this information to the local citizens through its website and local newspaper. Moreover, the operations manager regularly responded to individual inquiries about the biogas plant from citizens by phone, e-mail or in person, and would gladly drive out to a local citizen on a Sunday to provide information about the operations of Bånlev Biogas. The operations manager was also in regular contact with Aarhus municipality, especially the planning department, about operational issues and purpose of the current biogas plant. Representatives from the three involved departments from Aarhus municipality's Technical and Environmental administration, namely the planning, climate and citizen engagement departments, met on a weekly basis to share insights, coordinate initiatives and make collective decisions. These departments, and especially the citizen engagement department, were regularly in contact with Spørring citizens through citizen meetings and conversations with the citizen association as well as individual citizens, to gather knowledge about their concerns and wishes for the development of Spørring.
This interaction between citizens and the municipality contributed to problem-solving insofar as it provided insights into citizens' concerns for inconveniences accommodating the biogas plant expansion, and facilitated a dialogue about possible solutions. However, in the end, the technological advancement of modern biogas plants preempted a large part of citizen concerns, as modern biogas plants emit a small amount of odor compared to older biogas plants.

6) The relation between consensus and conflict and the handling of the latter

As mentioned in the introduction, there were some emerging conflicts in the project related to three concerns among local citizens: (a) the current odor emissions from Bånlev Biogas would increase with the biogas plant expansion, (b) the expansion would entail increased traffic and noise on the local highway, and (c) citizens would have limited ability to influence decisions about the planning of the biogas plant expansion. The first concern about increased odor emissions was handled effectively by the operations manager at

Bånlev Biogas, who provided Spørring citizens with information about the limited odor emissions of modern biogas plants and, upon a suggestion from a city planner from Aarhus municipality, invited Spørring citizens to visit a modernized biogas plant in Denmark so they could experience the limited odor emissions of new biogas plants in person. This mitigated much of this citizen group's critical stance towards a modernization and expansion of Bånlev Biogas, and they could report back to the local community that an expansion of Bånlev Biogas would not have the anticipated consequences that they feared. The second concern about increased traffic persevered for many Spørring citizens. The promise of the modernization of Bånlev Biogas in relation to the expansion seemed to partially have mitigated this concern, as local citizens were positive towards the fact that the modernization would entail a reduction of the current odor emissions from the biogas plant. However, the concern about increased traffic continued to be a concern for many local citizens. The third concern about citizens' limited ability to influence the planning of the biogas plant was still rooted in the fact that Spørring citizens have not previously felt heard in municipal processes of planning of green energy projects in their local area. However, at the time of our case study, there was a general feeling among the citizens we interviewed that the contact between Aarhus municipality and the community in Spørring was improving, and a feeling that Aarhus municipality took increasing measures to solicit input from Spørring citizens. Moreover, Nature Energy had taken measures to establish plants and vegetation around the biogas plant in accordance with the wishes of the citizens.

7) The role and form of leadership: lead actor, steering group and/or collective leadership

As one out of two municipalities in Denmark, the political leadership of Aarhus municipality takes the form of municipal authorities ("magistrater" in Danish) that have their own designated areas of responsibility. Thus, the municipality is politically led by the city mayor and five members of the city council who each lead one of the five municipal authorities. The formal leadership of this project lied with Aarhus municipality's Technical and Environmental authority, led by an elected city council member. Several sub-units under the Technical and Environmental administration were involved, including the planning department, the citizen engagement department, and the climate department. Formally, the project was led by a manager in the planning department in charge of environmental impact assessments and renewable energy. However, from our interviews, it seemed that the decision-making mandate of this leader was not strong enough to set a holistic direction for the project that included both planning, environmental, climate, and citizen engagement concerns. This provided limited clarity on which municipal department would have the final say in instances where there were conflicting interests between, for instance, the planning department and the citizen engagement department. Representatives from the climate, planning and citizen engagement departments therefore met every week to share insights, coordinate initiatives and make collective decisions. In this way, the leadership of the project can be characterized as distributed, but also somewhat fragmented due to the unclear role division and jurisdictional authority.

8) The temporal unfolding of the co-creation process: major shifts and ups and downs

The project started in 2020, when Nature Energy proposed an expansion of Bånlev Biogas to Aarhus municipality. Shortly thereafter, Aarhus municipality and Nature Energy began to obtain the necessary approvals and assessments for the expansion to take place, including an environmental approval, an environmental assessment and a new district plan for the expansion. The environmental approval was granted Nature Energy by the Danish Environmental Protection Agency. As a part of this work, the proposed expansion was sent into two public hearings, which were mandatory according to the Danish Planning Act:

one hearing before Aarhus municipality started the development of the new district plan for the expansion, and one hearing after the municipality had developed the draft district plan.

The first public hearing took place in February 2021, where citizens had the opportunity to provide their ideas and suggestions for topics that should be considered by the municipality when working with the project's approvals and assessments. The public hearing received 53 responses from Spørring citizens which were predominantly negative, albeit some were positive. The main issues flagged by the negative responses were concerns about increased traffic on the local highway and increased odor emission from the expanded biogas plant. The positive responses expressed support for green transition initiatives such as the expanded biogas plant. Notably, the response from the local citizen association was negative, as the association feared that the expanded biogas plant would make the area less attractive for current inhabitants and potential newcomers. They also expressed dissatisfaction with the limited contact between Aarhus municipality and Spørring citizens.

The second hearing took place between March and May 2023 and included a public hearing meeting in April 2023. In the meantime, Nature Energy had invited selected citizens from Spørring, including representatives from the citizen association, to visit one of their modern biogas plants in Denmark and experience the limited odor emissions from new biogas plant constructions. Aarhus municipality had also taken increasing measures to maintain continuous contact with the local citizens since the first public hearing and had reached out to them on several occasions. As a result, the latter hearing received four responses, including a significantly more positive response from the citizen association. While still expressing concerns about increased traffic in the Spørring area due to the biogas plant expansion, they expressed a positive overall attitude towards the expansion, and credited Aarhus municipality for taking more measures to collaborate with local citizens. They also provided input to the construction of green areas that could visually cover some of the expanded biogas plant to Spørring citizens, which were rejected by the city planner due to formal planning requirements. In June 2023, after the conclusion of the public hearing, the operations manager from Bånlev Biogas participated in Spørring village fair with a stand, where they set up visualizations of the biogas plant expansion and answered questions from citizens together with a communications officer from Nature Energy. The final district plan for the expansion of Bånlev Biogas was discussed and passed in Aarhus city council in November 2023. The construction of the biogas plant expansion is set to begin in the spring of 2024 and finish by the end of 2025, when the expanded biogas plant is expected to be operational.

9) The most important governance factors (may include factors other than those in focus in this project)
GF 2

Legislation, programs and formal goals were an important driver for collaboration in the project. The Danish Planning Act provided the primary legal framework for the project, as the district plan for the expansion of Bånlev Biogas had to live up to the requirements of this legislation. The Danish Planning Act encourages public authorities to include the public "to the greatest possible extent" in local urban planning and requires municipalities to conduct at least two public hearings in the development of new district plans. This has provided Aarhus municipality with a framework and institutional channels to include citizens in their planning processes. Moreover, programs issued by Aarhus municipality such as their climate action plan and official political orientation points for Aarhus municipality's Technical and Environmental administration provided a

strong mandate for Aarhus municipality to engage citizens in their green initiatives, not least citizens in villages in the outskirts of the municipality.

GF 5

Downward accountability from Aarhus municipality and Nature Energy towards citizens was a key driver for collaboration in the project. Historically, Spørring citizens have had a somewhat critical stance towards Aarhus municipality, as they have not felt heard in decisions about the planning and development of their village. However, Aarhus municipality's efforts to strengthen communication with Spørring citizens have created a more favorable attitude towards the municipality among citizens. Moreover, the continuous communication of the operations manager at Bånlev Biogas to local citizens about the day-to-day operations of the biogas plant has strengthened the trust between citizens and Nature Energy, which has benefitted the collaboration between these two actors.

GF 16

The leadership in the project was distributed, which was important for the project, as it had some advantages and some disadvantages. The advantage was that it led to continuous collaboration between the different sub-units in the Technical and Environmental administration of Aarhus municipality, as they needed to conduct weekly meetings and coordinate decisions. The disadvantage was that none of the municipal departments involved had a strong mandate to make decisions, which also made it unclear for local citizens in which situations and to which extent they could influence municipal decision-making.

10) The generated outputs and outcomes

The generated output of the project is the district plan for the expansion of Bånlev Biogas (Lokalplan 1184), which enables the biogas plant to increase its annual production of biogas from 7 million cubic metres of biogas to 20 million cubic metres of biogas. It also increases the capacity of the biogas plant to handle biomass; today it can handle 185.000 tons of biomass annually, while the expanded biogas plant will be able to handle 700.000 tons of biomass annually, increasing the plant's handling capacity with around 180%. In the district plan, it is recommended that the municipal guidelines for planting are changed, so that the municipality can accommodate local citizens' wish to construct a tall plant belt around the expanded biogas plant that will conceal parts of it visually.

11) Lessons learned about the conditions for co-creating green solutions

One of the key lessons from this case is that citizen engagement does increase support for green solutions, even in cases where the local community has a critical starting point. When citizens feel included in and informed about the developments of green projects in their local area, it increases their trust in the local authorities and private companies taking part in these projects. However, the findings from our case study also stress the importance of having clarity about what part of green projects citizens can and cannot influence. In our case study, citizens only wanted to be included in co-creation processes if they could influence project outputs and outcomes, and they preferred to collaborate with organizational representatives that could make executive decisions. This points to the importance of considering who should co-create in what situations to provide optimal conditions for citizen engagement and satisfaction.

Scoring and analysis of governance factors

1. Perceived importance of biosphere conditions

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☐ Medium confidence	☒ Documents
☐ 0.66	☒ High confidence	☐ Observations
☒ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

The project facilitators and participants unanimously report that climate change is a main driver for the project's collaborative processes. As previously mentioned, Aarhus municipality has set the goal to become CO2 neutral in 2030, and the expansion of renewable energy production, including biogas, is a core means to achieve this goal. This was a clear drive for the municipality to collaborate with the local community in Spørring, as they realized that these green ambitions could not be met unless you had the support of the local community. For Nature Energy, there was naturally an economic interest in the expansion of the biogas plant, but the operations manager at the biogas plant also described climate change as a core personal motivation for their work at Bånlev Biogas and their collaboration with the local community. For the local citizens in Spørring, who had been skeptical towards the many green projects in their local area, the severity of climate change still motivated them to collaborate with Aarhus municipality and Nature Energy to find solutions that could contribute to the green transition. Several informants also declared that despite the potential inconveniences posed by the expansion of the biogas plants, they conceded the importance of advancing such green technologies. The green motivations thereby paved the way for the project's success, as it increased the latitude of tolerance towards the biogas plant by acting as an overriding factor. A particular narrative was the sense of urgency and necessity for Denmark, and by extension Aarhus and Spørring, to partake in the green transition agenda. Thus, climate change has played a key role in supporting the collaboration in the project.

2. Legislation, programs, and formal goals

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☒ Medium confidence	☒ Documents
☐ 0.66	☐ High confidence	☐ Observations
☒ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

Several legislations, programs and formal goals were relevant for this project. First, the Danish Planning Act, a national legislation, was set to ensure “a coherent urban planning that unites different societal interests” in Danish urban planning (see the Danish Planning Act, link in the bottom of the document). This act provided a mandate to protect the environment and biodiversity in urban planning, as well as including the public “to the greatest possible extent” in local urban planning. On the local governmental level,

Aarhus municipality's climate action plan 2021-2024 provided the framework for the project, as the project was described to live up to particularly "IL-5" (industry and agriculture target 5 related to alternative energy sources to liquid gas) of this action plan. Both the climate action plan and the 2023 official political orientation points for Aarhus municipality's Technical and Environmental administration pointed to citizen involvement as an important pathway to achieve the green transition. For example, the Technical and Environmental administration's 2023 political orientation document emphasized the importance of not just including citizens in central Aarhus, but also citizens living in the countryside outside the city in developing a sustainable community. It thus provided a political mandate to specifically include these citizens in the municipality's planning decisions. The municipality's resources for citizen engagement have also increased since the 2022 municipal budget agreement, which increased the number of employees in the citizen engagement team from 2 to 6 employees. This shift entailed a strengthened mandate for citizen engagement in municipal planning processes, so that the citizen engagement department had more power in planning decisions than before. Moreover, Aarhus municipality's realm of understanding for citizen engagement, Aarhuskompasset, provided the municipality with an overall mandate to engage citizens in providing solutions to public problems such as climate change. All these legislations supported collaboration in the project by providing Aarhus municipality with a clear mandate, incentive and manpower to engage citizens and other nonstate actors in the development of green solutions.

3. Relative openness of public governance paradigms

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☐ Medium confidence	☒ Documents
☒ 0.66	☒ High confidence	☐ Observations
☐ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

There was a declared openness in Aarhus municipality regarding inputs from local citizens, as evidenced by the policy document "Aarhuskompasset." This document outlines the municipality's principles for citizen engagement and explicitly emphasizes the need to reevaluate New Public Management principles, supplementing them with strengthened citizen engagement. In the context of the Bånlev Biogas expansion, efforts were made to involve citizens through two public hearings and a corresponding formal citizen meeting in Spørring. Additionally, the municipality initiated informal plenum meetings and individual conversations with citizens to gather their input (refer to GF 4).

However, this apparent openness did not effectively support the collaborative process of the project, primarily due to a lack of clarity regarding the extent of citizens' influence on the project. Local citizens often found it unclear how much impact they could have on the municipality's decisions, leading to frustration and hindering collaborative dynamics between authorities and citizens. This situation highlights that the relative openness of the governance paradigm may have a counterproductive effect on collaborative dynamics when not supported by meaningful channels of participation or transparent processes. In cases like this, where non-state inputs are not clearly transformed into discernible outputs,

the governance paradigm's openness may not translate into effective collaboration. This underscores the importance of establishing clear and transparent mechanisms for citizen (or private sector) participation to ensure meaningful engagement and collaboration in governance processes, lest it trigger frustrations amongst non-state actors and deter them from participating as intended.

4. Formalized institutional channels for citizen participation and community mobilization

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☐ Medium confidence	☒ Documents
☒ 0.66	☒ High confidence	☐ Observations
☐ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

Within the context of Danish municipalities in general, there are several channels for citizen participation enshrined in the municipal law. For example, municipalities make use of user boards, participatory budgeting, town hall meetings, and so-called §17.4 special committees whereby local citizens can perform advisory functions for the municipality. All these institutional channels suggest that a panoply of mechanisms is at the disposal of the municipalities for mobilizing local communities and citizen inputs. The main formalized institutional channel for citizen participation in the project were two statutory public hearings in February 2021 and March-May 2023, where citizens had the opportunity to provide written inputs to the project. According to the Danish Planning Act, planning proposals such as the proposal for the biogas plant expansion should be sent into public hearings both at an early and a late stage of the proposal development process. During the first public hearing in February 2021, people had two weeks to provide early inputs to the proposal, while they had two months to provide final input to the proposal during the second public hearing, which lasted for two months from March to May 2023. A citizen meeting about the expansion of Bånlev Biogas was also arranged in April 2023, related to the second public hearing. Arranging such a meeting is not mandatory by law, but Aarhus municipality and Nature Energy agreed that it should be arranged. These channels shaped the project's collaborative process insofar as they have provided an arena for collaboration between the municipality and local citizens. However, the hearing process did not create a discernable improvement in the project's collaborative process, as citizens were frustrated with public hearings due to experiences of having limited influence through them.

5. Mechanism for ensuring top-down government and bottom-up social accountability

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☐ Medium confidence	☒ Documents
☐ 0.66	☒ High confidence	☐ Observations
☒ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

Many efforts were made in the project to communicate between the local community in Spørring, Nature Energy, and Aarhus municipality. This communication occurred regularly between different constellations of actors in the project, but rarely between all actors in the project. The operations manager at Bånlev Biogas communicated regularly to local Spørring citizens, and particularly the local citizen association, about the day-to-day operations of the biogas plant, even at times when there was not much new to say. When there was news about the operations of the biogas plant, the citizen association communicated them to the broader local community through the local newspaper and/or the local Facebook group. Aarhus municipality regularly contacted the local community about planning the local area through more formal and informal meetings. In the case of developments in the project that affected Spørring citizens, a message was sent out to these citizens via a digital mailbox for messages from Danish governmental organizations (e-Boks). The municipality was also in regular contact with Nature Energy about the necessary approval and assessments for the expansion of the biogas plant, such as environmental approvals, etc. All this communication back and forth supported the project's collaborative process significantly. For instance, local citizens highlight communication from the operations manager at Bånlev Biogas and Aarhus municipality as a key factor that improved their goodwill toward the project, because it made them feel taken seriously as important project stakeholders. For the citizens, it was important to communicate with the people in the municipality and at the biogas plant that had the mandate to make decisions, so that they could hear the reasoning for why particular decisions were made. Communication between Aarhus municipality and Nature Energy was also a key factor for the collaboration between the municipality and the biogas plant, as it helped build trust between these two actors.

6. Strategic agenda-setting by means of translation

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☒ Medium confidence	☒ Documents
☒ 0.66	☐ High confidence	☐ Observations
☐ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

From the perspective of Aarhus municipality, the project did not explicitly relate to the SDGs but to related climate goals such as the CO2 neutrality by 2030 goal outlined in their climate action plan. However, the SDGs played an important role for the operations manager at Bånlev Biogas, who used the SDGs actively to communicate their work with biogas production to local stakeholders such as for instance school pupils. In this communication, the SDGs were actively translated to fit local problems and projects initiated by Bånlev Biogas were related to how they contributed to the SDGs. However, the translation of the SDGs has not supported the project's collaborative process, as the SDGs did not seem to have played an important role in the project for other actors than the operations manager at Bånlev Biogas. Consequently, there seemed to be a gross overestimation in terms of the degree to which appealing to the SDGs could garner increased support for the project. Several informants declared that they were familiar with the SDGs and had a generally positive view of it, but none suggested that it had any discernible effects on the

collaborative process. In conclusion, the SDGs received significant attention from the project as part of its strategy to secure consensus and support, although it did not significantly improve the collaborative processes of the project.

7. Construction of narratives about successful multi-actor collaboration

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☐ Medium confidence	☒ Documents
☐ 0.66	☒ High confidence	☐ Observations
☒ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

As previously mentioned, Spørring citizens' previous experiences with collaborating with Aarhus municipality have predominantly been negative. This was based on a long-standing experience of not being considered in important decisions about their local area, and the experience of bureaucracy prohibiting citizen initiatives. For example, the establishment of a privately funded local sports arena, was in the end not implemented due to slow bureaucracy. Thus, Spørring citizens have previously largely perceived the municipality as not being interested in their inputs and views. However, this image has changed over the past 2-3 years, where Aarhus municipality has taken measures to improve the contact with Spørring citizens, which has not gone unnoticed. Several of our interviews show that positive learnings from previous negative collaborative experiences support collaboration in this project. For instance, Aarhus municipality and Nature Energy/Bånlev Biogas have invested more time and energy than before in strengthening the communication with Spørring citizens, which has increased the goodwill of citizens to collaborate with them.

8. Building or harnessing institutional platforms and arenas

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☐ Medium confidence	☒ Documents
☐ 0.66	☒ High confidence	☐ Observations
☒ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

On multiple occasions, the project made use of the local parish community house as a physical venue for meetings between Aarhus municipality and Spørring citizens. This supported the collaborative process, as it generated goodwill among Spørring citizens that the municipality visited their local area and reached out to them there. Moreover, the Spørring citizen association used digital platforms such as a website, a local newspaper, and a Facebook group for local citizens to disseminate information about the progression of the expansion of Bånlev Biogas. This also supported the collaborative process as it generated an increased level of trust in Aarhus Municipality and Nature Energy among citizens. The continuous

dissemination of information through these digital and physical platforms made the citizens feel more seen and heard in this collaborative process than in previous interactions with the municipality.

9. Provision of access to blended financing

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☒ Medium confidence	☐ Documents
☐ 0.66	☐ High confidence	☐ Observations
☒ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

The project had two funding sources for salaried working time that supported collaboration, including salaried working time for municipal citizen engagers from Aarhus municipality and salaried working time for the communications department of Nature Energy. The intention behind prioritizing salaried working time for citizen engagement and communication was from the perspective of Aarhus municipality and Nature Energy to increase the local support for the expansion of Bånlev Biogas through strengthened communication and transparency. The dedication of resources to citizen involvers was integral to the project's collaborative processes. Most importantly, the 'citizen involvers' ensured the inclusion of a broad range of local citizens in the project, as they were responsible for coordinating these citizen engagement meetings. Most importantly, they possess a repertoire of 'best practices' related to citizen engagement due to their specialized knowledge, which ensured a generally positive atmosphere. They were also tasked with the ongoing dialogue with the local citizens to ensure a sense of accountability among the local communities, which consequently increased the trust between participants.

10. The capacity to leverage support from authorities to enable local collaboration

QCA score:	Scoring confidence:	Data sources:
☒ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☐ Medium confidence	☐ Documents
☐ 0.66	☒ High confidence	☐ Observations
☐ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

The Danish Environmental Protection Agency was hired to conduct a part of the environmental approval for the Bånlev Biogas expansion, as it lied under their mandate. However, higher-level authorities were not contacted to solve challenges in this project altogether.

11. Inclusion and empowerment of relevant and affected actors

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☒ 0.33	☒ Medium confidence	☒ Documents
☐ 0.66	☐ High confidence	☐ Observations
☐ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

The participating citizens in the project were predominantly retired individuals from Spørring, actively involved in the local citizen association. Aarhus municipality implemented various measures to ensure outreach to all relevant and affected stakeholders in the project, including families with children—a demographic often challenging to engage in citizen participatory processes. As an example, the municipality reached out to a support association for Spørring children to seek their input.

Despite the municipality's efforts, the participation of families with children in the collaborative process of the project was limited, leading to a partial inclusion of relevant and affected actors. One informant highlighted their inability to attend meetings due to incompatible working schedules, driven by their responsibilities in caring for their children. They expressed a willingness to participate if the meetings were more accessible, suggesting that providing complementary childcare services on-site would enhance their ability to engage.

Other informants actively chose not to participate in the meetings, citing a lack of understanding of the meetings' purpose. They perceived these gatherings as informational rather than collaborative, raising questions about the genuineness of the call for citizen inputs. This suggests the presence of certain prejudices or preconceptions about the nature of these citizen meetings, potentially rooted in past negative experiences. These perceptions may have contributed to the belief that the solicitation of citizen inputs was either insincere or entirely absent. Addressing these preconceptions and ensuring clear communication about the collaborative nature of such meetings is crucial to fostering broader and more meaningful citizen engagement in future projects.

12. Clarification of interdependence vis-à-vis common problem and joint vision

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☒ 0.33	☒ Medium confidence	☒ Documents
☐ 0.66	☐ High confidence	☐ Observations
☐ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

It was clear for Aarhus municipality and Nature Energy that they depended on Spørring citizens, as they were aware of the Not In My Backyard (NIMBY) effect that could occur related to the expansion of Bånlev Biogas if citizens were not properly included in decisions about it. It is estimated that the NIMBY effect has

contributed to the cancellation of several planned biogas plant constructions in Denmark[1]. Spørring citizens also depended on Aarhus municipality to be able to influence the planning process of the biogas plant expansion, and on Nature Energy to gain information about the day-to-day operations of the plant. While this interdependence was recognized by most of our interview participants, no measures were taken by the project facilitators to display how the different participants in the project could contribute to the common goal of the project. Specifically, there was a lack of clarity related to the extent and scope of local citizens' contributions to the project.

13. Trust-building and conflict mediation

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☐ Medium confidence	☒ Documents
☒ 0.66	☒ High confidence	☐ Observations
☐ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

Systematic measures to build trust and mitigate conflicts were taken by both Aarhus municipality and Nature Energy. For instance, the operations manager at Bånlev Biogas was continuously available to respond to calls from citizens, regularly visits citizens at their home to respond to their questions and concerns, and regularly informs the citizen association about the progress of the project. This contributed to building a high level of trust between Nature Energy and local citizens and prevented conflicts that might occur due to poor information about the operations in and decisions made about Bånlev Biogas. Representatives from Aarhus municipality also regularly visited Spørring citizens in their local area, contacted the citizens for input, and would happily respond to a call or drive out to a meeting upon request. One municipal representative stated that Aarhus municipality's "account was overdrawn" when they went to Spørring due to suboptimal past collaboration between the municipality and local citizens. According to a broad range of our interviewees, the increased outreach from Aarhus municipality strengthened citizens' trust in them and prevented conflicts. However, the fact that Spørring citizens rarely got to speak with the person(s) making the final decisions about the biogas plant expansion led to a certain level of distrust in the municipal representatives among citizens, as citizens did not know whether their inputs to the expansion would have an impact on final decisions.

14. Use of experimental tools for innovation

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☒ 0.33	☐ Medium confidence	☐ Documents
☐ 0.66	☒ High confidence	☐ Observations
☐ 1		

[1] https://www.dr.dk/nyheder/indland/danskere-frygter-stank-fra-biogasanlaeg-benthe-vil-have-groen-energi-bare-ikke-i

Please elaborate on the reasoning behind your scoring for this governance factor:

The project used posters and visualizations of the proposed biogas plant expansion on several occasions. Such visualizations provided a point of departure for the first municipal public hearing about the project in 2021. Moreover, at the Spørring town fair in June 2023, Nature Energy and Bånlev Biogas had a stand where the operations manager of Bånlev Biogas and a communications officer from Nature Energy used prototypes such as posters with maps and visualizations of the biogas plant expansion. The purpose of this was to inform citizens about the forthcoming biogas plant expansion and invite them to ask questions about the expansion. While these prototypes were used as a point of departure for discussions between Aarhus municipality, Nature Energy and Spørring citizens, and contributed to solicit inputs from local citizens, the gathered inputs were not used systematically in the process of designing the final biogas plant expansion.

15. Ongoing critical self-reflection and learning (i.e., process and/or developmental evaluation):

QCA score:	Scoring confidence:	Data sources:
☒ 0	☐ Low confidence	☒ Interviews
☐ 0.33	☐ Medium confidence	☒ Documents
☐ 0.66	☒ High confidence	☐ Observations
☐ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

The project facilitators have continuously discussed the learnings from the project. However, no formal evaluations have been made during the project's lifespan.

16. Exercise of facilitative leadership:

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Interviews
☒ 0.33	☐ Medium confidence	☒ Documents
☐ 0.66	☒ High confidence	☐ Observations
☐ 1		

Please elaborate on the reasoning behind your scoring for this governance factor:

The formal leadership of the project lied with Aarhus municipality's Technical and Environmental Authority, which is led by an elected member of the city council. Several sub-units under the Technical and Environmental administration were involved, including the planning department, the citizen engagement department and the climate department. Formally, the project was led by a planning department manager in charge of environmental impact assessments and renewable energy. However, most of our interviewees could not name this leader as the leader of the project. Rather, they named one or more of the representatives from the planning department, the citizen engagement department and/or the climate department that was most frequently in contact with Spørring citizens. In this sense, there was a distributed leadership in the project. However, the absence of a steering committee in Aarhus municipality

for the overall holistic land use project in Spørring led to confusion about who had the mandate to come to a decision in cases where there were conflictual wishes between the planning, citizen engagement and climate departments. This confusion trickled down to the local citizens who, whenever they provided input to a municipal representative, became unsure of whether the person they talked to would have the mandate to make decisions. It also hampered the project from setting a holistic direction for the project that included both planning, environmental, climate, and citizen engagement concerns. Consequently, the project's final decision-making was made by the planning department, which followed a statutory planning process. Broadly evaluated, the Technical and Environmental Authorities intended to act in the capacity as facilitative leaders in principle, although these efforts were controverted in practice by the role ambiguity (lack of role division and jurisdictional clarity) within the project. This role ambiguity also resulted in a general diffusion of leadership, as there was no outward representative (from the perspective of the local citizens) leader of the project.

Outcome variable: Successfully co-created green transitions

The outcome variable 'co-created green transitions' will be scored in two parts. First, 'co-creation' will be scored based on an assessment of whether the participants in the initiative, project or process engaged in collaborative problem-solving that fostered creative ideas and innovative solutions (data will consist of survey data combined with interviews and documents). Next, 'green transitions' will be scored based on an assessment of whether the initiative, project or process has fulfilled or is expected to fulfill its green goals, ambitions and aspirations (data will consist of survey data combined with interviews and internal and/or external evaluation reports, including scientific publications).

The scoring of this variable is done in two parts:

1. *Is the developed solution based on collaborative problem-solving spurring creativity and innovative solutions?*
2. *Does the developed solution engender a green transition?*

This scoring should be conducted based on both the survey and complementary green outcome evaluations. Please consult Sections 4.4 and 6.10 in the Research Protocol for more details.

1. Is the developed solution co-created?

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Survey
☐ 0.33	☒ Medium confidence	☒ Interviews
☐ 0.66	☐ High confidence	☒ Documents
☒ 1		☐ Observations

Please elaborate on the reasoning behind your scoring for this part of the governance factor, including the data sources used for the scoring.

The mean for most of the relevant survey items for collaboration (1, 6, & 9) are positive, whereas the mean for one of them (12) is negative. This indicates that the expansion of Bånlev Biogas was largely developed in collaboration between the involved actors. The district plan for the biogas plant expansion indicates some joint decision-making, as it recommends that the municipal guidelines for planting are changed, so that the municipality can accommodate local citizens' wish to construct a tall plant belt around the expanded biogas plant that will conceal parts of it visually. The mean of two out of three survey items relevant for collaborative creativity are positive (1 & 6), whereas one is slightly negative (12). This indicates that the developed solution is creative and breaks with conventional solutions. The mean of most survey items related to innovation is positive (2, 3, 4, 5, 7, 8, 10), although one is slightly negative (11). This shows that the expanded biogas solution is largely perceived as innovative by our survey respondents. These results are backed up by our interviewees from Nature Energy, who emphasized the technical innovation of the expanded biogas plant, as the expansion will eliminate most of the plant's current odor emission and almost triple the handling capacity of the biogas plant (see green transition scoring below).

If possible, please insert your survey responses in the table below (in % for each response), including the mean/average % for each survey item.

	Strong. dis.	Dis.	Slight. dis.	Neither agr/dis	Slight. agree	Agree	Strong. agree	Don't know	Mean
1. Problem-solving mobilized different experiences, and/or ideas and/or forms of knowledge to develop new perspectives	0 %	0 %	0 %	14,3 %	14,3 %	42,9 %	14,3 %	14,3 %	1,66
2. Through the collaborative problem-solving process, different experiences and/or ideas and/or forms of knowledge have been mobilized to search for unconventional solutions	0 %	0 %	14,3 %	14,3 %	14,3 %	28,6 %	14,3 %	14,3 %	1,16
3. The collaborative problem-solving process mobilized different experiences, and/or ideas and/or forms of knowledge to search for solutions that go beyond standard/text-book solutions	0 %	14,3 %	0 %	14,3 %	28,6 %	14,3 %	0 %	28,6 %	0,4
4. The co-created solution breaks with established practices	0 %	14,3 %	14,3 %	14,3 %	28,6 %	0 %	14,3 %	14,3 %	0,33

5. The co-created solution disrupts conventional wisdom	0 %	14,3 %	0 %	14,3 %	28,6 %	0 %	14,3 %	28,6 %	0,6
6. The co-created solution offers new ideas to address the green transition problem	0 %	14,3 %	0 %	14,3 %	14,3 %	14,3 %	28,6 %	14,3 %	1,16
7. I'm supportive of the co-created solution	0 %	0 %	0 %	0 %	0 %	42,9 %	57,1 %	0 %	2,57
8. I'm content with the overall collaborative process of the project	0 %	0 %	0 %	14,3 %	28,6 %	42,9 %	0 %	14,3 %	1,33
9. I feel the multi-actor collaboration process was a prerequisite for the success of the project	0 %	14,3 %	0 %	0 %	0 %	28,6 %	57,1 %	0 %	2
10. I'm satisfied by the results of the co-creation effort in terms of expected impact on the welfare of the community	0 %	0 %	0 %	14,3 %	14,3 %	28,6 %	14,3 %	28,6 %	1,6
11. The collaborative interaction in the project has led to an innovative solution	0 %	14,3 %	14,3 %	42,9 %	14,3 %	0 %	0 %	14,3 %	-0,33
12. The actors involved in the project are engaged in collaborative interaction that stimulated creative problem-solving	0 %	14,3 %	14,3 %	42,9 %	0 %	14,3 %	0 %	14,3 %	-0,16
13. The co-created solution meets the proposed goals of the project	0 %	0 %	0 %	0 %	14,3 %	42,9 %	28,6 %	0 %	2,16
14. The co-created solution will be durable and robust in the long run	0 %	0 %	0 %	0 %	0 %	57,1 %	28,6 %	14,3 %	2,33
15. The co-created solution is expected to significantly improve sustainability for the whole community	0 %	0 %	0 %	14,3 %	57,1 %	0 %	0 %	28,6 %	0,8

2. Does the developed solution engender a green transition[2]?

QCA score:	Scoring confidence:	Data sources:
☐ 0	☐ Low confidence	☒ Survey
☐ 0.33	☐ Medium confidence	☒ Interviews
☐ 0.66	☒ High confidence	☒ Documents
☒ 1		☐ Observations

Please elaborate on the reasoning behind your scoring for this part of the governance factor, including the data sources used for the scoring:

Estimates conducted by Nature Energy and Aarhus municipality state that the expansion of Bånlev Biogas allows the biogas plant to increase its production of biogas from 7 million cubic metres of biogas to 20 million cubic metres of biogas annually. It will make the plant able to handle 700.000 tons of biomass annually compared to its previous handling capacity of 185.000 tons of biomass annually, which increases the plant's biomass handling capacity with around 180 %. These estimates are stated in the final district plan for the biogas plant (Lokalplan 1184) and an interview with the operations manager at Bånlev Biogas.

If possible, please insert your survey responses in the table below (in % for each response).

1. The project:	Yes	No	Don't know
…did not produce any green transition solution	71 %	14 %	14 %
…is expected to produce/has produced a green transition solution aiming to avoid a worsening in the status quo	71 %	14 %	14 %
…is expected to produce/has produced a green transition solution aiming to maintain the status quo	14 %	43 %	43 %
…is expected to produce/has produced a green transition solution aiming to improve the status quo	71 %	0 %	29 %

Please list all the informants you have interviewed for the case study (list project role + interview date):

Project facilitator (development consultant 1 in Aarhus municipality's climate department), 24.05.2023
Project facilitator (development consultant 2 in Aarhus municipality's climate department), 25.05.2023
Project facilitator (citizen engagement officer in Aarhus municipality's citizen engagement department), 12.06.2023
Project facilitator (city planner in Aarhus municipality's planning department), 31.08.2023

[2] By "green transitions", we mean objectives and aspirations that correspond to at least one of the Green SDGs (SDG 6, 7, 11, 12, 13, 14, 15). The project does not have to refer explicitly to the green SDGs, but the project's green objectives

Project participant (middle manager in Nature Energy), 26.09.2023
Project participant (citizen and chairperson of Spørring citizen association), 19.09.2023
Project participant (operations manager at Bånlev Biogas), 10.10.2023
Project participant (citizen 1), 06.11.2023
Project participant (citizen 2), 18.12.2023
Project participant (citizen 3), 22.12.2023
Project owner (administrative manager in Aarhus municipality), 11.01.2024

Please list all the observations you have made (type of meeting/workshop/etc. + observation date):

Unfortunately, we were not able to conduct any observations of this project.

Please list all the documents you have analyzed (document name + source + year):

Publicly available documents:
Aarhus municipality's climate action plan 2021-2024: https://endelafloesningen.aarhus.dk/media/5jnlckap/klimahandlingsplan-2021-2024.pdf
Political orientation points for Aarhus municipality's Technical and Environmental administration: https://aarhus.dk/media/c0mdazi2/pejlemaerker-for-teknik-og-miljoe-2023.pdf
The Danish Planning Act: https://www.retsinformation.dk/eli/lta/2020/1157
Aarhus municipality budget agreement 2022-2027: https://aarhus.dk/media/sy4prxpn/endelig-budgetaftale-2024-dato-22-09-2023.pdf
Description of Aarhus municipality's mode of governance: https://aarhus.dk/demokrati/politik/byraadet/saadan-styres-aarhus/saadan-styres-aarhus/#magistratsstyre-88
Public hearing about the expansion of Bånlev Biogas, February 2021 (hearing introduction and responses): https://deltag.aarhus.dk/node/254/ticket/3682
Public hearing about the expansion of Bånlev Biogas, March-May 2023 (hearing introduction and responses): https://deltag.aarhus.dk/hoering/forslag-til-lokalplan-nr-1184-udvidelse-af-baanlev-biogas-trige
Final district plan about the expansion of Bånlev Biogas (Lokalplan 1184): https://dokument.plandata.dk/20_11238553_1701176168514.pdf
Aarhuskompasset: Aarhus municipality's realm of understanding for citizen engagement: https://aarhus.dk/demokrati/planer-og-politikker/medborgerskab-frivillighed-og-samskabelse/aarhuskompasset
Website for the village of Spørring: https://xn--sprring-by-1cb.dk/

Internal documents shared by the project facilitators:
Project memorandum, September 2022
Presentation for citizen meeting about the expansion of Bånlev Biogas, April 2023

Please note the response rate for the survey/measurement of outcome variable:

77 % (7 out of 11 possible respondents)