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Social Acceptance of a Multi-Purpose Reservoir in a Recently Deglaciated Landscape in the Swiss Alps

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Abstract: Climate change impacts such as shrinking glaciers and decreasing snow cover are expected to cause changes in the water balance throughout the 21st century. New proglacial lakes in recently deglaciated areas could be used for mitigation measures such as hydropower production and adaptation measures to temporarily retain water and transfer it seasonally to compensate for seasonal water scarcity. Such multi-purpose reservoirs could counterbalance the water currently provided by glaciers and the seasonal snowpack. However, new dam projects often face various conflicts due to their impact on nature, biodiversity, and the landscape. This article presents the determinants for social acceptance of the first reservoir in a recently deglaciated landscape in the Swiss Alps. Three main determinants were identified: (1) the forthcoming popular vote on the national Swiss Energy Strategy 2050; (2) the participatory process, which contains a polycentric design; and (3) the project area, which does not yet have protected status. The three determinants facilitate social acceptance of the dam project, but lead to less attention on using the stored water for multiple services. These findings have implications on sustainable development, because dams in recently deglaciated areas support the transition to renewable energy sources, but transform a natural resource system into a hydroelectric landscape.

Keywords: social acceptance; polycentric governance; multi-purpose reservoir; renewable energy; hydropower; deglaciated landscape; water; climate change; Trift; Switzerland

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1. Introduction

Climate change has impacts on the alpine cryosphere, hydrosphere, and biosphere [1–3]. These impacts call for mitigation through renewable energy production such as hydropower and for adaptation to the occurrence of regional water scarcity. One potential strategy to jointly address mitigation and adaptation challenges is the use of multi-purpose water reservoirs, which should be operated for multiple services [4–7]. However, new dam projects often face various conflicts due to their impact on nature, biodiversity, and the landscape [8,9]. These conflicts will intensify in the future because most of the potential sites for dams are already built up, and it is necessary to penetrate into areas that deserve protection, such as recently deglaciated high mountain areas [10,11].

This paper demonstrates the determinants of social acceptance of a dam project in a European landscape that deserves protection. To this end, a case study research design of the first dam project using a proglacial lake in a recently deglaciated high-mountain area in the Swiss Alps was used. This area is in front of the retreating Trift glacier, canton of Bern, Switzerland.

Analytically, the concept of social acceptance was used [12–18]. The concept conceives social acceptance as the interdependence of the three different dimensions of socio-political, community, and market acceptance [12]. Social acceptance was analyzed by dividing the process of the dam project into nine stages according to steps of (in)formal decision-making that address the object of interest, the relevant actors, and their roles [15]. This allows for an analysis of the determinants and processes that influence social acceptance in each stage, between the stages, and beyond the project. After an overview of all the stages, the analysis focuses on the stage of the participatory process.

In the context of global energy transition from non-renewable to renewable energy sources, there has been widespread documentation of social acceptance of renewable energy projects [19] such as wind [20–23], biomass [24,25], and solar energy [26–28]. Surprisingly, the literature has poorly documented research on social acceptance of hydropower projects, particularly in economically developed countries [13,29]. The case studies are often of small hydropower projects in developing countries [30–36]. Similar to the results regarding social acceptance of other renewable energies, these studies demonstrate that a participatory approach positively correlates with social acceptance. Results from choice experiments in Switzerland [13], Sweden [37], and Austria [38] indicate that the ecological impacts of the hydropower plant are the most important determinants of social acceptance. Local ownership of the hydropower company is important to Swiss residents [13,39]. However, there is limited systematic evidence through a case study approach for dam projects in Switzerland. There is no literature on social acceptance of dams for multi-purpose uses or in recently deglaciated areas.

Switzerland has a strong expansion of hydropower that is responsible for 59.6% of its electricity production [40]. The new national Swiss Energy Strategy 2050 has the goal of expanding hydropower by 10% up to 2050 with respect to 2010. The national strategy for adaptation to climate change considers measures to use water reservoirs for multiple services. Therefore, an expansion of water reservoirs is likely. However, dam projects often lead to conflicts and stalemates [41,42], because the watercourse habitat is one of the most severely affected habitats in Switzerland [43,44]. Therefore, it is surprising that the Trift project in a valuable deglaciated landscape is accepted by most of the actors. However, it was only accepted for hydropower and not for multiple services. The main aim of this paper is to understand the emergence of social acceptance in this case study. The paper has a particular interest in the dynamics between several levels of decision-making and intertwined policy areas. This article is guided by the following research question: which determinants and processes influence social acceptance of a multi-purpose reservoir in a recently deglaciated landscape?

This study demonstrates that three determinants facilitate social acceptance of the dam project, but lead to less attention to use the stored water for multiple services. The determinants are as follows: (1) the forthcoming popular vote on the national Swiss Energy Strategy 2050; (2) the performed participatory process, which has a polycentric design; and (3) the project area, which does not yet have protected status.

The remainder of this article is structured as follows. The next section (Section 2) provides a review about how social acceptance has been conceptualized in previous research. Then, the paper introduces the methodologies used (Section 3), followed by a contextual overview of the case study (Section 4). The section on results presents key findings (Section 5), followed by a discussion of these findings (Section 6). The conclusion discusses the results' wider implications for sustainable development.

2. Social Acceptance

Social acceptance of renewable energy is studied in different conceptualizations and backgrounds. A highly cited theoretical framework has proposed social acceptance through a three-dimensional approach [12]. The first dimension is socio-political acceptance. This refers to the acceptance of technologies and policies by the public, key stakeholders, and policy makers. Second, community acceptance focuses on responses to the siting of the new infrastructure from local stakeholders, particularly residents and local authorities. Community acceptance is influenced by procedural justice, distributional justice, and trust. Third, market acceptance refers to economic aspects. This is the process of the market adoption of an innovation involving consumers (demand side) and investors (supply side).

Other perspectives of social acceptance have been studied to understand the response of actors to renewable energy infrastructures. The study of Fast [45] analyzed the existence of geographical factors including place, landscape, and distance decay. The author has suggested that geographical concepts should be considered to understand actors' responses to alternative energy technologies. The environmental impacts of a project are also key influencers of social acceptance [8,9]. Other studies have demonstrated that the ownership of the electric company is an important factor [13,39,46,47]. People are more likely to prefer local ownership over foreign investors. This might be because respondents to surveys implicitly assume that "foreign investors are more likely to 'take the money and run' than locally-embedded organizations" [13], which is an issue of distributional justice. Dermont et al. [15] presented a political science perspective, and argued that the responses of actors depend on specific elements of policymaking such as (i) actors' roles (e.g., decisionmaker, target, sovereign), (ii) timing (e.g., proposal, final decision at the ballot), or (iii) the institutional room of maneuver accorded to the actors (e.g., direct democracy, lobbying). The study's examples demonstrate that different actors with different roles are relevant at each stage of a project and should be analyzed separately.

Some authors have argued for going beyond sets of actor positions and viewing social acceptance as a bundle of processes that are complex, mutually influencing, multi-level, and polycentric [17,48,49]. For example, social acceptance is influenced by the design of a project process such as procedural justice [13,50]. This includes the processes related to the inclusion and exclusion of actors and the starting time. It is also important to ensure that actors in a process have the room to build trust over time [51–53]. Furthermore, there must also be trust in responsible actors such as the hydropower company that must implement the negotiated compensatory measures [54] or the actors who are responsible for (risky) technologies, as these actors influence the citizens' perceptions of the risks [55]. There must also be trust among actors with different perspectives. Trust is a precondition for successful negotiations in a participatory process and for the effective coordination of resource claims, especially whenever rules are not yet formalized [51]. Consequently, processes, actors, their roles, and (in)formal decision-making should be integrated in studies on social acceptance [15]. Furthermore, it is important to consider the interdependence between the three dimensions of social acceptance as they play out within and between several levels of decision-making and intertwined policy areas [16]. Such approaches would cover all dimensions, different actors, multiple levels, and thus polycentric processes. This paper contributes by specifying the approaches to social acceptance of a dam project in a recently deglaciated landscape in the European Alps that deserves protection.

3. Methods

3.1. Case Study Methods

The complexity of social acceptance at the project level can be best grasped through a case study. The greater the complexity and contextualization of the research subjects, the more appropriate it is to use a case study approach [56]. This paper chose an exemplary case study where the mechanisms of social acceptance of a dam project are easily identifiable (Yin, 2018). The empirical work is based on the author's fieldwork between 2017 and the beginning of 2019. The data collection included 24 semi-structured face-to-face interviews carried out with major actors who represented the hydropower company, the associations involved, and the public authorities on different levels (Appendix A). These expert interviews provided in-depth information on determinants and processes of social acceptance. The data collection also involved document analysis of legal material (such as laws, regulations, concessions, national, cantonal and regional strategies) and review of gray literature on the case (including administrative and NGOs reports, newspaper articles); excursions in the region; and participatory observation of meetings. Data analysis followed the principles of qualitative content analysis [57] and process tracing [58].

3.2. Analytical Approach

A deductive approach was taken to the concepts of social acceptance that were described in Section 2. The first tier and the associated second-tier variables of social acceptance correspond to the three dimensions of social acceptance [12], the geographical concept [45], the factors of environmental impacts [59], the ownership of the hydropower company [13,46,47], and the polycentric approach [17,48]. According to Devine-Wright et al. [16], the concept of community acceptance [12] was extended to societal and community acceptance to indicate the full gamut of societal beliefs and responses to the process of the Trift project. Other variables were the relevant actors [15], the interrelations between several levels of decision-making and intertwined policy areas [16], and indications for the different stages of the process and for the multi-purpose use of the reservoir. The variables structured the coding scheme for data analysis (Table 1).

Table 1. Coding scheme: first-tier and second-tier variables.

Actors (A)	Environmental impacts (EI)
A1 Relevant actors	EI1 Environmental impacts
Stages of the process (S)	EI2 Compensatory measurements
S1 Indications for the process stages	EI3 Protection status
Socio-political acceptance (SPA)	Ownership of the hydropower company (OS)
SPA1 Socio-political acceptance	OS1 Ownership
Market acceptance (MA)	Multi-purpose reservoir (MR)
MA1 Market acceptance	MR1 Indications for multi-purpose uses
Societal and community acceptance (SCA)	Polycentric approach (PA)
SCA1 Procedural justice	PA1 Polycentric processes
SCA2 Distributional justice	Interrelations (I)
SCA3 Trust building	I1 Interrelations with other stages
Geographical concepts (GC)	I2 Interrelations with other processes
GC1 Place	
GC2 Landscape	
GC3 Distance decay	

First, the different stages of the Trift project were clarified with their objects of acceptance, relevant actors, related dimensions of social acceptance, and processes at other stages and levels. Subsequently, a focus was placed on the participatory process, which is a typical and very important stage in a renewable energy infrastructure project. This stage was deeply analyzed to identify which determinants and processes influenced the actors to accept the Trift project and to determine interrelations with other stages of the project and with processes beyond the Trift project. Furthermore, the main arguments from the objection against the project [60] were evaluated.

4. Case Study

4.1. The Mitigation Lens

The case study is located in the alpine region of Oberhasli, in the canton of Bern, Switzerland. As a consequence of the Fukushima nuclear accident, the Swiss Federal Council has been working since 2011 to develop a new energy strategy. The Swiss Energy Strategy 2050 targets in its Energy Act the phasing out of nuclear power reactors at the end of their service life to reduce energy consumption, reduce CO_2 emissions, and increase renewable energy production [61]. Hydropower should grow by 10% with respect to 2010 (Figure 1), which is the maximum potential for Switzerland [62]. Ten percent may seem small, but existing hydropower plants must comply with higher residual water volumes when they need a renewed concession. Furthermore, environmental laws and the economic situation of the energy market generally make conditions more difficult [63]. The goal of hydropower expansion should be achieved by supporting power plant operators with market premiums, subsidies, and the status of national interest. The Swiss Energy Strategy 2050 was approved through several stages by votes in parliament and was adopted in 2017 by a public vote.

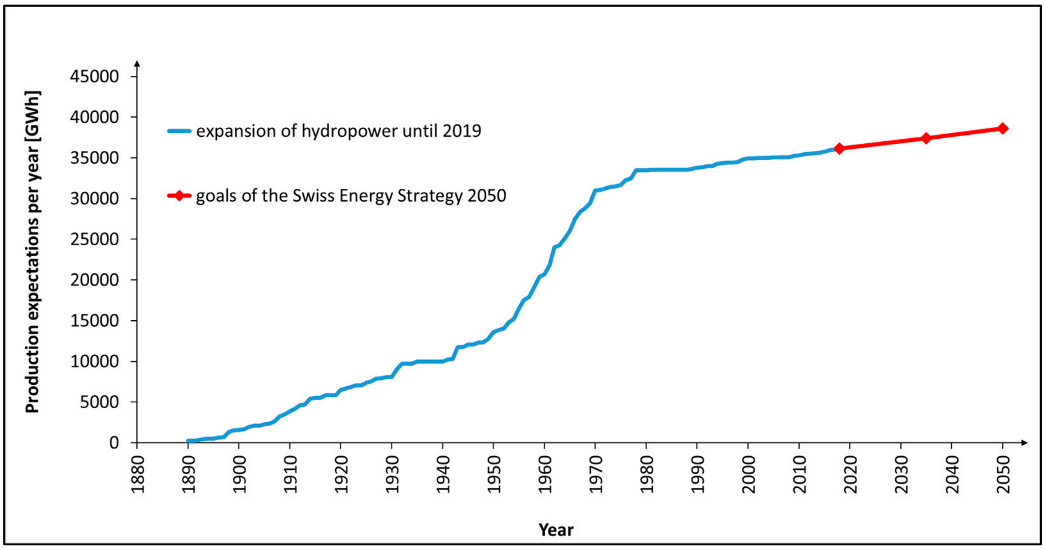

Figure 1. The expansion of hydropower in Switzerland until 2019 and the goals of the Swiss Energy Strategy 2050 (source: own diagram based on [64]).

The Swiss population has a fundamentally positive attitude toward the expansion of renewable energies [19], and environmental non-governmental organizations (NGOs) promoted the new Swiss Energy Strategy 2050 [65]. However, this does not mean that there is significant acceptance of concrete plants for the production of renewable energy at the local level. In fact, the construction of hydropower plants or wind farms often face strong opposition [23,42,66]. Some of these projects have already been stopped or are facing contestation. However, in 2013, the Swiss Federal Office of Energy mentioned that "the assessment of the Swiss Energy Strategy 2050 as a whole is positive regarding the part of energy policy, technical, landscape, and environmental protection organizations" [67].

Toward the end of the 19th century, the expansion of hydroelectric production began with the possibility of transporting electricity over longer distances (Figure 1). The construction of dams began a few years later. The Second World War and the subsequent boom in demand for electricity triggered a major expansion in the use of hydroelectric power. In this phase, which took place between 1910–1970, the annual growth rate in the installed capacity and production expectations for hydropower was around 5%. This coincided with the sharp increase in electricity demand in Switzerland. The focus of the expansion was between 1950–1970. Since 1970, production has increased further by 20%, but the annual growth rate in output and production has flattened out from 5% to 1.5%. On one hand, most of the favorable locations were developed. On the other hand, the first nuclear power plants were put into operation, thereby supplementing Switzerland's electricity production, which until then had been almost exclusively based on hydropower. Since the turn of the millennium, the overall net increase has been almost zero. Although individual plants have been renovated or expanded, and subsidized small hydropower plants were built, these changes are hardly reflected in the statistics, not least because of the simultaneous production losses due to residual water remediation [68].

Today, hydropower is the main electricity source in Switzerland. It accounts for 59.6% of electricity production, of which more than 50% originates from storage or pumped storage hydropower plants [40]. Hydropower currently accounts for almost the entire share (96%) of renewable electricity production [69]. In Switzerland, the cantons are the legal owner of the water and are responsible for the enforcement of legislation. Cantonal authorities are in charge of all matters concerning the attribution or renewal of hydroelectric concessions. Therefore, the hydropower companies have to submit a draft of a concession to the canton, and the Great Council can grant a hydroelectric concession after an assessment of the draft's legal conformity.

4.2. The Adaptation Lens

Glacier and snow are two forms of natural water storage that are expected to decline due to climate change [1,4,70,71]. New lakes are likely to form in front of retreating glaciers [10,72]. These changes cause a shift in the seasonality of Alpine runoff regimes, and there is related increasing variability in water availability and regional water scarcity [73–75]. This situation poses new challenges for water management [76]. Agriculture, hydropower production, and tourism directly depend on alpine headwater catchments and need to adapt to changes in water availability [1]. It has been demonstrated that reservoirs will become more important for water security [77] because they can reduce deficit volumes in the dry season [78].

The national strategy for Adaptation to Climate Change in Switzerland considers measures to use water reservoirs for multiple services [79,80]. As a result, the Swiss Federal Office for the Environment (FOEN) supports projects to examine the potential for multi-purpose reservoirs to reduce summer water scarcity in Switzerland [81]. Possible uses for these reservoirs include irrigation, livestock feeding, drinking and industry water supply, tourism, ecology, and thermal cooling [4]. Switzerland has limited experience with water reservoirs, which are commonly used in other countries [7,82–85]. However, this situation may change due to climate change. The new proglacial lakes in the European Alps could be used for multi-purpose reservoirs [10,72]. The Trift project is the first dam project in a recently deglaciated area in Switzerland that would transform the proglacial lake into an artificial reservoir.

4.3. The Trift Project

The Trift project is located in the region of Oberhasli in the Bernese Oberland, Switzerland, where a complex system of power plants has been built over the years by Kraftwerke Oberhasli AG (KWO), which is the local hydropower company. In total, 195 million m^3 of water is stored in eight reservoirs (one of which is a natural lake). The retreat of the Trift glacier, which was caused by climate change, uncovered a depression in the terrain. A proglacial lake formed in this depression. This lake is situated in basement rocks that are made up of the gneisses and granites of the Erstfeld gneiss unit. These rocks strike in direction that is oblique to the direction of the main valley. The bedrock is heavily fractured, which facilitates ice sculpting. The lake sits on an over-deepened trough that was sculpted by the Trift glacier. KWO has developed a project that includes a reservoir at the site of the proglacial lake at an altitude of 1767 m above sea level and a power plant in the lower Trift (Figure 2). The reservoir would have a volume of 85 million m^3, a capacity of 80 megawatts, and an annual energy output of 145 gigawatt hours. The yearly inflow would be twice the volume of the planned reservoir.

In 2009, a hanging bridge was installed across a deep gorge above the lake to enable access to a mountain hut. Before the retreat of the glacier, the hut could be reached by crossing the glacier surface. The hanging bridge and the new lake with a view of the retreating glacier have become tourist attractions. An early warning system has been installed to protect people against possible flood waves that are triggered by ice or rock avalanches into the lake. Further glacier shrinkage and continued growth of the proglacial delta are likely to decrease this hazard soon. However, "hazards from destabilizing lateral valley walls as a result of glacial debuttressing will continue to exist for extended time periods into the future" [86].

Figure 2. Planned hydropower dam at Trift glacier, Swiss Alps, with the glacier existing in 1948 (left), the proglacial lake existing in 2008 (middle), and with a full reservoir (right) (Source: Kraftwerke Oberhasli AG).

From 2008 to 2011, scientific actors have elaborated feasibility studies for the hydropower dam at Lake Trift as part of the large Swiss National Research Programme 61, titled 'Sustainable water management' [87]. Based on the results, KWO decided to drive forward the project at this location. Later, the canton of Bern initiated a feasibility study to determine the flooding-related and drought-related possibilities and limits of managing the Trift reservoir as a multi-purpose reservoir [88].

Hydropower projects across Switzerland have led to intense conflicts and project stalemates. Based on these experiences, a number of Swiss NGOs and hydropower companies tested new processes with a participatory approach. The canton of Bern and KWO learned from these approaches and experimented with the same approach in another hydropower project in the region, which was called KWOplus [89]. The success of this process and the results of the feasibility studies led the canton and KWO to start a participatory process to develop a draft of a concession and prevent objections. Participants of the process, which lasted from 2012 to 2017, were actors from KWO, the cantonal administration, affected municipalities, and NGOs that could file an objection to a granted concession. After initial participation, one NGO decided to withdraw from the process and partnered with a local grassroots organization to file an objection when the draft of the concession was submitted to the canton in 2017 [60]. At the beginning of 2019, which is when this research was being finalized, the concession's legal conformity was being assessed by the administration.

5. Results

This section covers the key results of the analysis. Section 5.1 describes the nine process stages of the Trift project, which are distinguished from the analysis. The following Section 5.2 focuses on the determinants and processes that influences social acceptance in the stage of the participatory process.

5.1. Social Acceptance in Different Stages of the Trift Project

Nine process stages were extracted from the analysis of the interviews and documents (Table 2). Each phase is divided into (1) the object, which means *what* is to be accepted concretely; (2) the relevant actors, which means *who* is to accept the object; (3) the dimensions of social acceptance; and (4) interrelations, which means the influential contextual factors from other stages and processes beyond the Trift project. At the beginning of 2019, the process was in Stage 6.

Table 2. Stages of the Trift project from initial project idea to final permits and their related dimensions of acceptance (adapted from [15]). KWO: Kraftwerke Oberhasli AG, NGO: non-governmental organization.

	Stage	Object of Acceptance	Relevant Actors	Dimension of Social Acceptance	Interrelations
1	Launch a project	Launch of the project	Hydropower Company KWO	Market acceptance; Socio-political acceptance of energy policies at international and national level	European and Swiss energy market
2	Choosing a site for a project	Site of the project	Hydropower Company KWO	Not a question of acceptance. Natural conditions led to a potential side.	Public policies about nature conservation; Protected areas in the intended territory; Climate change
3	Feasibility studies "hydropower"	Feasibility studies	Scientists; Hydropower Company KWO; Engineering offices	Not a question of acceptance. Natural conditions led to a potential project.	
4	Feasibility study "multi-purpose"	Multi-purpose use of the Trift reservoir	Cantonal administration of Bern;	Socio-political acceptance of energy and water policies at national and cantonal levels	
5	Participatory process	Collectively negotiated draft of a concession	Hydropower Company KWO; Municipalities; Cantonal administration of Bern; NGOs with veto power	Socio-political acceptance of energy, water and environmental policies at international, national, and cantonal levels; Market acceptance; Societal and community acceptance of the Trift project	Forthcoming vote on the Swiss Energy Strategy 2050; Selected site of the project in Stage 2; Results of the feasibility studies in Stage 3; Experience with other hydropower projects; Funding instrument for electricity from renewable energy sources
6	Administrative process	Recommendation to the Great Council	National administration; Cantonal administration of Bern; State Council	Not a question of acceptance. The concession is proofed for legal conformity.	Commitment to the participatory process in Stage 5

Table 2. *Cont.*

	Stage	Object of Acceptance	Relevant Actors	Dimension of Social Acceptance	Interrelations
7	Vote on the concession	Granting a concession	Great Council of the canton of Bern	Socio-political acceptance of energy, water and environmental policies at international, national, and cantonal levels; Market acceptance	Result of the administrative process with the recommendation in stage 6; Participating actors and the result of the participatory process in Stage 5
8	Permit	Trift project	Local authorities; People affected; NGOs with veto power; Cantonal administration of Bern; Cantonal or national courts	Societal and community acceptance; Socio-political acceptance of energy, water, and environmental policies at international, national, and cantonal levels	Participating actors and the result of the participatory process in Stage 5
9	Realisation decision	Realization of the project	Hydropower Company KWO	Market acceptance	National subsidies; European and Swiss energy market

The following paragraphs provide a detailed description of each stage of the Trift project.

In **Stage 1**, the main actor was KWO, which decided to launch a new hydropower project. This decision depended on market acceptance, because KWO is a market player on the supply side and has to offer hydropower electricity. On the other hand, society and industry both demand hydropower electricity. The market acceptance was based on the political commitment in Switzerland to increase and support renewable energy such as hydropower production. Furthermore, the decision to launch a new project was influenced by the European and Swiss energy markets.

In **Stage 2**, KWO chose the proglacial lake of the Trift glacier as a site for its new hydropower project. This decision was not a question of acceptance, because it was caused by the following natural conditions: the retreating glacier and the new proglacial lake due to climate change, a special rock formation in front of the natural lake, and the lack of protection of the area.

In **Stage 3**, scientific actors, engineering offices, and KWO researched feasibility studies for the hydropower dam at Lake Trift, as part of the Swiss National Research Programme 61 titled 'Sustainable water management' between 2008–2011 [87,90]. These studies were not a question of acceptance, because natural conditions such as local hydrology and climate change led to the results of the feasibility studies. However, the studies have pointed out that a hydropower dam could be operated economically, but could also lead to conflicts because of the environmental and touristic interests at this location. Based on the results, KWO decided to follow up on the project.

In **Stage 4**, the cantonal administration of Bern launched a feasibility study to determine the flooding-related and drought-related possibilities and limits of managing the Trift reservoir as a multi-purpose reservoir [88]. These analyses should be used to identify options for canton action and as a basis for discussions with the State Council and, if necessary, with the Grand Council. However, when the contract was awarded, the canton already limited the study by taking into account the KWO's main objective of producing electricity. The study revealed that the reservoir would have the potential to take over part of the function of the snow and glacier: the reservoir could delay the accumulating water and release it in a targeted manner to the downstream riparian. However, "focusing on this function would call into question the important task of grid stabilization and generally profitably electricity production" [88]. This indicates high socio-political acceptance for the Swiss Energy Strategy 2050 and no acceptance for a restriction of hydropower.

The canton had a strong interest in using the Trift project to fulfill (instead of restrict) its contribution to the national Swiss Energy Strategy 2050. Droughts that are caused by climate change are not yet a major problem in the canton of Bern. In the event of flooding, the KWO storage facilities are generally operated at 92% or 93% capacity, which means that the canton sees its interests covered.

This reflected the national perspective, because the national goal was to win the vote on the new Swiss Energy Strategy 2050. A conscious decision was taken to avoid linking the Swiss Energy Strategy 2050 to a national water strategy [91], because there were concerns that this would become too complicated and not put forward for voting. Although hydropower (electricity as derived from water) accounts for a significant proportion of renewable energy in Switzerland.

Stage 5 is described in detail in Section 5.2.

In **Stage 6**, the cantonal and national administration will assess the legal conformity of the submitted draft of a hydroelectric concession. Based on the results of the assessment, the State Council of the canton of Bern will provide a recommendation on granting the concession to the Great Council. Therefore, this stage will be not a question of social acceptance; the assessment of the draft of the concession will be influenced through the commitment of the different actors to the participatory process in Stage 5.

In **Stage 7**, the Great Council of the canton of Bern will vote on granting the concession. This decision will be based on the socio-political acceptance of water and environmental policies at the national and cantonal level and on the Swiss Energy Strategy 2050's goal to expand hydropower. The market acceptance will also influence the decision, because the canton holds more than 50% of the shares of the hydropower company and simultaneously collects the water rates from it. Furthermore, the decision will be influenced through the recommendation in Stage 6 and the successful process in Stage 5.

In **Stage 8**, the project could be permitted in accordance with societal and community acceptance. This depends on whether the local municipalities, the affected people, and the NGOs with veto power will appeal an objection. Permission will depend on how this situation will be solved through the cantonal administration or national courts. The relevant actors will decide on the basis of their socio-political acceptance of energy, water, and environmental policies at the international, national, and cantonal level, and its implementation in the concession (e.g., residual water, compensatory measures), which will depend on the results of the participatory process in Stage 5.

In **Stage 9**, KWO will decide whether they want to realize the project directly after the permission or at a later time. This will depend on the market acceptance, and will be influenced by national subsidies and the European and Swiss energy market at this time.

5.2. Social Acceptance in the Stage of the Participatory Process

The previous section explains the different stages of the Trift project. In this section, we focus on Stage 5, which is the participatory process.

Hydropower projects across Switzerland have led to intense conflicts and project stalemates. A number of Swiss NGOs and hydropower companies learned from these experiences and took a participatory approach to test new processes [41]. The canton of Bern and KWO learned from these successful participatory processes and applied them to KWOplus, which is another hydropower project in the Oberhasli region [89]. The success of this process and the results of the feasibility studies led the canton and KWO to start a participatory process to develop a draft of a concession and prevent objections. Therefore, in **Stage 5**, a participatory process with different sub-groups was conducted in front of the administrative process.

The relevant actors in this stage were present in three different sub-groups. One group, which was a broad advisory group, brought together state and non-state actors from different governmental levels, including politicians. This group met twice a year for information and consultation purposes. Another group, an expert committee, consisted of NGO representatives, the hydropower company, and the canton. The collaboration was very intense, because meetings took place every second month. Finally, a group brought together the heads of the affected municipalities. The most important task of this group was to discuss the locations of the compensatory measures so that the local community would not be excessively restricted. The outcome of this stage was a consensus-approved draft of the concession, which was submitted to the canton of Bern in 2017.

The interviews and document analysis reveal that social acceptance of the project and the draft of the concession were based on the different dimensions of social acceptance and specific determinants. These are described in the following paragraphs.

5.2.1. Socio-Political Acceptance

The canton's willingness to carry out a time-consuming participation process to develop a draft of the concession was attributable to its obligation to contribute to the national Swiss Energy Strategy 2050 and the Cantonal Strategy of Water. The Trift reservoir would meet or exceed the target of the cantonal strategy, which envisages an increase of 300 gigawatt hours per year.

The NGOs also supported this approach, because they have been advocating for the phase-out of nuclear power for many years. Thus, the NGOs felt obliged to support the expansion of renewable energies such as hydropower shortly before the vote on the new Swiss Energy Strategy 2050. The new Swiss Energy Strategy 2050 requires an ecologically justifiable expansion of hydropower, and the NGOs did not want to be seen as obstructionist. This overarching goal to achieve the aims of the Swiss Energy Strategy 2050 led to a high willingness to compromise in developing a draft of the concession.

5.2.2. Market Acceptance

KWO's willingness to carry out the time-consuming and cost-consuming participatory process of developing a draft of the concession was based on the profitability of the hydropower project. Its profitability depended on market acceptance in the European and Swiss energy market and on experience with another unrealized hydropower project that is only 10 km away and has a more than 20-year history of conflicts.

5.2.3. Societal and Community Acceptance

Procedural Justice

The NGOs appreciated the sincere intent of the responsible persons at KWO to enter into dialogue in the participatory process, took them seriously, and tried to understand which questions are important with regard to landscape and nature protection.

Distributional Justice

- Water tax The canton holds more than 50% of the shares of the hydropower company and simultaneously collects the water resource tax (Wasserzins) from the hydropower company. The local municipalities collect corporate and property taxes from KWO. This is taken for granted because the taxes are regulated by law.
- Regional jobs It was important to the regional actors that the construction and the operation of the dam would create new jobs in the region. Job creation is essential in such remote areas.
- Regional tourism KWO created the tourism sector 'Grimselwelt', where power plants are marketed. Former KWO works railways have been opened for tourism, and hiking trails, bridges, restaurants, and hotels are also in operation. The regional actors appreciated that the local economy benefits from these tourism opportunities.
- Regional engagement The regional actors valued that KWO supports local events and projects. KWO's activities have gained a favorable reputation within the region.

Trust Building

Most actors could built upon mutual trust from earlier collaborations. The NGOs trusted in the hydropower company because they have repeatedly fulfilled their promised compensatory measurements. In addition, the transparent sharing of information during the participatory process built trust between all actors.

5.2.4. Geographical Concepts

Place

Most NGOs mentioned that the geographical basis of the selected site is unique for a water reservoir because of the natural lake and its location. The lake fills itself twice a year, and only one water supply pipe would be built to increase the electricity production.

Following their guidelines, some NGOs would have to take a negative attitude toward the project because it is a new infrastructure in an undeveloped natural terrain unit. However, these NGOs wanted to express their support to the Swiss Energy Strategy 2050, and were convinced that the project could be an important pillar for the transition toward renewable energies.

Landscape

The basis for the reservoir would be a new natural lake that is in front of the retreating glacier. The NGOs estimated that the new dam would not disrupt the landscape, because there is a rock formation that partly hides the dam.

Distance Decay

Most actors emphasized that the dam would lie hidden in a mountain region and not be visible from lower sites.

5.2.5. Environmental Impacts

Environmental Impact

The NGOs emphasized that the project could generate substantial amounts of energy in relation to the damage to nature. Furthermore, the project could replace or prevent the construction of many new small hydropower plants, which would result in greater environmental impacts.

Compensatory Measurements

In the expert committee, consensus was reached on compensatory measurements that were designed on the basis of recognized evaluation methods and detailed environmental studies conducted by KWO.

Protection Status

The project area is the last not (yet) protected area in the region that is suitable for a water reservoir. This was a basic condition for the NGOs to participate in the process.

5.2.6. Ownership of the Hydropower Company

The majority of the hydropower company is owned by the cantons, and the company is anchored locally. The local residents assumed that the company is able to respond more closely to the needs of the region than foreign investors could.

Additionally, the local engagement of the hydropower company led to trade-offs for members of local NGOs. These members usually had a close connection to the company as an employer or supporter of the sport or alpine club. This led to conflicts of loyalty toward the hydropower company, which was why a national representative usually also participated in the expert group. Therefore, the national representatives were more active in negotiating the local compensatory measurements.

5.2.7. Multi-Purpose Reservoir

Surprisingly, the multi-purpose function of the reservoir was not an issue in the participatory process. The involved NGOs were not informed that the canton ordered a study regarding an assessment of a multi-purpose reservoir.

5.2.8. Polycentric Approach

The participatory process was designed with multiple overlapping decision-making groups that were on different levels and had some degree of autonomy. The actors came from different sectors such as hydropower, nature conservation, landscape protection, fishers, and the administration. They were active at different levels (national, cantonal, and regional), and acted in ways that consider others through the processes of cooperation, competition, conflict, and conflict resolution. All of them pursued the overarching goal of increasing renewable energy. This polycentric approach brought a variety of perspectives and interests into the negotiations, which increased social acceptance of the negotiated draft of the concession. Furthermore, the society felt that it was represented in the different sectors and levels, and it trusted the negotiations surrounding the draft of the concession.

5.2.9. Interrelations

Interrelations with Other Stages of the Trift Project

Social acceptance in Stage 5 depended on decisions in former stages, such as the selected site (Stage 2), the results of the feasibility studies (Stage 3), and will influence on the granting of the concession (Stage 7), because the politicians trusted in the negotiations of the actors from different sectors and levels in Stage 5.

Interrelations with Processes beyond the Trift Project

In 2008, a new instrument for the financial support of renewable energy projects was adopted (kostenorientierte Einspeisevergütung, KEV). This led to a boom of new small hydropower plants with negative environmental impacts. The NGOs' agreement on the Trift project was contingent on halting the future development of small hydropower plants in the canton of Bern.

5.2.10. The Objection Against the Trift Project

One NGO and a local grassroots organization filed an objection with contingent applications against the project when KWO submitted the draft of the concession to the canton [60].

These organizations' main objection concerned the environmental impacts. They argued that the project would lead to severe impacts on the unique and protection-worthy mountain landscape of Trift (with Trift-water, Trift-meadow, Trift-lake, and Trift-glacier). In the event that a concession will be granted, the opponents requested the examination of a re-dimensioned project variant (only the existing natural lake volume should be used), the amendment of existing basic reports, and various other conditions and requirements. Finally, the opponents demanded that no further hydropower plants in the canton of Bern should be granted.

6. Discussion

Constructing multi-purpose water reservoirs that can be operated for multiple services is a strategy to jointly address the mitigation and adaptation challenges of climate change [4–7]. However, new dam projects often face low social acceptance due to their impact on nature, biodiversity, and the landscape. While social acceptance of renewable energy has become a prominent topic for social scientists for at least the past decade, hydropower projects have not received much attention, particularly dams in recently deglaciated high-mountain areas. Research on multi-purpose reservoirs has not even been considered in the literature.

This paper analyzes the determinants and processes that influenced social acceptance of the first dam project in a recently deglaciated landscape in the European Alps. The analysis identifies three main determinants:

First, the forthcoming popular vote on the new national Swiss Energy Strategy 2050 was an overarching goal for the majority of the involved actors and had the most important influence. The NGOs have been advocating the phase-out of nuclear power for many years, and therefore supported the Swiss Energy Strategy 2050. This support also required support of the expansion of renewable energies such as hydropower. The NGOs did not want to be seen as obstructionist just before the vote. Furthermore, the Trift project would enable the canton to fulfill their cantonal contribution to the goal of the national Swiss Energy Strategy 2050 and to the goals of the Cantonal Strategy of Water, which is why the construction of small hydropower plants with higher environmental impact could be stopped. However, this overarching goal to support the Swiss Energy Strategy 2050 leads to less attention being paid to using the reservoir for multiple services.

Second, the participatory process, which has a polycentric design, was another key factor for social acceptance of the project. The results demonstrate that the three dimensions of socio-political acceptance, market acceptance, societal and community acceptance, and the dynamics among them were important in the stage of the participatory process. The canton of Bern had to contribute to the goals of the national Swiss Energy Strategy 2050 (socio-political acceptance). Therefore, they were willing to invest in a broad participatory process to increase the chances of success, which in turn results in a higher societal and community acceptance because of effective procedural justice. The NGOs had a high willingness to compromise (societal and community acceptance) for the support of the vote on the Swiss Energy Strategy 2050 (socio-political acceptance). KWO had a high preparedness to invest in procedural and distributional justice (societal and community acceptance) because of the high market acceptance of the project.

Furthermore, state and non-state actors in the participatory process appreciated the constructive dialogue. This constructiveness was in contrast to another dam project in the same region; this project involved the courts and still has unsolved conflicts almost two decades later. The polycentric design of the participatory process had a strong influence on social acceptance because of the different groups, which were composed of actors with different perspectives and interests. This was a key factor for successful negotiating regarding the draft of the concession. In addition, the members of the Great Council who will grant the concession trusted in the jointly developed draft of the concession, because of the polycentric design of the process.

Third, the project area's unprotected status was a basic condition for the NGOs to participate in the process. The conflict with another project in the region that was mentioned above played a role in this respect. In that project, the same representatives conflicted for over 20 years. The conflict is about raising a dam that would flood a nationally protected moor. The NGOs did not want to resolve that conflict in a participatory way, and left it to the court to decide. In the Trift process, the NGOs wanted to indicate that they are cooperative with hydropower projects if the project does not affect a protected area.

These three determinants cover other factors that influenced social acceptance such as geographical aspects, the environmental impact, and the local ownership of the hydropower company. However, one NGO submitted an objection due to environmental impacts. They prioritized the protection of water bodies in Switzerland over the Swiss Energy Strategy 2050; this was in accordance with their statutes.

Scholarship on social acceptance has been criticized for describing positions taken by certain actors, who are often 'the public'. These descriptions are usually in a response to actions and initiatives taken by others [17,92]. For instance, a common view suggests that environmental impacts [8,9], ownership of the infrastructure company [13,39,46,47], or distance decay [45] are important factors for the position of actors. However, the positions of actors are usually dynamic and are continually reconsidered and redefined. This paper contributes to this debate by demonstrating that contextual factors such as the temporal proximity to the vote of the new Swiss Energy Strategy 2050 and historical events such as the exceptionally long conflict over a nearby dam project can change the actors' positions regarding dam projects in landscapes that deserves protection. Specifically, the actors in this study changed their position concerning new infrastructure projects in an undeveloped natural terrain unit. These results underline the statement of Wolsink [17] that "social acceptance is complex and dynamic, as it is a process".

Furthermore, the results support the findings of previous studies that social acceptance is influenced through complex dynamics between several levels of decision-making and linked policy areas that include state and non-state actors [16,93], and strategies and processes that are beyond the project [14,94,95]. More specifically, the results demonstrate the mutual influence of other processes and dimensions of social acceptance, such as the vote on the Swiss Energy Strategy 2050, other political instruments such as financial support for small hydropower plants, and the European and Swiss energy markets. The results in this study also underline the perspective of Dermont et al. [15], which is to focus on different stages of a process, actors, and their roles. This focus contributes to the consideration that the stage and the dynamics between the stages influence social acceptance. This is evident in this study; for example, the success of the participatory process (Stage 5) will lead to higher social acceptance of the Great Council (Stage 7).

According to Jami and Walsh [96], participatory processes in renewable energy projects are favorable, because a participatory process "empowers people to help resolve problems, improve governance, deepen democracy, and build trust". The interviews revealed that trust building and the opportunity to speak and be heard are important for social acceptance. This underlines the statement of Peterson et al. [97] that the transition of the energy system requires technical and social changes, including to the style of decision-making. Recent scholarship has suggested that a polycentric organization of climate governance has a higher capacity to deal with complex challenges that arise from climate change [98–100] and produce institutions that are tailored to specific ecological and social contexts [101,102]. The outcomes in this case underline that the participatory process, which involved actors with different perspectives and interests, was a key factor for finding a consensus on the draft of the concession that fits the specific ecological and social context. This consensus was essential for social acceptance of the project.

The study of Ehrbar et al. [11] has rated the Trift Glacier as "the best-rated reservoir, as it does not affect a protected area, it is invisible from settlement areas, and still provides a high annual electricity production", but the ratings are "generally subjective and were based on personal experience". The results of this article contribute empirical evidence that confirms this rating and supplements them with process-related and contextual factors.

7. Conclusions

The present study demonstrates that current political processes such as voting on the new Swiss Energy Strategy 2050 and past experiences with other dam projects in the same region influenced social acceptance of the project. This led to a high acceptance of the dam for hydropower and a low acceptance for the multi-purpose use of the reservoir. Furthermore, the project area's unprotected status ensured that NGOs were highly willing to participate in the process.

The study points out three aspects that are critical to sustainable development:

First, some NGOs felt obliged to agree to the project, even though doing so was contrary to their own statutes, so that they would not be perceived as obstructing the Swiss Energy Strategy 2050. The local resource system must be transformed from a natural protection-deserving terrain into a hydroelectric landscape if global climate change mitigation goals are to be reached by expanding renewable energy such as hydropower. Due to the temporal proximity to the vote of the Swiss Energy Strategy 2050, compromises have been made regarding the environmental impacts at the local level, even though hydroelectric concessions are granted for 80 years.

Second, the project created trade-offs between mitigation and adaptation. Due to the forthcoming popular vote on the Swiss Energy Strategy 2050, mitigation was prioritized, and the potential for the reservoir's multi-purpose use (adaptation) was neither focused on by the NGOs nor supported by the canton.

Third, the NGOs justified their decision with the unprotected status of the area. If a glacier is retreating rapidly because of climate change, the new deglaciated landscape is not automatically legally protected. The area can only achieve protected status due to the establishment of new biotopes. However, the retreat of a glacier is a highly dynamic and rapid process. The area that will become vacant can include geotopes that are the basis for rare biotopes, but this process needs time. If hydropower companies (such as those in this study) act quickly, the area will not yet have achieved protected status.

The three aspects demonstrate the trade-off situations of nature protection between different scales and between mitigation and adaptation. These situations require careful consideration of the advantages and disadvantages. From a perspective of sustainable development, it must be questioned whether social acceptance of a project should be based on an actual political process beyond the project. This dam will be the first in a glacier forefield and could be a legal precedent for other dam projects in new deglaciated landscapes. Such dams support the transition to renewable energy sources, but transform a natural resource system into a hydroelectric landscape with impacts on nature, biodiversity, and the landscape.

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Appendix A

Table A1. List of interviewees.

No	Function	Category	Date
I1	Regional NGO	NGO	06.06.2017
I2	Regional NGO		09.06.2017
I3	Cantonal NGO		07.06.2017
I4	Cantonal NGO		22.08.2018
I5	National NGO		10.06.2017
I6	National NGO		13.06.2017
I7	National NGO		15.06.2017
I8	National NGO		26.10.2017
I9	Commune President	Politicians	22.06.2017
I10	Commune President		22.06.2017
I11	Commune President		22.06.2017
I12	Cantonal politician		30.10.2017
I13	Cantonal politician		20.10.2017
I14	Cantonal politician		16.10.2017
I15	Cantonal politician		24.10.2017
I16	Cantonal politician		06.10.2017
I17	Cantonal politician		10.10.2017
I18	Regional administration	Administration	15.08.2017
I19	Cantonal administration		30.10.2017
I20	Cantonal administration		14.12.2017
I21	Cantonal administration		20.12.2018
I22	Hydropower Company	Industry	13.08.2017
I23	Hydropower Company		14.11.2018

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