

More acceptance for power lines in Switzerland

An evaluation of the acceptance increasing factors for
transmission lines in Switzerland



Master Thesis
ETHZ

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Zurich, 17 Mai 2016

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Executive Summary

Existing and developing bottlenecks in the European and the Swiss transmission grid are a problem. Grid expansion is necessary to reach the European and Swiss renewable energy and emission reduction targets. The achievement of these targets is threatened by project delays. One major reason for the delays is the lack of acceptance for power line projects. Different acceptance influencing factors like health risks and landscape disruption were identified by literature. However, it is unclear if they can be applied to Switzerland and if they are complete. We ask therefore the following overarching research question:

What factors influence the acceptance of affected stakeholders?

Among these factors, the question about the disclosure of the *need for grid expansion* is highly relevant but not extensively discussed in the existing literature. Therefore, we go more into detail concerning disclosure of need for grid extension. We ask if the understanding and therefore the acceptance for grid expansion increase with the disclosure of need from the transmission system operator (TSO) on the national grid plan and on the line project level.

To measure the effect of the disclosure of need for grid expansion, we used quantitative and qualitative approaches. On the national grid plan level, we set up a survey before and after two conferences where the Swiss national grid plan (Strategic Grid 2025) was presented by the TSO Swissgrid. In this quantitative experimental setting, we measured if the understanding and acceptance increased between before and after the event. In a similar way, we carried out a feedback survey at the end of three information events held for the Swiss power line project “Bickigen – Chippis” where we measured the an increased perceived understanding and acceptance of the needs for the power line project. Furthermore, recorded semi structured interviews (qualitative approach) were made. Subsequently, data have been coded to evaluate the importance of the disclosure of need on the acceptance and other acceptance influencing factors.

Our results suggest that the disclosure of need for grid expansion significantly increases the understanding of the rationale behind the national grid development plan. Furthermore, the disclosure of need increases the acceptance for the grid plan and for a particular line project but it exists criticism related to the timing where the need is disclosed. Our qualitative data show that affected stakeholders are still sceptical due past disclosures that happened late in the process. Our results show that an early disclosure of need is a prerequisite for acceptance. Only when this fundamental condition is fulfilled, a constructive stakeholder dialogue about acceptable solutions can be carried out.

Besides the disclosure of need for grid expansion, the main issues related to stakeholder opposition to power lines are landscape disruption, health risks and property value losses. Furthermore, the indirect acceptance influencing factors “land use and bundling of infrastructure”, “replacement measures”, “direct benefit for the region or the stakeholder” and “openness for different solutions and technologies” and the procedural factors “public opinion” and “perceived participation possibility” could be identified in a Swiss context.

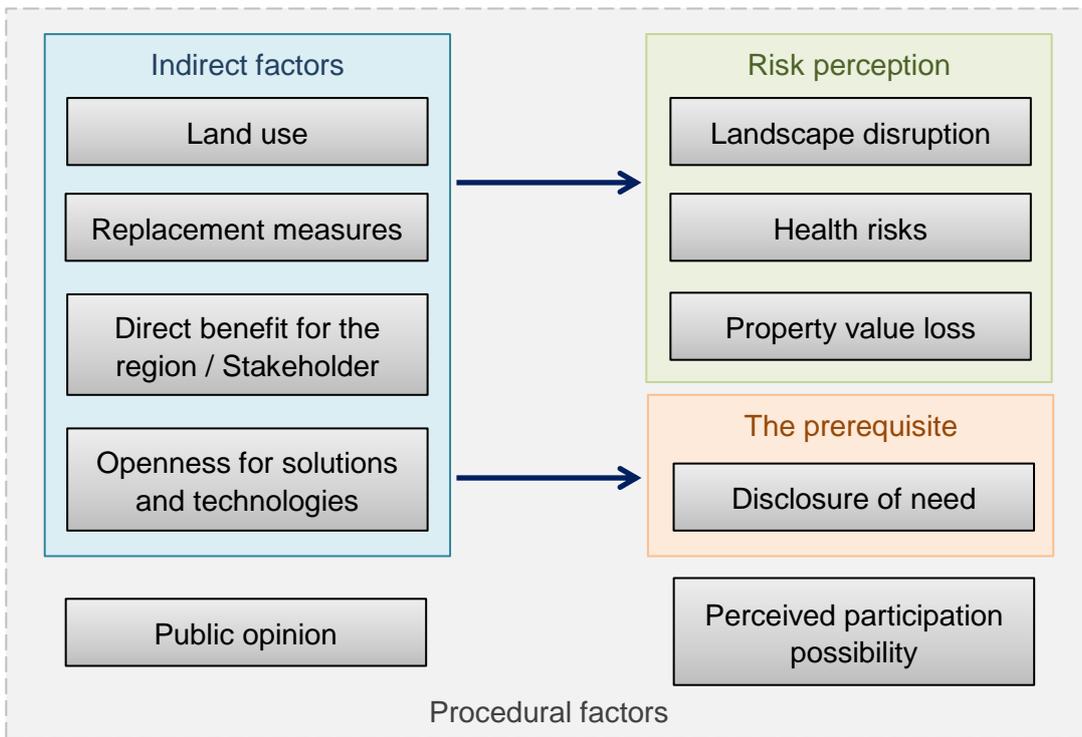


Figure 1: Systematic representation of the acceptance influencing factors (arrows symbolise influences of the indirect factors on the risk perception and the prerequisite)

We conclude that each of the identified acceptance influencing factors has to be considered and addressed to reach higher acceptance for line projects. The Swiss Transmission System Operator Swissgrid, national and cantonal authorities have to take into account these factors for the communication and planning process of the grid plan and the line projects to avoid public opposition and project delays. It is crucial to start early the dialogue with the stakeholders concerning the disclosure of need. If the affected stakeholders understand the need for grid expansion, they are more willing to discuss about possible solutions. This would lead to a quicker grid development for a better integration of renewable energies. The timely realisation of Swiss power line projects is highly relevant to reach the goals of the Energy Strategy 2050 set by the Federal Council, but also crucial to reach climate change mitigation targets in Europe.

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1. Introduction

1.1. Motivation and context

The European and Swiss transmission grids are out-dated and have existing bottlenecks where reinforcement solutions are necessary (ENTSO-E, 2014) (RGI, 2013) (Swissgrid, 2015b). Increased demand and increased production of renewable energies are major challenges for the European transmission grid which make a modernisation and expansion necessary (VSE, 2014) (ENTSO-E, 2014). The transmission grid plays an important role for the achievement of European and Swiss renewable energy and climate policy targets (COMMISSION OF THE EUROPEAN COMMUNITIES, 2008) (Federal Council, 2013a).

Project delays are a major problem in the context of the planned grid modernisation and expansion (Roland Berger Strategy Consultants, 2011). A primary reason for project delays is public opposition (Cain and Nelson, 2013) (Roland Berger Strategy Consultants, 2011) (Battaglini, Komendantova et al., 2012). The legal instrument for opposition is in Switzerland the objection (see Federal Council, 2013b). Opposition has different reasons, for instance health risks (SFOE, 2015) and negative visual impacts (Lienert, Suetterlin et al., 2015) of power lines. Procedural fairness, i.e. the involvement of the citizens in the process, plays also an important role (Cain and Nelson, 2013). These and other factors are discussed in literature (see SFOE, 2015) (see Cain and Nelson, 2013). The lack of acceptance is a big issue in power line modernisation and expansion projects (SFOE, 2015).

We assume that if the in the literature described factors are addressed, the public acceptance increase and therefore the project delays decrease. It remains unclear if we know all important acceptance influencing factors and which of the discussed factors are important for Switzerland. Our overarching research question is therefore:

What factors influence the acceptance of affected stakeholders?

We tried to answer this question with a quantitative approach. Representatives of important stakeholder groups in Switzerland were qualitatively interviewed. The interviewees had to identify the most important factors for their acceptance through questions of the interviewer.

Furthermore, we assume that the disclosure of need for the grid expansion is also important acceptance influencing factor (see Federal Council, 2013a). Cain and Nelson (2013) and SFOE (2015) did not identify this factor but RGI (2012) confirms that the question about the need of grids is fundamental to grid development. The reviewed literature did not identify this factor (see Cain and Nelson, 2013) (see SFOE, 2015). To increase the accuracy, for this factor a quantitative approach beside the qualitative approach was used.

2015, the Swiss Transmission System Operator Swissgrid communicated the first time a proper grid plan named "Strategic Grid 2025" (see Swissgrid, 2015a). The grid planning and in this process identified drivers of the grid expansion were explained transparently and in a for each stakeholder group understandable way (see Swissgrid, 2016a). This situation allowed us to make a quantitative and a qualitative analysis of the effect of the disclosure of need for grid ex-

pansion on the acceptance of the stakeholders. It was possible to set up on the national grid plan level an experimental setting for two conferences with a comparison of before and after. In an exemplary line project (Bickigen – Chippis), a survey on the end of three information events for invited guests was realised. Furthermore, representatives of affected stakeholders in this project were interviewed.

1.2. Research questions

Acceptance is a big issue in power line projects. Low acceptance in the context of power line construction is a main reason for delay or even the failure of power line projects (SFOE, 2015). In the electricity grid strategy of the Federal Council, the increase of acceptance is defined as an important element to reach the goal of a needs-based and timely grid development (Federal Council, 2013a).

We focused therefore on the following overarching research question in the context of Switzerland:

What factors influence the acceptance of affected stakeholders?

We try to answer this question with qualitative methods. We made semi-structured expert interviews with representatives of each important stakeholder group. Different important factors for acceptance like health risks and landscape disruption were already found in literature (Cain and Nelson, 2013) (SFOE, 2015). The relevance of the factor “disclosure of need” for acceptance is not yet part of the discussion in the here considered literature. To have a higher accuracy, we analyse therefore the factor “disclosure of need” additionally with quantitative methods.

For the factor “disclosure of need” two quantitative analyses (experimental: surveys before and after two conferences on the national grid plan level, case: survey at the end of three events about the line “Bickigen – Chippis”) were made. We set four sub questions up for this quantitative analysis of the influence of the factor “disclosure of need”. We assumed that the understanding is a prerequisite for the acceptance. Therefore we have one question (abbr. Q) for the understanding and one for the acceptance on each level:

Level national grid plan (experimental setting):

Q 1: Does the disclosure of need increase the understanding of the grid plan?

Q 2: Does the disclosure of need increase the acceptance for the electricity grid and its expansion?

Level line project (case setting):

Q 3: Does the disclosure of need increase the understanding of a particular line project?

Q 4: Does the disclosure of need increase the acceptance for a particular line project?

2. Background

2.1. Context

The European transmission grid has existing bottlenecks where reinforcement solutions are necessary (ENTSO-E, 2014). The current grid is out-dated (RGI, 2013). Also the Swiss transmission grid has bottlenecks because of changed needs (Swissgrid, 2015b). A reason for these bottlenecks from the production side is amongst others the increase of renewable energy production (Eurostat, 2016). Another reason for the bottlenecks in Europe is the increasing electricity demand (VSE, 2014). In Switzerland, the high production of hydro power and the connection of the new power plants (especially pump storage power plants like Nant de Drance) are a challenge for the transmission grid (VSE, 2014) (VSE, 2013). Furthermore, the demand increase in the continuously growing centres of consumption (Swissgrid, 2015b).

The existing and developing bottlenecks make a modernisation and needs-based expansion of the European and Swiss transmission grid necessary (ENTSO-E, 2014) (Swissgrid, 2015b). A fast development of the energy grids in Europe is crucial to reach the ambitious renewable energy and emissions reductions targets (COMMISSION OF THE EUROPEAN COMMUNITIES, 2008). The electricity grids in Switzerland are a key element in the context of the realisation of the Energy Strategy 2050 (Federal Council, 2013a). In Switzerland, the NOVA principle (grid optimisation before reinforcement before expansion) is used as planning basis for the transmission grid (Swissgrid, 2015a). The aim of the principle is to minimize impact on the landscape and environment (Swissgrid, 2015b).

For the realisation of the modernisation and expansion of the transmission grid, a grid plan has to be developed which defines the necessary power line projects (see ENTSO, 2014) (see Swissgrid, 2015a). In Switzerland, three main drivers of grid modernisation and expansion were identified: major new power plants in Switzerland, international association and supply of downstream grids (Swissgrid, 2015b). The Swiss grid plan named "Strategic Grid 2025" consists of 9 Swissgrid (name of the Swiss Transmission System Operator) and 4 legally obligatory projects (see figure 2). The time horizon of the defined projects in Europe and Switzerland is 10 years (ENTSO-E, 2016) (Swissgrid, 2015a). An open question is, if the projects can be realised on time.

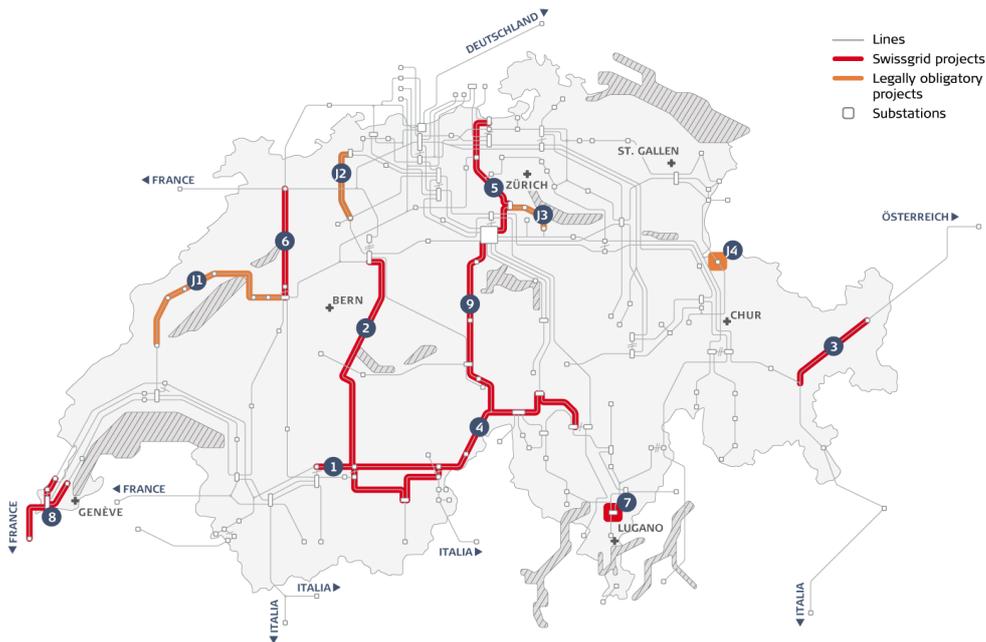


Figure 2: The Strategic Grid 2025

Project delays are a major problem of power line projects (Roland Berger Strategy Consultants, 2011). One of the main reasons for project delays is opposition of affected stakeholders (Cain and Nelson, 2013) (Roland Berger Strategy Consultants, 2011). In the majority of the EU countries, public opposition is the main cause preventing the grid expansion (Battaglini, Komendantova et al., 2012). Other reasons for delays are complex permitting procedures (Roland Berger Strategy Consultants, 2011) and long time limits for authorities leading the procedure (see Federal Council, 2013b).

The instrument of opposition is in Switzerland the objection (see Federal Council, 2013b). The possibility to make an objection exists just in the last phase of the planning and permitting process (see Federal Council, 2013b) (see chapter 2.3.1). In this phase, the possibility for changes in the project and therefore the participation possibility is very low (Albrecht et al., 2013). The participation paradox describes that the interest and engagement increases and the participation possibility decreases with the progress of the planning process (Albrecht et al., 2013) (see appendix A4).

A reason for objections is that the affected stakeholders have the feeling that they are not involved in the planning procedure (Cain and Nelson, 2013). Affected stakeholders express the desire to be more completely and earlier informed about the technology choice and the planning process (Battaglini, Komendantova et al., 2012). Furthermore, health risks in the context of electromagnetic fields are one of the main factors for opposition (SFOE, 2015). The visual impact of power lines has also a high relevance for the people's acceptance (Lienert, Suetterlin et al., 2015). Further factors influencing the acceptance and opposition were discussed in literature (e.g. property value loss) (see Cain and Nelson, 2013) (see SFOE, 2015). The lack of public acceptance is one of the primary barriers to the currently needed level of grid expansion (Battaglini, Komendantova et al., 2012).

2.2. Need for grid expansion and stakeholder opposition

Considering the currently happening energy transition toward more renewable energy sources, grid expansion can be suitable for the whole society (see ENTSO-E, 2014). However, these additional infrastructures affect some stakeholders more than others. Affected stakeholders have different needs and concerns. Needs have mainly the form of desires, interests and necessities. On the opposite, concerns exist in form of doubts, fears and objections regarding grid expansion (Hildebrand et al. 2015).

As a result of concerns, opposition from stakeholders can grow to the point to either delay or block grid expansion projects (see Ciupuliga and Cuppen, 2013). Therefore, it is important that the needs of all affected stakeholders in the process are addressed, for instance the needs of the project owner, the neighbouring communities or local individuals. These needs vary greatly between the different stakeholder groups (see Hildebrand et al. 2015).

In this thesis, we consider the need of the Transmission System Operator (project owner) as need for grid expansion. The question about “need for grids” is fundamental for the grid development (RGI, 2012). According to RGI (2012), the determination of need phase is often made by the Transmission System Operators without public involvement. Therefore, early engagement concerning the discussion of need for grid expansion can be important to foster acceptance.

Additionally, the needs of the affected stakeholders are also considered. These cover a broader spectrum, from health risks, landscape disruption, property value losses and perceived participation possibility. Cain and Nelson (2013) and SFOE (2015) cover most of these aspects in form of factors for opposition. Their factors may be reduced to following aspects that are also highlighted by other scholars:

- **Risk perception:** Although It is not proven that magnetic fields from power lines are harmful for health, this is one of the main factors for opposition (see also SFOE, 2015) (Cotton and Devine-Wright, 2013). Landscape disruption through power lines is also identified as a main reason (Lienert, Suetterlin et al., 2015). Furthermore property value losses are also identified as a perceived risk (Cain and Nelson, 2013).
- **Indirect influencing factors:** “Openness for different solutions and technologies” (see Cotton and Devine-Wright, 2013) and the perceived benefit associated with power lines (see Lienert, Suetterlin et al., 2015) are also very relevant for acceptance.
- **Procedural Factors:** “Public opinion” and “perceived participation possibility” are environmental factors which influence the opinion and acceptance of the stakeholders (see Cain and Nelson, 2013).

In this thesis, we consider the above described factors parallelly to the fundamental factor “disclosure of need” for grid expansion (see RGI, 2012). We will evaluate the effect of an early disclosure of need for grid expansion. Furthermore, we will evaluate how the Swiss context of stakeholder opposition fits with the factors highlighted in the literature. Therefore we aim to address the following overarching research question in the regional context of Switzerland:

What factors influence the acceptance of affected stakeholders?

We assume that if above described factors and the involvement of the affected stakeholders are addressed, the acceptance for power lines will increase and therefore the delays of projects decrease. However, it remains unclear which of the above discussed factors are relevant in Switzerland and if there are more factors which are not yet discussed in above described literature.

2.3. The Swiss Process

In the electricity grid strategy of the Federal Council, the increase of acceptance is defined as an important element to reach the goal of a needs-based and timely grid development (Federal Council, 2013a).

In this chapter the planning and permitting process of Switzerland is explained (see chapter 2.3.1). Furthermore, the chosen cases to answer the research questions are described (see chapters 2.3.2 and 2.3.3).

2.3.1. Structure of the planning and permitting process in Switzerland

The planning and permitting process in Switzerland has four phases (see figure 5). In the first phase, the determination of need, absolutely necessary line projects were defined by Swissgrid in a strategic grid plan (see chapter 2.3.1.1). Each of these line projects goes through the three following phases: the sectoral plan process (see chapter 2.3.1.2), construction project (see chapter 2.3.1.3) and planning approval procedure (see chapter 2.3.1.4).



Figure 3: The four project phases in Switzerland

During the planning and permitting process, two levels are important: the national grid plan level and the line project level. At the beginning, in the determination of need phase, the main focus is on the national grid plan level because the national needs are discussed with national stakeholders and the national grid plan (“Strategic Grid”) is defined (see Swissgrid, 2015a). Acceptance on the national grid plan level means in this study the acceptance for the grid modernisation and expansion in general and on a national level (see Swissgrid, 2015a). When the need is defined, the main focus is on the specific lines projects of the grid plan. Acceptance on the line project level means in this study the acceptance for a specific project of the grid plan in the affected region. The important stakeholder groups for each level are defined in chapter 4.1.

In the following chapters, the different project phases in Switzerland are described.

2.3.1.1. Determination of need

Swissgrid plans the grid. For the different future production and consumption scenarios in 10 and 20 years, the necessary grid expansion is calculated with a multi criteria analysis. These scenarios equal possible future developments. One scenario for 2035 was made together with environmental organisations. The resulting line projects are necessary in all calculated scenarios (i.e. they are robust) (see chapter 2.3.2) (see Swissgrid, 2015a).

2.3.1.2. Sectoral plan process

The sectoral plan process has two phases. The planning territory will be defined in the first phase, the planning corridor in the second phase (Swissgrid, 2016c).

The Swiss Federal Office of Energy (SFOE) has the lead of the sectoral plan process. In the first phase, Swissgrid proposes different planning territories. The support group of the SFOE analyses the different options and give recommendations for a decision. The support group is put together by the SFOE and includes representatives of the concerned Swiss federal offices (ARE, SFOE, BAV, etc.), the ESTI, the EICom, the affected canton, environmental protection organisations (e.g. Swiss Foundation for Landscape Conservation (SL-FP)) and Swissgrid. The federal council decides for one planning territory due to the recommendations of the support group (Swissgrid, 2016c).

In the second phase, Swissgrid proposes different corridor options and grid technologies (e.g. overhead line or cabling) within the planning territory. The support group analyses the different corridor and technology options and gives recommendations. The federal council decides for one planning corridor and a technology with the help of the recommendations (Swissgrid, 2016c).

2.3.1.3. Construction project

In the construction project phase, different routes within the corridors are defined. Swissgrid normally set up a project advisory council with representatives from the regional environmental organisations, affected municipalities, interest associations and directly affected land owners are members. The different routes were discussed in the council. Recommendations from the council were taken into account for the final routeing (Jan Schenk, personal communication, 2016).

At the end of this phase, the final routeing will be prepared for the submission of the planning approval dossier to the ESTI (see SFOE, 2016).

2.3.1.4. Planning approval procedure

Before the start of the planning approval procedure, the transit agreements (“Einverständniserklärung”, not the same as the “Dienstbarkeitsvertrag”) have to be signed from the land owners. Land owners who do not want to sign have to receive a personal announcement that they have the possibility to sign the contract or to make an objection (see Federal Council, 2013b). An information event is normally set up by Swissgrid to inform the affected municipali-

ties, regional sections of environmental organisations and cantonal authorities about the line project and the upcoming approval procedure (see case project Bickigen – Chippis).

If this condition is fulfilled, Swissgrid sends the planning approval dossier to the ESTI. Afterward the project is available to the public for 30 days in the affected municipalities. Objections can be made by directly affected individuals, environmental organisations (with the right of appeal for associations) and affected municipalities. The ESTI sets up a procedure-conforming objection hearing for the outstanding objectors (Federal Council, 2013b).

“If the ESTI is unable to deal with all objections or settle disputes between the involved federal authorities, it forwards the documentation to the Swiss Federal Office of Energy (SFOE), which then carries out negotiations with the parties concerned and subsequently issues a planning approval ruling. Appeals against rulings by the planning approval authorities (SFOE / FOT) may be submitted by the involved parties to the Swiss Federal Administrative Court, and subsequently to the Swiss Federal Supreme Court as final instance.” (SFOE, 2016)

2.3.2. The case for the disclosure of need

In 2015, the Swiss Transmission System Operator Swissgrid presented for the first time a grid plan (“Strategic Grid 2025”) (see Swissgrid, 2015a). The time horizon of the grid plan is 10 (two core scenarios) years with an outlook for 20 (four scenarios) years. A multi criteria analysis including a social cost benefit analysis was used to evaluate the grid expansion need. On the basis of the multi criteria analysis the chosen line projects are robust in all scenarios and therefore absolutely necessary (Swissgrid, 2016a). This is paradigm change. In the past (before the foundation of the national grid company Swissgrid) the grid was always planned from the technical perspective; a technically optimal system guarantees no critical operating situations. This leads to a potentially oversized grid. In the new world critical operating situations are accepted in the transmission grid if they can be handled and therefore the construction of a new line, that is more expensive than the handling of these critical situations, can be avoided (see appendix A5). The resulting grid is economically efficient and the pressure on the landscape is lower due to less line projects. Swissgrid identified projects that are no longer absolutely necessary and will not construct them (see Swissgrid, 2015a).

In the “Strategic Grid 2025”, three main drivers of grid expansion were identified: major new power plants in Switzerland, international association and the supply of downstream grids (the relevance of the drivers is in this order) (Swissgrid, 2016a).

Also new for Europe was the way of the communication of the grid plan. On different levels of complexity for each stakeholder group, Swissgrid explained the grid planning process from its beginning until the final grid. The communication of the “Strategic Grid 2025” started with the annual media conference (30 April 2015), continued with three big conferences: the grid forum for the energy sector (12 May 2015, 200 participants), two conferences for participants from research, the energy sector, politics and the authorities at EPFL (21 May 2015, 250 participants) and ETHZ (18 June 2015, 430 participants) (Swissgrid, 2016a).

Besides these events on the national level, there were also events for the affected stakeholders on the line project level in September and October 2015, where the need of the specific project was one subject. There were three events for the project Bickigen – Chippis, one event for all projects in the Upper Valais (Bickigen – Chippis, Mörel – Ulrichen, Chippis – Mörel) and a booth on a public space event (Foire du Valais) for the projects in the Lower Valais (Power plant connection Nant de Drance, Chamoson – Chippis).

2.3.3. Strategic Grid 2025: Selected Swiss line projects

The red and orange line projects in the map (see figure 4) are part of the “Strategic Grid 2025” of Swissgrid. These projects are necessary under all scenarios. We selected two case projects.

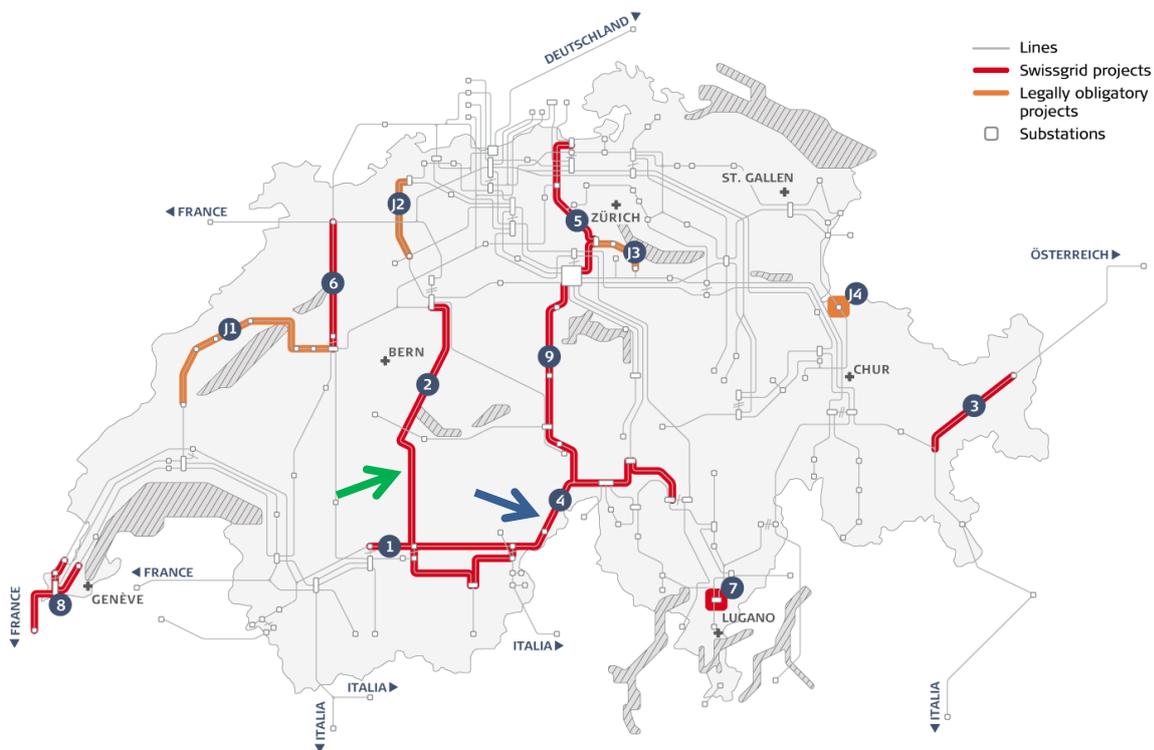


Figure 4: Strategic Grid 2025 of Swissgrid and EU projects

2.3.3.1. Case project: Bickigen – Chippis

The line project Bickigen – Chippis is marked by a green arrow (project no. 2) in figure 4. The project details are listed in table 1 (Swissgrid, 2016d). From this project, quantitative survey data and qualitative interview data were collected for this study.

After the information events before the start of the planning approval procedure, opposition mainly due to the concern of health risks was led by the interest association Gigahertz (see Kalbermatten, 2015a). The regional newspaper “Walliser Bote” published two very critical articles. In the first article, Kalbermatten (2015a) says that 500 human lives are in danger because of the

magnetic field of the upgraded line. In the second article, Kalbermatten (2015b) wrote that Swissgrid ignores studies about children leukaemia.

Table 1: Project details of Bickigen – Chippis (Source: Swissgrid, 2016d)

Line project:	Bickigen – Chippis
Type	Optimisation (voltage increase from 220 kV to 380 kV on an existing line)
Project phase	Planning approval procedure (at ESTI)
Data from this case project	Quantitative and qualitative data

2.3.3.2. Case project: Mörel – Ulrichen (part of Chippis – Lavorgo)

The line project Mörel – Ulrichen is marked by a blue arrow (part of the project no. 4) in figure 4. The project details are listed in table 2 (Swissgrid, 2016e).

Municipalities and directly affected individuals appealed against the planning approval rulings by the planning approval authorities (SFOE) and demanded for a cable study (BGE 139 II 499, 2013). In the section Mörel-Filet – Ernen/Fiesch, the Federal Supreme Court demanded for a cable study (see BGE 139 II 499, 2013). Swissgrid set up a project advisory council for the cable study with representatives from regional sections of environmental organisations and private objectors. The cable study and the recommendations were sent to the SFOE which has to decide now for an option (underground cable or overhead line) and give a planning approval decision (Swissgrid, 2016e).

Table 2: Project details of Mörel – Ulrichen (Source: Swissgrid, 2016e)

Line project:	Mörel – Ulrichen (superior project: Chippis – Lavorgo)
Type	Reinforcement by new construction of a 380 kV line (old 220 kV line will be dismantled)
Project phase	Mörel-Filet – Fiesch: planning approval procedure (at Federal Supreme Court)
Data from this case project	Qualitative data

3. Methodology

As described above, the lack of public acceptance is one of the primary barriers to the currently needed level of grid expansion (Battaglini, Komendantova et al., 2012). Our overarching research question is therefore the following:

What factors influence the acceptance of the affected stakeholders?

The overarching research question is formulated very openly. A qualitative approach therefore makes sense.

We look in particular at the factor “disclosure of need” because this factor was not mentioned in the reviewed literature for this study (see SFOE, 2015) (see Cain and Nelson, 2013). Four sub research questions about the disclosure of need were therefore formulated to increase the accuracy of the findings for this factor:

On the national grid plan level:

Q 1: Does the disclosure of need increase the understanding of the grid plan?

Q 2: Does the disclosure of need increase the acceptance for the electricity grid and its expansion?

On the line project level:

Q 3: Does the disclosure of need increase the understanding of a particular line project?

Q 4: Does the disclosure of need increase the acceptance for a particular line project?

These questions address the effect of the disclosure of need on the acceptance. To evaluate this effect, a quantitative approach was chosen.

Three different methods were used in total. Two different quantitative methods (two surveys, one with experimental and one with case setting) were used to evaluate the effect of the factor “disclosure of need” on the acceptance (four sub research questions); a qualitative method (semi-structured interviews) was used to identify all important acceptance influencing factors for Switzerland (overarching research question) (see chapter 3.3).

For each of the two levels (national grid plan and line project level), a quantitative analysis was made. On the national grid plan level, an experimental setting with an online survey before and after two conferences was made (see chapter 3.1). On the line project level, a feedback survey was made at the end of three information events about the project “Bickigen – Chippis” (see chapter 3.2).

3.1. Quantitative approach on the national grid level

A survey before and after two conferences (experimental setting) was made to measure the effect of the disclosure of need on the acceptance on the national grid plan level. The first conference was on the 21 May 2015 at the EPFL (École polytechnique fédérale de Lausanne) with 250 participants. The second conference was on the 18 June 2015 at the ETHZ (Swiss Federal Institute of Technology in Zurich) with 430 participants. The conferences had the title “The electricity grid of the future”. The universities and Swissgrid organised the events about the “Strategic Grid 2025” and actual research. The participants had to sign in for the participation on the event. They received a link to an online questionnaire in the confirmation e-mail. After the event, the participants received a thank-you e-mail with the link to the questionnaire (including feedback questions about the event). To compare the answers of the particular participant before and after the event, the participant had to generate a unique code which guarantees the anonymity of the survey. In the survey, questions to measure the understanding and acceptance were asked. The difference in the responses before and after the event was statistically analysed (see chapter 4.2.1.1) to answer the sub questions 1 and 2 (see Q 1 and Q 2 in chapter 1.2).

3.2. Quantitative approach on the line project level

To measure the impact of the disclosure of need on the line project level, a survey at the end of three information events on the line project “Bickigen – Chippis” in September 2015 was made. The first event was in Visp (24 September 2015, Canton Valais), the second in Burgdorf (29 September 2015, Canton Bern) and the third in Spiez (30 September 2015, Canton Bern). The events principally informed the municipalities affected by the project Bickigen – Chippis, but also cantonal authorities and locally engaged environmental organisations about the start of the planning approval procedure of the project. At the beginning of the event, the need of the project was disclosed; afterwards project details and approval procedure were presented. The participants were asked to give the feedback via iPad or in Flyer form. The participants were asked to estimate if the event helped to increase their understanding and acceptance for the project. Due to their responses, the hypotheses 3 and 4 (H 3 and H 4 in chapter 1.2) could be answered qualitatively (see chapter 4.2.2.1).

3.3. Qualitative approach

Recorded semi-structured expert interviews were made to find the main acceptance influencing factors in Switzerland and to verify and underline the results of the quantitative analysis. Before starting the interviews, acceptance influencing factors were extracted from the literature (mainly Cain and Nelson, 2013) and from informal meetings with the Swissgrid employees from the project communication. Furthermore, the first interviews were made with Swissgrid employees (project managers, project communicators) to get inputs for acceptance factors. Therefore, our result structure will address all factors that Cain and Nelson (2013) highlighted, where we also added Switzerland specific factors collected through preliminary discussions.

The interviewees were asked at the beginning of the interview what the main problems of extra-high voltage power lines are. Then they were asked about solutions for these problems, followed

by questions about the importance and role of the factors “perceived participation possibility”, “land use and bundling of infrastructure”, “disclosure of need” and “replacement measures” (see exemplary questionnaire in Appendix A2). At the end of the interview the actual list of acceptance factors was shown to the interviewees and they were asked whether there is missing a factor and whether they have additional remarks to the factors.

The interviewees were the project owner (about the perception of the reaction of the stakeholders), national stakeholders (stakeholder groups: research, environmental organisations, interest associations, electricity sector) and the stakeholders affected by a line project (stakeholder groups: affected municipalities, regional sections of environmental organisations, interest associations, directly affected individuals). The aim was to interview from each important stakeholder group someone (see Table 10 in the Appendix A3). Some interviewees were chosen due to recommendation of other interviewees (snowball sampling).

The interviews were held in Swiss German and protocolled in a paraphrased way in German. Each interviewee approved the protocol. For this study, the statements of the interviewees were translated analogously.

4. Results – acceptance influencing factors

Our overarching research question is what the acceptance influencing factors are. In this chapter, the 10 acceptance influencing factors identified in the semi-structured expert interviews were therefore described. Furthermore, the influence of the factor “disclosure of need” was analysed more deeply in order to have a higher accuracy because this factor was not identified in the literature used for this study. We analysed if the understanding and acceptance increased due to the disclosure of need with quantitative methods (see chapter 4.2).

In the last chapter a synthesis describes the conceptual, spatial and systematic dimension of these factors (see chapter 4.6).

We begin the results section with a map of the identified stakeholder groups (see chapter 4.1).

4.1. Stakeholder groups

Figure 5 shows the identified important stakeholder groups of the two levels. These groups were defined during discussions with different Swissgrid employees. The stakeholder groups national politics (e.g. the National Council, the Council of States), electricity sector (e.g. distribution grid operators) and research (e.g. universities) are mainly relevant for the acceptance on the national grid plan level. The stakeholder groups interest associations like HSUB (abbr. for “Hochspannung unter den Boden”, promoting for the cabling of high-voltage lines) and Gigahertz (against magnetic radiation), environmental organisations (e.g. Swiss Foundation for Landscape Conservation (SL-FP) and Pro Natura), national authorities (e.g. Swiss Federal Office of Energy SFOE, Swiss Federal Electricity Commission EICOM, Federal Inspectorate for Heavy Current Installations ESTI) and media (e.g. national and regional newspapers) are important for the national grid plan and the line project level. Local politics (e.g. municipal council of an affected municipality), affected cantons, affected municipalities and directly affected individuals (e.g. land owners) are only relevant at the line project level. The project owner (Swissgrid) has to address the important stakeholders on both levels.

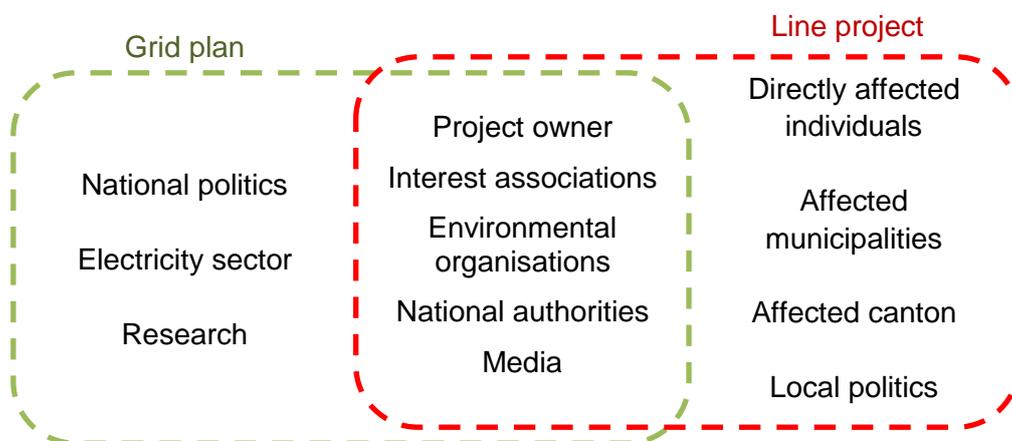


Figure 5: Important stakeholder groups of the grid plan and the line project level in Switzerland.

In the qualitative analysis, we tried to interview one person from each relevant stakeholder group (see table in Appendix A3). For the national grid plan level, participants of the two conferences were interviewed. For the line project level, three municipalities affected by the project “Bickigen – Chippis” (participants from the information events), the interest association Gigahertz which is active in this project and directly affected individuals of the project “Mörel – Ulrichen” were interviewed. Furthermore, the executive director of the biggest opposition organisation HSUB and representatives of national and regional sections of environmental organisations were interviewed.

4.2. Disclosure of need

Swissgrid, the Swiss transmission system operator, communicated first time a grid plan (“Strategic Grid 2025”) with a transparent disclosure of need for line projects in 2015 (see Swissgrid, 2015a). The impact of the disclosure of need on the acceptance has been analysed for the national (grid plan) and regional level (line project).

4.2.1. National grid plan level

On the national grid plan level, the goal is that the acceptance for the grid plan of the stakeholder groups national politics, national authorities, electricity sector, environmental organisations, interest associations and research should be reached (see chapter 4.1). We assume that the acceptance on the national level is important for the acceptance on the line project level.

The following sub research questions were defined to evaluate the effect of the disclosure of need on the acceptance on the national grid plan level (see chapter 1.2).

First, we had to find out whether the understanding increases due to the disclosure of need:

Q 1: Does the disclosure of need increase the understanding of the grid plan?

If the understanding is increased, we would like to know whether the understanding of the need increased the acceptance for the grid plan and its projects:

Q 2: Does the disclosure of need increase the acceptance for the electricity grid and its expansion?

In the two following chapters, the results of the quantitative (see chapter 4.2.1.1) and qualitative (see chapter 4.2.1.2) analysis about the change in understanding and acceptance for the electricity grid and its expansion are presented.

4.2.1.1. Quantitative results

For each of the two sub research questions on the national level, we formulate a hypothesis to answer with the quantitative data.

For sub research question one (Q 1):

H 1: The disclosure of need increases the understanding of the grid plan.

For sub research question two (Q 2):

H 2: The disclosure of need increase the acceptance for the electricity grid and its expansion.

Setting

An internet survey sent by e-mail to all participants was conducted before and after the events at EPFL and ETHZ. The questions had a six-level Likert Scale from 1 (I disagree strongly) to 6 (I agree strongly). A six-level scale (and not five-level scale) was chosen because the goal was to see clear preferences of the stakeholders. The participants had to generate a unique code at the end of the survey that the answers of each person before and after the event were clearly allocable. A big part of the participants responded just before or just after the events. This data could not be used for the experimental setting.

58 participants (14 from the EPFL event, 44 from the ETHZ event) answered the questions before and after the events (see table 3). A normality-test (Shapiro-Wilk – see table in the appendix A1) test showed that all variables are not normally distributed ($p < 0.05$ for all variables), thus requiring the use of non-parametric tests for subsequent tests. A Wilcoxon signed rank test for related samples was used to analyse the differences in the answers before and after the event. We used a both sided significance level of 5 %.

Table 3: Respondents of the survey with the experimental setting

Respondents per event	Before	After	Before and after
EPFL event	39	39	14
ETHZ event	96	99	44
Total			58

Sample description

In the sample (N = 58) we have about 90 % males. The age is very flatly distributed from 23 to 81 years. 45 % of the participants work in the electricity sector, 22% are students and only one participant is a politician. 90% of the participants have a high or medium degree of familiarity with the topic “electricity grid”. The education level is very high, 76 % of the participants have graduated a university.

Results

The understanding for the two main drivers of grid expansion “major new power plants in Switzerland” and “international association” increases significantly. Only the least important driver “supply of downstream grids” does not increase significantly (see table 4). An explanation could be that this driver was not mentioned as much as the other drivers during the events. After the event, the participants understood significantly better that Swissgrid only constructs new lines where no other solutions to eliminate bottlenecks exist (see table 5). We can conclude that the

understanding for the grid expansion increases with the explanation of the grid planning process and of the drivers of grid expansion.

Table 4: Understanding of the drivers of grid expansion

No.	Question	N	AM ¹ before	AM ¹ after	AM ¹ diff.	Sign. Wilcox.
1	New transmissions lines are necessary to connect new, big power plants (like pump storage power plants) with the electricity grid.	51	4.75	5.22	0.47	0.010*
2	New transmission lines are needed in order to ensure the electricity exchange with foreign countries that is important for the security of supply.	54	4.67	5.22	0.56	0.001*
3	New transmission lines are needed to connect the distribution grids better with the transmission grid.	54	4.13	4.33	0.20	0.277

Six-level Likert scale: 1: I disagree strongly, 6: I agree strongly. *The null hypothesis (no difference between before and after the event) can be rejected at the 5% significance level. ¹AM: Average Mean as a descriptive variable independent from the Wilcoxon test

Table 5: Understanding of the grid planning procedure

No.	Question	N	AM ¹ before	AM ¹ after	AM ¹ diff.	Sign. Wilcox.
4	New transmission lines are going to be constructed in Switzerland only where no other possible measures to eliminate grid bottlenecks and to ensure the security of supply exist.	52	4.88	5.27	0.38	0.006*

Six-level Likert scale: 1: I disagree strongly, 6: I agree strongly. *The null hypothesis (no difference between before and after the event) can be rejected at the 5% significance level. ¹AM: Average Mean as a descriptive variable independent from the Wilcoxon test

The results of the questions no. 1, 2 (see table 4) and 4 (see table 5), about the understanding show that the hypothesis H 1 (see above) is valid. The understanding increased due to the disclosure of need.

The understanding of the importance of the transmission grid for the economy, the need of grid expansion for security of supply and a sustainable energy future was already high before the event and therefore there is no significant change after the event (see table 6).

Table 6: Understanding of the importance of the transmission grid and the need of grid expansion

No.	Question	N	AM ¹ before	AM ¹ after	AM ¹ diff.	Sign. Wilcox.
5	A modern and safe electricity grid has a high importance for Switzerland and the Swiss economy.	58	5.76	5.67	-0.09	0.251
6	The modernisation and expansion of the electricity grid are important to ensure the security of supply in Switzerland.	57	5.25	5.28	0.04	0.670
7	The modernisation and the expansion of the electricity grid are important for a sustainable energy future.	57	5.35	5.33	-0.02	0.906

Six-level Likert scale: 1: I disagree strongly, 6: I agree strongly. *The null hypothesis (no difference between before and after the event) can be rejected at the 5% significance level. ¹AM: Average Mean as a descriptive variable independent from the Wilcoxon test

In the next questions, we focused on acceptance. We used the word “support” instead of “accept” for the acceptance questions. We know that “support” and “acceptance” do not have the same meaning (Batel, Devine-Wright et al., 2013). “Support” is stronger than “acceptance”. Our

results are therefore conservative. We used “support” because we assume that this word is less abstract and clearer for the respondent. It is clear that the difference between the answers before and after the events is tendentially smaller because of this conservative approach.

The support for the grid expansion increases (see table 7). There is a shift from 1 (I disagree strongly), 3, 4 to 5 (I agree) (see figure 6). This shift is significant if we cluster 1 and 2 to *disagreement*, 3 and 4 to *neutrality* and 5 and 6 to *agreement*. The effect (r) is 0.28 and therefore medium (The effect accounts for around 9% of the total variance) (Field, 2009). The hypothesis H 2 formulated at the beginning of this chapter can be verified only with the clustered data (see no. 9 in table 7). A shift of the answers into the direction of acceptance (from disagreement and neutrality to agreement) is significant.

Table 7: Support of grid modernisation and expansion and a line project near the home

No.	Question	N	AM ¹ before	AM ¹ after	AM ¹ diff.	Sign. Wilcox.
8	I support the modernisation and a needs-based expansion of transmission lines in Switzerland. (non-clustered)	57	5.21	5.40	0.19	0.107
9	I support the modernisation and a needs-based expansion of transmission lines in Switzerland. (clustered)	57	2.77	2.89	0.12	0.035*
10	I would accept a transmission line near my home.	55	3.89	3.87	-0.02	0.872

Six-level Likert scale not clustered: 1: I disagree strongly, 6: I agree strongly; clustered: 1: I disagree; 3: I agree.
 *The null hypothesis (no difference between before and after the event) can be rejected at the 5% significance level.
¹AM: Average Mean as a descriptive variable independent from the Wilcoxon test

The acceptance for line projects in the neighbourhood of the participant’s home does not change at all. This could be explained with the fact that the events were focusing on the national grid plan level and not on the line project level.

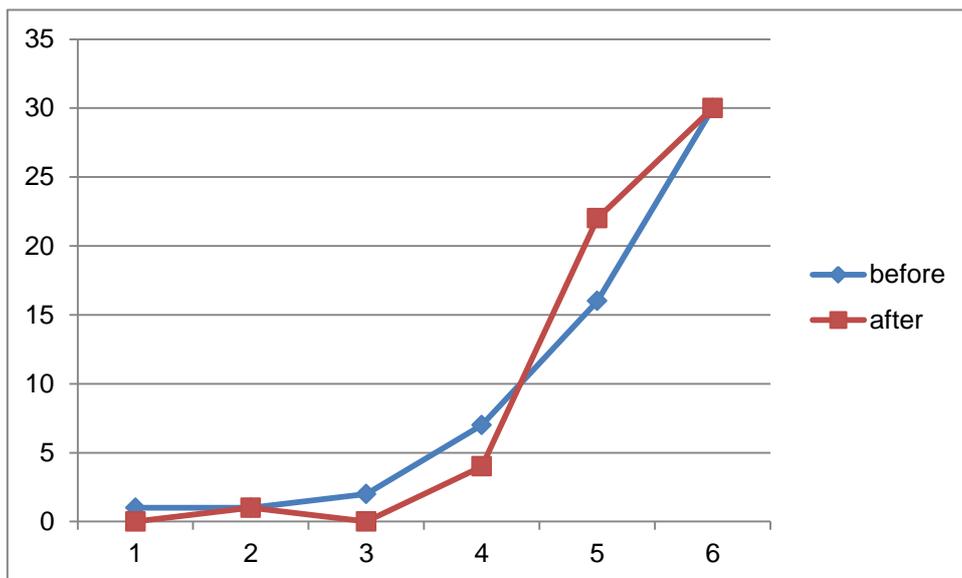


Figure 6: Support of the modernisation and need oriented expansion of the transmission grid (unclustered). We put lines to show the shift of 3 and 4 (before) to 5 and 6 (after).

We conclude that the two hypotheses (H 1 and H 2) formulated at the beginning of this chapter on the national grid plan level are verified (H 2 just with clustered data). The disclosure of need increases therefore the understanding and the acceptance for the electricity grid and the grid modernisation and expansion. The goal of the events to increase the acceptance for the grid plan on the national level seems to be achieved.

In some additional questions it was evaluated whether the risk perception (negative impacts of power lines on health, landscape, property values and noise impacts) changes with the understanding of the need of the line projects (see table 8). After the events, the risk perception was not lower. For the noise impact the risk perception even increased significantly. This could be explained with a sensitization of the participants for this subject due to the presentation of Professor Franck who spoke amongst others about corona noise (Franck, 2015). There could be no effect measured of the disclosure of need on the risk perception.

Table 8: Risk perception of the participants

No.	Question	N	AM ¹ before	AM ¹ after	AM ¹ diff.	Sign. Wilcox.
11	The impacts of transmission lines are a risk for my health.	54	3.07	2.91	-0.17	0.229
12	Transmission lines decrease the value of properties in their neighbourhood.	56	4.55	4.48	-0.07	0.524
13	Transmission lines influence the image of the landscape.	58	3.90	4.03	0.14	0.263
14	Transmission lines cause disturbing noise.	54	3.13	3.54	0.41	0.014*

Six-level Likert scale: 1: I disagree strongly, 6: I agree strongly. *The null hypothesis (no difference between before and after the event) can be rejected at the 5% significance level. ¹AM: Average Mean as a descriptive variable independent from the Wilcoxon test

4.2.1.2. Qualitative results

With the interviews, we evaluated if the interviewees approve the findings of the quantitative evaluation. We asked the senders (i.e. those who disclose the need for grid expansion e.g. Pierre-Alain Graf, Bettina von Kupsch) about the reactions of the different stakeholders to the disclosure of need (communication of the “Strategic Grid 2025”). The reaction on the communication of the “Strategic Grid 2025” was according to the interviewees highly positive. Pierre-Alain Graf (interview, 2015), former CEO of Swissgrid, and Bettina von Kupsch (interview, 2016), former project manager of the “Strategic Grid 2025”, confirm that all national stakeholders accepted the grid plan:

“The wide range of chosen scenarios and the choice of the projects, which are necessary in all scenarios, had increased massively the Goodwill.” (Interview with Pierre-Alain Graf, 2016)

“The credibility among the Confederation, the authorities, the courts and the environmental organisations increased and therefore also the understanding and acceptance that some projects are necessary.” (Interview with Bettina von Kupsch, 2016)

“The very different scenarios for 2035, the multi criteria methodology, the argumentation logic with the response to all “what if” questions, the offensive disclosure of the limits of the grid planning study and naturally the innovative communication with the use of new media

campaign were well received and increased additionally the acceptance.” (interview with Bettina von Kupsch, 2016)

The correctness of the “Strategic Grid 2025” according to the interviewees was not questioned. We conclude that from senders perceived reactions are in line with the findings of the quantitative survey (see chapter 4.2.1.1) that the acceptance increased due to the disclosure of need. The qualitative results underline quantitative results. The interviewees confirm that the disclosure of need had an effect on the acceptance and they say also that the disclosure of need is a prerequisite for acceptance.

Furthermore, we asked the recipients (e.g. Göran Andersson, Georg Klingler) about the importance of the “disclosure of need”. Göran Andersson, professor at the Power Systems Laboratory at ETHZ, says:

“Because everyone has electricity and the people are today more sensitive and engaged and they can question also line projects, line projects should be better reasoned.” (interview with Göran Andersson, 2016)

All interviewees (2015, 2016) confirm that the disclosure of need for the grid plan at its line projects is important for the acceptance.

Transparency is a key element according to Georg Klingler, Solutions campaigner climate and energy at Greenpeace Switzerland:

“You do not understand exactly the reason for transmission lines because you have electricity at home. There is a need for transparency and educational work.” (interview with Georg Klingler, 2016)

We assume that the reasons of grid expansion were transparently communicated in the case of the “Strategic Grid 2025” because the feedback about the disclosure of need from the interviewees of the national grid plan level was positive.

The interviewees gave further advises about important topics which have to be discussed during the disclosure of need:

“It has to be highlighted that the planned power line projects are needed for sustainable future.” (interview with Georg Klingler, 2016)

“It is important to mention (...) that the planned projects contribute to the achievement of the goals of the Energy Strategy 2050.” (interview with Raimund Rodewald, 2016)

This suggests mentioning during the disclosure of need that the power line projects of the “Strategic Grid 2025” contribute for a sustainable energy future and for the current energy policy (Energy Strategy 2050).

4.2.2. Line project Level

Our results show that on the level of a line project, the disclosure of the need for the specific project is essential. All the interviewees on this level confirm that stakeholders affected by a project have to understand its need to accept it:

“The willingness of the affected stakeholders to find a consensus increases when they understand the need of the project.” (interview with Heinrich Zimmermann, 2016).

The following sub research questions were defined to evaluate the effect of the disclosure of need on the acceptance on the line project level (see chapter 1.2).

First, we had to find out whether the understanding increases due to the disclosure of need:

Q 3: Does the disclosure of need increase the understanding of a particular line project?

If the understanding is increased, we would like to know whether the understanding of the need increased the acceptance for the line project:

Q 4: Does the disclosure of need increase the acceptance for a particular line project?

In the following chapter (see chapter 4.2.1.1) we will show the results of the feedback surveys of the three events for affected municipalities, environmental organisations and cantonal authorities regarding the project Bickigen – Chippis just before the planning approval procedure started.

In the second chapter (see chapter 4.2.1.2) we explain the results from the interviews. We made semi-structured interviews with stakeholders from the line project level (mainly project managers, affected municipalities, directly affected individuals, environmental organisations and interest associations). Especially affected stakeholders from the project Bickigen – Chippis and Mörel – Ulrichen were interviewed. We have quantitative and qualitative data from the project Bickigen – Chippis what allows us to validate the quantitative with the qualitative data.

4.2.2.1. Quantitative results

For each of the two sub research questions on the national level, we formulate a hypothesis to answer with the quantitative data.

For sub research question one (Q 3):

H 3: The disclosure of need increases the understanding of a particular line project.

For sub research question two (Q 4):

H 4: The disclosure of need increases the acceptance for a particular line project.

Setting

Three events to inform principally the affected municipalities of the project Bickigen – Chipps, but as well cantonal authorities and locally engaged environmental organisations were organised

in September 2015. The first event was in Visp (24 September 2015, Canton Valais), the second in Burgdorf (29 September 2015, Canton Bern) and the third in Spiez (30 September 2015, Canton Bern). The three events had in total 54 participants. The participants were asked to give a feedback via iPad or in Flyer form. We received 30 feedbacks which corresponds to a response rate of 56%.

Sample description

The respondents (N=30) are mainly representatives of the communal authorities, but there was also a respondent from a cantonal authority and one from an environmental organisation (Pro Natura). Almost 80 % of the respondents have a low or medium degree of familiarity with the subject “power lines”. For 10 % of the respondents this event was the first time they dealt with this topic. 13 % have a high degree of familiarity with the subject.

Results

We asked the participants of the event about the perceived absolute level of understanding and acceptance after the event und the perceived increase of understanding and acceptance due to the event. We used also in this setting the word “support” and not “accept” for the acceptance questions. We know that “support” and “acceptance” do not have the same meaning (see Batel, Devine-Wright et al., 2013). “Support” is stronger than “acceptance”. Our results are therefore conservative. We used “support” because we assume that this word is less abstract and clearer for the respondent. The use of “support” can lead to less positive results due to the stronger meaning.

Our results show that all the participants had a high perceived understanding of (see figure 7) and a high perceived acceptance (see figure 9) for the need for the line project “Bickigen – Chippis” after the event. The perceived understanding (see figure 8) and the perceived acceptance as well (see figure 10) increased for every participant who hadn't yet a high understanding or acceptance before the event. These very positive results may appear due to the fact that the critical municipalities (mainly in canton Valais) did not participate in the event. Moreover only municipalities were invited and no directly affected individuals (like affected land owners). The affected individuals may have been more critical.

Under the assumption that the perception of the participants is correct, the two hypotheses (H 3 and H 4) formulated at the beginning of this chapter are verified. The disclosure of need increases the perceived understanding and the perceived acceptance for a particular line project.

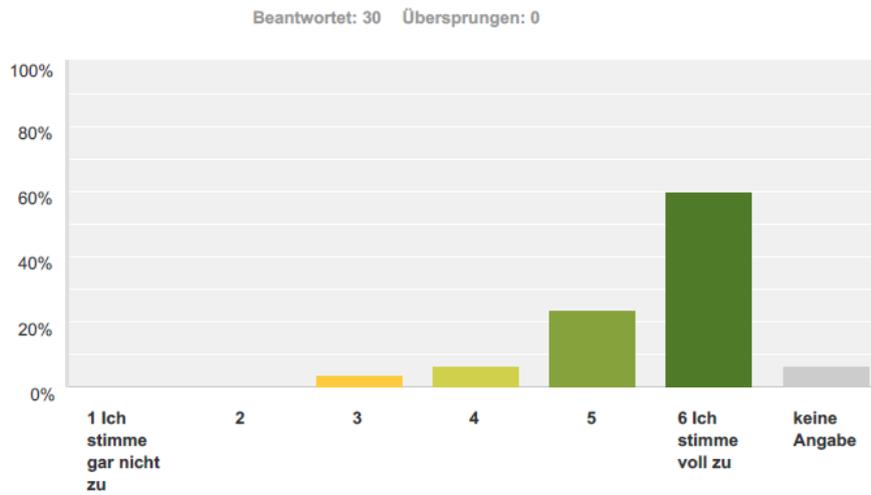


Figure 7: Understanding of the need of the project. “The line project “Bickigen – Chippis” is necessary.” (1: I disagree strongly, 6: I agree strongly, N=30)

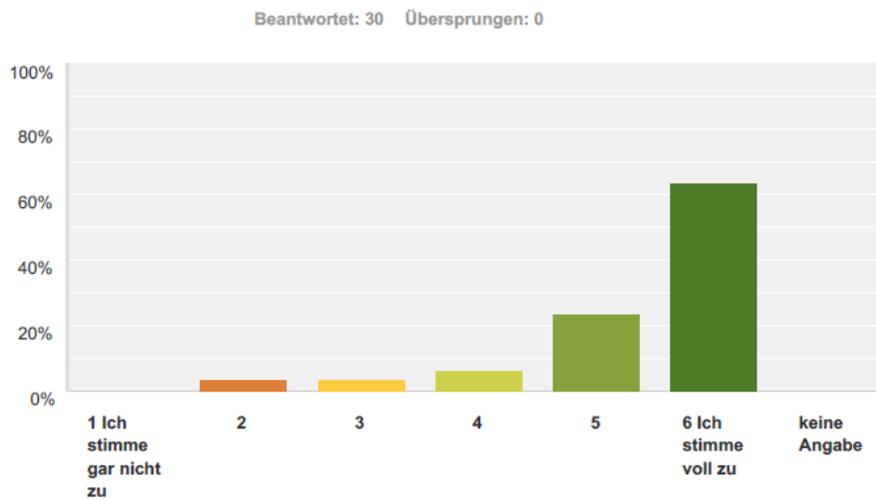


Figure 8: Increase in understanding due to the event. “The event increased my understanding for the project “Bickigen – Chippis”. ” (1: I disagree strongly, 6: I agree strongly, N=30)

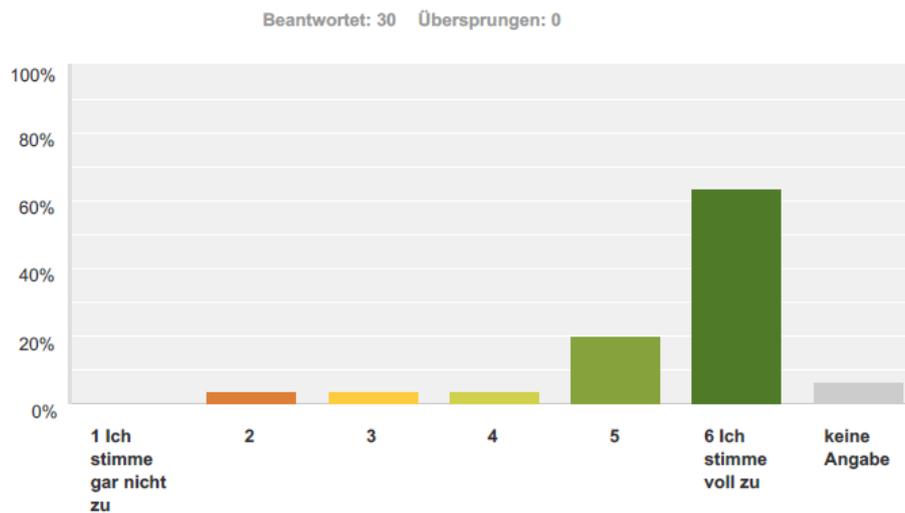


Figure 9: Acceptance for the line project. “I support the line project “Bickigen – Chippis”.” (1: I disagree strongly, 6: I agree strongly, N=30)

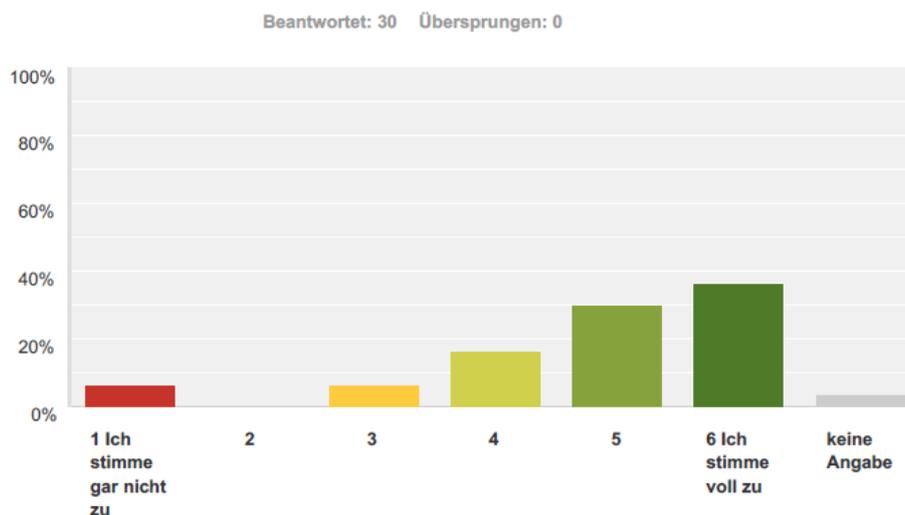


Figure 10: Increase in acceptance due to the event. “My acceptance for the line project increased due to the event.” (1: I disagree strongly, 6: I agree strongly, N=30)

4.2.2.2. Qualitative results

Official representatives of three affected municipalities of the project “Bickigen – Chippis” were interviewed: Franz Arnold, president of Spiez (Canton Bern), Priska Inniger of the authority of construction in Kandersteg (Canton Bern) and Marianne Müller, president of Inden (Canton Valais). The three representatives (interview, 2016) confirm that the disclosure of need is a prerequisite for local acceptance. Marianne Müller says for instance:

“It is not possible to accept a line project if you cannot see the sense of it.” (Interview with Marianne Müller, 2016)

They felt sufficiently informed about the need of the project to give their knowledge to the citizens:

“The information event was good and the information was well provided.” (interview with Marianne Müller, 2016).

“Until now, the communication of Swissgrid was very good from the perspective of the Municipal Council of Spiez.” (interview with Franz Arnold, 2016)

These qualitative results corroborate the quantitative results from the surveys at the end of the information events. However the interviewees stated criticism related to the timing where the need was disclosed:

“The municipalities should have been involved a bit earlier, in a more informal atmosphere. Like this, the municipalities could have expressed concerns and claimed studies in advance.” (interview with Marianne Müller, 2016)

The interviewed project managers explain important aspects that have to be considered in the context of the disclosure of need and the consequences of these aspects for the acceptance. Fritz Hug, project manager of Bickigen – Chippis at Swissgrid, states:

“Good arguments for the need of the line are the foundation pillar for acceptance.” (interview with Fritz Hug, 2016)

According to Hug, it is not possible to discuss with directly affected stakeholders without good arguments for the line:

“It is not possible to discuss [the project] with the affected individuals if the arguments are on shaky foundations.” (interview with Fritz Hug, 2016)

According to the interviewees from the project owner side, the reasons for the grid expansion play an important role for the affected stakeholders. The former project manager of Mörel – Ulrichen, Heinrich Zimmermann, says:

“A lot of private objectors said to me that the calculated grid is only planned for the transit between north and south of Europe. They questioned if so much transits through Switzerland are really necessary.” (interview with Heinrich Zimmermann, 2016)

This suggests that there is an incomplete perception by some of the directly affected individuals that the transmission line projects are just for transit. The data suggest that the benefit for the security of supply and the Swiss economy measured in the multi criteria analysis is not enough explained in a way easy to understand for the stakeholders.

The interviewees on the line project level see the “disclosure of need” as a prerequisite for the acceptance. According to the interviewees, possible solutions can be discussed if the need is disclosed. For instance Jürg Schildknecht, house owner in Grengiols affected by the project Mörel – Ulrichen, confirms says:

“The credibility of the proof of the need for a line projects is a prerequisite. The proof of need is the starting point to find acceptable solutions with the directly affected individuals.” (interview with Jürg Schildknecht, 2016)

Additionally, Hans Kneubühler, executive director of the interest association HSUB, explains:

“The understanding of the need leads to acceptance for a project. Afterwards, questions about the location and technology of the line are important.” (Hans Kneubühler, 2016)

These statements are also confirmed by the project owner. For instance, they state:

“The acceptance of the need is a prerequisite for the discussion of detail questions with directly affected individuals.” (interview with Jan Schenk)

Otherwise the affected individuals will always come back to the need discussion. Philippe Hans Meuli (interview, 2016), manager of special projects and permitting at Swissgrid, also confirms this phenomenon:

“If the understanding of the need is not given, the project has no chance.” (interview with Philippe Hans Meuli, 2016)

Therefore, our data suggest that the need for a project should be underlined with credible arguments. Only when this fundamental condition is fulfilled, a constructive stakeholder dialogue about acceptable solutions can be carried out.

4.3. Risk perception

Based on the interview analysis three main pillars of acceptance are identified: Landscape disruption (see chapter 4.3.1), health risks (see chapter 4.3.2) and property value loss (see chapter 4.3.3). They stand on the fundament named “disclosure of need”. These three pillars are the main reasons for opposition to power line projects. Cain and Nelson (2013) identified the same reasons for local opposition. We can speak about three different risks of power lines which affected stakeholders identify. These perceived risks have to be minimized to reach acceptance.

4.3.1. Landscape disruption

Landscape disruption and health risks are the main arguments against extra-high voltage power lines according to the interviewees (2015, 2016).

According to Eva-Maria Kläy, head of the regional secretary of Pro Natura Oberwallis, settlement pressure is a big issue:

“The space and also the feeling of space become more and more scarce.” (interview with Eva-Maria Kläy, 2016)

The interviewees see the power line as an intrusion from outside in their landscape. Raimund Rodewald from the SL-FP confirms that:

“High voltage overhead power lines are one of the most disturbing experiences in the landscape.” (interview with Raimund Rodewald, 2016)

“The observer cannot see a direct benefit from the high voltage power line.” (interview with Raimund Rodewald, 2016)

Natural landscape has a high value for the interviewees:

“Untouched natural landscape has a high value as a recreation area, for the well-being of local residents and tourism.” (interview Jürg Schildknecht, 2016)

According to the interviewees, an overhead transmission line is a disturbing element in such a natural landscape. Marianne Müller, president of the municipality Inden affected by the project Bickigen – Chippis, says:

“An extra-high voltage line is not part of the picture which we have in mind when we think about a natural landscape. The line is disturbing and bad to merchandise. This is harmful for the tourism and the population.” (interview with Marianne Müller, 2016)

According to the interviewees, a solution for the landscape disruption issue is to minimize the visibility of a power line. According to the interviewees, the project owner should try to integrate the line into the landscape. Raimund Rodewald from the SL-FP says:

“The location of a power line has to be the result of a deep analysis of the landscape. It should be obvious that the power line was integrated into the landscape with the greatest

possible care. Under this condition, a power line does not have to be disturbing in as landscape.” (interview with Raimund Rodewald, 2016)

According to our results, the landscape disruption has a regional and a local component. The results show that the integration of a line into the landscape has to be optimal from regional, but also from a local perspective. On the regional level, the different possible routes of a line in the region will be discussed. On this level, environmental organisations like SL-FP support zones worthy for protection (SL-FP, 2016). “Land use and bundling of infrastructure” and “replacement measures” have an important role on the regional level (see chapters 4.4.2. and 4.4.3.).

According to the interviewees, the visibility is for the land owner the most important criterion. The goal should be to minimize the visibility for the directly affected land owners. Theo Varonier (interview, 2016), who is responsible for the transit agreement at FMV Ltd., states:

“We try to find solutions in negotiations with the land owners who have a problem with the visibility of a line. We try to minimize the visibility for the land owners. Solutions are mostly enabled by small-scale displacements of the line or the pylons.” (interview with Theo Varonier, 2016)

Because of its relevance on local and regional level, the landscape disruption can be according to the interviewees the origin for the biggest group of opponents to a power line. The topic also has a national component. Some landscapes have a national importance concerning the protection (e.g. landscapes that are in the inventory of landscapes and natural monuments with national importance BLN) (BAFU, 2016). The landscape protection has a big relevance for the public. Bettina von Kupsch (interview, 2016) says:

“We weakened the argument “disruption of the landscape on the national level due to cancellation of the not absolutely necessary power line projects.” (interview with Bettina von Kupsch, 2016)

We conclude that landscape disruption has to be minimized on the regional and local level. The integration of the line into the landscape plays an important role.

4.3.2. Health risks

A big part of the interviewees identified health risks as a main problem together with landscape disruption. The interviewees were asked what they understand under health risks.

According to the interviewees, health risks include health effects from the magnetic field, the electric field and the noise of a high-voltage power line. Hans-Ulrich Jakob (interview, 2016) from Gigahertz, an interest organisation against electromagnetic pollution, states:

“The health risks caused through the magnetic field are the biggest problem for the residents. The electric field is not very relevant, because it is absorbed by house walls and roofs. Noise is rarely mentioned as a problem by the directly affected individuals.” (interview with Hans-Ulrich Jakob, 2016)

According to literature, electric fields from the daily life are unproblematic (SFOE, 2015). Jakob says further:

“Noise caused through the line appears mainly under humid and cold weather conditions when normally the windows are closed.” (interview with Hans-Ulrich Jakob, 2016)

Semmler (2005) confirms that corona noise occurs under humid weather conditions. The noise is furthermore dependent on the voltage of a power line. This could lead to a problem if the voltage of a line is increased from 220 kV to 380 kV like in the project Bickigen – Chippis. This voltage increase causes an increase in the corona noise (Semmler, 2005). This fact could be reason for opposition to a project like Bickigen – Chippis (interview with Fritz Hug, 2016):

“In the project Bickigen – Chippis, the noise level increases due to the voltage increase. This is also a reason for opposition.” (interview with Fritz Hug, 2016)

The main health issue of a power line is according to the interviewees the magnetic field. Fritz Hug says:

“The magnetic field creates fears in directly affected individuals. They are afraid of health damages and therefore negative impacts on their life quality. They relate extra-high voltage lines to cancer (especially leukaemia) or sleep disorders.” (interview with Fritz Hug, 2016)

A meta study from the Swiss Federal Office of Energy (SFOE, 2015) comes after the review of epidemiological studies to the conclusion that an increase of the children leukaemia risk could be assumed at a magnetic field exposure higher than 0.4 μT (system limit in Switzerland: 1 μT , see Swissgrid, 2016b). If this assumption is correct, we would have one or two new children leukaemia cases per year caused by power lines in Switzerland. The SFOE study (2015) identified no other health risks due to power lines. Fritz Hug states:

“The perception of the electromagnetic fields is very individual. Some people suffer from them, others not. Clear and open information is important to increase acceptance.” (interview with Fritz Hug, 2016)

The perceived risk is the crucial factor for opposition (Cain and Nelson, 2013). Even if there is no real risk, directly affected individuals could perceive a risk and therefore oppose a project. Directly affected stakeholders expect a scientific proof that there is no health risk due to the magnetic field. This is according to Jan Schenk (interview, 2016) from the project communication of Swissgrid a problem for the communication:

“It is difficult to calm the people and to take them on our side because there is no scientific proof that health risks do not exist. There are a lot of contradictory studies. That is a problem for the communication.” (interview with Jan Schenk, 2016)

There are just a lot of epidemiologic studies which are contradictory (see SFOE, 2015). The Transmission System Operator has difficulties to communicate and to get the acceptance in this situation:

“It is extremely difficult to get the acceptance of directly affected individuals. They expect clear studies which prove that the radiation of transmission lines is not harmful.” (interview with Fritz Hug, 2016).

The literature confirms that further studies about health risks due to magnetic fields of power lines are necessary (see SFOE, 2015). Professor Andersson from the Power Systems Laboratory of ETHZ says:

“Research has to show that the magnetic field of a power line has with a high probability no negative effects on the health of human beings. This should be optimally done by biological and not epidemiologic studies (no impacts of the magnetic field on the cells). Today we only assume that there are no negative effects but we do not know it.” (interview with Göran Andersson, 2016)

Health risks are according to the interviewees mainly important near the housing areas. Health risks are a dominant issue for individuals who live in the direct neighbourhood of a power line. Jürg Schildknecht confirms this:

“Health concerns are the main issue for residents in the direct proximity to power lines (until approximately 100 m).” (interview with Jürg Schildknecht, 2016).

The intensity of the opposition caused by magnetic fields is according to the interviewees higher than the one caused by landscape disruption because one's own health is in danger. For instance, Hans Kneubühler says:

“The directly affected individuals who lives direct neighbourhood to a power line are more concerned to electric and magnetic fields. The intensity of opposition is higher than the opposition due to for landscape disruption because one's own health is in danger. We have more requests from affected individuals concerning radiation than concerning landscape at the HSUB. Landscape has instead a bigger base because its regional dimension of affection.” (interview with Hans Kneubühler, 2016)

Landscape disruption and health risks are interlinked. According to the interviewees, the perception of health risks is connected to the visibility of a line. Overhead lines are visible in the landscape. On the one hand directly affected individuals can be afraid of health risks because they see the line. On the other hand the landscape plays also an important role for the physical and mental well-being and therefore for the health (see Liebefeld-Leist and SL-FP, 2009). The power line as a disruption of the landscape can therefore have a negative impact on the health of the directly affected individuals.

Underground cables are not directly visible and therefore it can be assumed that health risks are less perceived. This question has not been answered by research until now (SFOE, 2015). Philippe Hans Meuli from Swissgrid says:

“A cabling signifies that a line is not visible and when you do not know that there is a line, you also do not perceive the extra-high voltage line. But this does not decrease the problem of electric and magnetic fields.”

Representatives of opponents like the interest association Gigahertz declare underground cables as the solution of the health risks problems:

“It is important to say that we never wanted to block a project. We just claim for the realisation in form of a cabling. The spatial extent of the magnetic field in the case of an underground cable is 10 times smaller than in the case of an overhead line.” (interview with Hans-Ulrich Jakob, 2016)

The theory shows that the spatial extend of the magnetic field in the case of an underground cable is really much smaller than in the case of an overhead line (see Swissgrid, 2016b). Nevertheless, it has to be considered that underground lines have a measurable magnetic field over the ground (see Swissgrid, 2016b).

Our interview data shows that affected municipalities and directly affected individuals want to be informed about health risks, legal limits of radiation and the radiation at the locations with sensitive use (OMEN) before and after the realisation of the line project. According to interviewees is the explanation of the health risks essential:

“The explanation of health risks is very important. The municipalities have to understand the possible risks. Only then they can distribute the information to the concerned residents. If an affected municipality and its residents do not understand the risks, they will have negative attitude towards the line project.” (interview with Marianne Müller, 2016)

Transparency and clear information in the case of health risks is according to our results very important to increase acceptance.

4.3.3. Property value loss

The interviewees (2015, 2016) identify a property value loss caused by transmission lines as the third issue after health risks und landscape disruption. It is the least mentioned factor from the three. Therefore, it can be assumed that the property value loss is a less important factor than the other two factors.

The property value loss is one of the three main issues of power lines because there are directly affected individuals who are not against extra-high voltage power lines in their region but who do not accept a financial risk in the form of property value loss (see also Cain and Nelson, 2013). Professor Andersson confirms that:

“Some people do not feel personally disturbed by extra-high voltage power lines but they do not want to suffer a financial loss in form of a property value loss. The property value loss is caused through other people who do not like power lines and therefore pay less for a property in the neighbourhood of a power line. This is an economical risk for the land owner.” (interview with Göran Andersson, 2016)

The property value loss occurs due to perceived health risks and landscape disruption caused by a power line (see Cain and Nelson, 2013). According to some interviewees, health risks and

the disruption of landscape caused by power lines can decrease the quality of life in a region. Eva-Maria Kläy says for instance:

“Health concerns and the intrusion in the landscape lead to a decrease of quality of life in the affected region. This decrease of quality of life lead to a decrease of property values what is the third reason for opposition [after landscape disruption and health risks].” (interview with Eva-Maria Kläy, 2016)

It can be assumed that the property value loss is directly caused by landscape disruption and health risks. Therefore, measures to decrease the health risks and the landscape disruption should also solve the problem of property value losses. Some interviewees confirm this causality, for instance:

“If we solve the two problems above [landscape disruption and health risks], the arguments of the third group [NIMBY group] that just do not want the line are less powerful. The group 3b that do not want a property value loss also will be smaller because the property value loss will be smaller.” (interview with Göran Andersson, 2016)

Furthermore, the interviewees see a financial compensation of the directly affected land owners as a solution for this problem, for instance:

“The missing financial compensation for the disruption caused by infrastructures is a gap in the Swiss law. A financial compensation of the decrease in value increases the acceptance of land owners and therefore can prevent private objections.” (interview with Heinrich Zimmermann, 2016)

Today, only agricultural losses caused by a power line must be compensated because the line always passes through agricultural and never through residential zone (VSE, SBV et al., 2015). But according to Varonier, financial compensation is not the primary reason for objection:

“If the land owners do not agree [with the planned route of the line], I try to find out why they do not agree. Then I try to address their concerns. The financial compensation is not often mentioned. It is not necessary the main reason because a land owner does not sign [the transit agreement]. Other things like the position of the pylon on the property are often discussed.” (interview with Theo Varonier)

It can be concluded that property value loss is according to our interview data a reason for opposition, but it can be decreased by measures against health risks and landscape disruption.

4.4. Indirect influencing factors

The following acceptance influencing factors directly influence one or more of the three main issues (landscape disruption, health risks and property value loss) and fundamental factor disclosure of need. Therefore they are indirect influencing factors.

4.4.1. Openness for different solutions and grid technologies

For the factor openness for different solutions and grid technologies, we identified three dimensions, a national, a regional and a local dimension.

On the national dimension, it is according to Georg Klingler (interview, 2016) from Greenpeace Switzerland important to plan the grid on the basis of different and also new (not yet considered) scenarios (link to the disclosure of need – see chapter 4.1.):

“In earlier days, the focus was placed on the transportation from large-scale power plants and on trading. The situation is better nowadays as the overall perspective is considered. Alternatives such as batteries as storage medium need to be considered in the scenarios. The SUN scenario is great! It would be even better if Swissgrid itself developed such scenarios (not only with the assumptions of environmental organizations).” (interview with Georg Klingler, 2016)

The regional dimension of the factor “openness for different solutions and grid technologies” is important especially for the landscape disruption but also for the health risks. The goal is to find an optimal routing for a power line. According to the interviewees, different routings and transmission technologies (underground cable or overhead line) should be discussed with the affected stakeholders.

“If different solutions are presented from the beginning, the acceptance is much higher. (...) The openness for different solutions and technologies of the project owner is very important.” (Interview with Jürg Schildknecht, 2016)

“It is very important to demonstrate different solutions, even if they are unrealistic (feasibility study), including financial impacts: How much does the power line cost? How much do the alternatives cost? An explanation is needed, why another solution as the chosen one is out of question. What would be the (financial) consequences, if the project could not be realized? In my eyes, openness towards technology and solutions is very important for the acceptance.” (interview with Marianne Müller, 2016)

According to the interviewees, the consideration of underground cables as a solution is important:

“It is crucial to consider an underground cable alternative from the beginning. (...) For an underground cable, the acceptance is 100%.” (interview with Hans-Ulrich Jakob, 2016)

“The cabling is the most accepted solution. It should be considered for sensitive locations [like near or in residential areas, nature protection or historically important zones] to prevent opposition.” (interview with Jürg Schildknecht, 2016)

The local dimension refers to the particular directly affected land owners. This dimension is also important for landscape disruption and health risks. On the local dimension openness for solutions means according to Varonier small displacements of the line to consider the wishes of the land owners:

“Different solutions are discussed in negotiation with the land owner in order to reduce the visibility of the power line. The displacement of the line and tower may help. We try to respect the concerns of the land owner.” (interview with Theo Varonier, 2016)

It can be concluded that openness for different solution and technologies is according to the interviewees important on the national, regional and local level. According to Jan Schenk (interview, 2016), the message of the project owner has to be:

“We eventually decide, but we are open for proposals.” (interview with Jan Schenk, 2016)

A solution finding process should to be participative according to the interviewees (further discussed in chapter 4.5.2).

4.4.2. Land use and bundling of infrastructure

The first priority is for the interviewees that a power line is built as far as possible from residential areas. The displacement of power lines from residential areas to peripheral regions has a positive impact on the factors health risks and landscape disruption on the level of the directly affected individuals. The second priority for the interviewees is to integrate the power line as well as possible into the landscape that the visibility of the line is minimal for the affected stakeholders in the region. Here we speak automatically about the factor landscape disruption on a regional level. Jürg Schildknecht states for example:

“As a first priority, settlement areas must be avoided. As a second priority, the visibility of the power line should be minimized. The line may be hidden in the forest for example.” (interview with Jürg Schildknecht, 2016)

According to the environmental organisations, nature protection areas, protected cultural landscapes and landscapes worthy of protection have to be avoided or maximally conserved for the routing of a power line. Raimund Rodewald says for instance:

“Natural reserves and protected areas are no-go’s for high voltage overhead lines. They need to be bypassed.” (interview with Raimund Rodewald, 2016)

In the priority directly after these zones, the interviewees want that local recreation areas will be avoided as far as possible for the siting of an overhead power line. Mostly accepted under the interviewees are power lines in zones rarely frequented by human beings like shadowy forests.

Bundling of infrastructure is according to the interviewees an important measure to decrease the landscape disruption. Bundling could refer to the bundling of different power lines and to the bundling of power lines with other infrastructures. According to the interviewees, the bundling of different power lines on the same pylons and route is highly accepted. The bundling of low-, middle- and high-voltage lines with highest-voltage lines is also done as a replacement measure (see chapter 4.4.3.). The bundling of power lines with other infrastructures could be in form of an overhead line or in form of an underground cable. Underground cables next to or under motorways, rail tracks or in tunnels (e.g. train or car tunnels) are widely accepted among interviewees. For instance, Hans-Ulrich Jakob says:

“A project will be more accepted, if it includes bundling. For example, a high voltage line could be integrated within a motorway tunnel. (...) The line could also be placed under the emergency lane.” (interview with Hans-Ulrich Jakob)

The power line is not visible in this form of bundling and the acceptance is therefore very high. The idea of the interviewees is that if the ground is already excavated due to the construction of the other infrastructure, a power line could be included without high additional costs. The bundling of overhead lines with other infrastructures does also make sense for the interviewees. According to the interviewees, the acceptance is normally higher in regions already hosting with an infrastructure than in infrastructure free zones because the affected stakeholders are accustomed to the infrastructure in their landscape.

A transmission line is a linear infrastructure which can be bundled with other linear infrastructures like other power lines, motorways and rail tracks. It can be concluded that bundling of infrastructure is desirable and important for the interviewees where it is possible.

4.4.3. Replacement measures

The idea of replacement measures is to compensate the caused landscape disruption of the transmission line with for example a cabling of a line with a lower voltage level or afforestation in the region of the line project (Jan Schenk, personal communication, 2016).

According to Heinrich Zimmermann, project manager of Mörel – Ulrichen, objection can be avoided with replacement measures:

“In particular, objections from affected municipalities and environmental organisations could be avoided when using replacement measures. But also private objections might be avoided as long as the replacement measure goes along with a direct benefit for the affected individual.” (interview with Heinrich Zimmermann)

Very good accepted from the interviewees is the cabling of power lines with a lower voltage level. Eva-Maria Kläy thinks that the reason for the high acceptance could be the fact that from these lines more people are affected because they pass through residential areas:

“The cabling of power lines with a lower voltage level is a great thing! It brings a major value to the landscape. Quite many people are dependent on these low voltage lines as they are often located in settlement areas.” (interview with Eva-Maria Kläy, 2016)

According to Raimund Rodewald (interview, 2016), it can be difficult to get the acceptance from the directly affected individuals if the spatial distance between the new transmission line and the replacement measure is big:

“It gets difficult if the distance is big. Then it is easy to lose the acceptance for the replacement measure. I am not saying that it is not possible, it is simply more difficult to communicate. The meaning for whole Switzerland must be demonstrated. There must be a value for the affected individual from the replacement measures.” (interview with Raimund Rodewald, 2016)

If the direct benefit is visible (see also chapter 4.4.4), replacement measures are a good instrument to increase the acceptance for power line projects according to the interviewees.

4.4.4. Direct benefit for the region or the stakeholder

The benefit perception is an important factor for the acceptance of extra-voltage power lines (see Lienert, Suetterlin et al., 2015) (see SFOE, 2015). A big issue of extra-voltage power lines is that the affected stakeholders cannot perceive a direct benefit. The directly affected individuals have electricity in their houses. The transmission line does not deliver the electricity to their houses. The directed affected individual do not profit directly from electricity transit.

The interviewees identify a power plant connection in the region as the most direct form of a benefit due to a power line. They emphasise that if a power line creates jobs in the region, the opposition is much smaller. According to Heinrich Zimmermann, the opposition decreases with decreasing distance to a power plant:

“The closer a region is located to the power plant, the lower the opposition. The opposition is lowest in close proximity. There was not one objection in the municipality Finhaut, where the pump storage hydro power plant Nant de Drance is under construction.” (interview with Heinrich Zimmermann, 2016)

Another direct benefit for the affected stakeholders and regions can result according to the interviewees due to replacement measures (see chapter 4.4.3.) or due to the dismantling of an old existing transmission line in residential area (new line in peripheral area). A direct benefit occurs if the overall situation for a region or an affected stakeholder ameliorates. An example for a direct benefit due to a replacement measure is the cabling of a middle or high voltage line in the residential area.

The third benefit is the most invisible because it has to be understood the electricity system. The transmission grid of Switzerland creates a benefit for the Swiss economy and increases the competitiveness of Switzerland:

“An additional point on the national dimension is the economic benefit of the transmission grid and the related competitiveness of Switzerland. Low electricity costs and a safe transmission grid promote the competitiveness of Switzerland. An example are data centres coming to Switzerland due to the high security of power supply and the low electricity costs.” (interview with Bettina von Kupsch, 2016)

The directly affected stakeholder profits in the end also for example from low electricity costs. According to the interviewees, this benefit should be made visible for the stakeholders. In the end we speak here again about the disclosure of need (see chapter 4.1).

Our results show that it is very important to explain the different benefits for a region and affected individuals caused by a power line project. Furthermore, Göran Andersson mentioned an interesting aspect:

“A very small health risk always exists. There are many other dangers where the benefit can directly be seen, for example in aviation. Here, the risk of falling is somewhat accepted. For high voltage lines, the benefit is not directly observable.” (interview with Göran Andersson)

4.5. Procedural factors

Under procedural factors we understand acceptance influencing factors which occur due to the interaction between different stakeholders during the different process phases of a line project. We identified two essential factors: the public opinion (chapter 4.5.1) and the perceived participation possibility (chapter 4.5.2).

4.5.1. Public opinion

Interest associations like HSUB or Gigahertz have a big influence on the opinion of directly affected individuals. A lot of objections in a project are made with templates of interest associations (Jan Schenk, personal communication, 2016). Raimund Rodewald says further:

“Landscape and environment protection organisations have a big influence on the opinion of directly affected individuals and on the acceptance of the public.” (interview with Raimund Rodewald, 2016)

The affected individuals trust these organisations. Furthermore these organisations are well connected with the local press. If they say something about the project, the local newspaper often print it. Local press is opinion-forming. Interest associations, environmental organisations and the local press have a big influence on the quite large group of affected individuals who are unsure if they should support or oppose against the project (Jan Schenk, personal communication, 2016).

The amount of land owners signing the transit agreement for a line can be influenced by the opposition of a regional interest association:

“Interest associations and the local press might have a massive influence on the opinion of land owners. As an example, the agreement for a line project was only 40 % in areas where an association against electromagnetic pollution had formed, while the agreement was 80 % in the areas where no such association was present.” (interview with Theo Varonier, 2016)

The affected municipalities play as well an important role for the opinion-forming. The municipalities represent the interests of their inhabitants. Marianne Müller, president of the municipality Inden, says:

“It is important that municipalities are well informed about a project from the beginning as they represent the main point of contact for directly affected land owners.” (Marianne Müller, 2016)

The public opinion can be used to put social pressure on the opponents. According to Pierre-Alain Graf (interview, 2015) says:

“It is necessary to have support of a part of the directly affected individuals who convince the rest of them that the project is needed. The project owner needs to have a high credibility in order that the last 10 % of the inhabitants of an affected municipality can be convinced of the project.” (interview with Pierre-Alain Graf, 2016)

Our results the public opinion has a big influence on the acceptance of the directly affected individuals. It is important to involve affected municipalities in a project planning process from the beginning. Further interest associations and environmental organisations have to be involved in the project. They can function on affected individuals as an amplifier of opposition (Cain and Nelson, 2013). The local and regional press plays an important role in the distribution of information (see Kalbermatten, 2015a) (see Kalbermatten, 2015b).

4.5.2. Perceived participation possibilities

Participation is important for the acceptance in each phase of a project.

In the determination of need phase on the national grid plan level it is important to have inputs from stakeholders for different scenarios for the future on which the grid plan is based. In the case of the “Strategic Grid 2025” the involvement of environmental organisations for the SUN scenario was well accepted on the national level according to the interviewees (see chapter 4.4.1).

On the line project level, our interview data suggest that the affected stakeholder should be involved in the planning process as early as possible. According to the interviewees, the different interests of the stakeholder should be taken into account. Hans-Ulrich Jakob says:

“The directly affected individuals have to feel that they are taken seriously and not being laughed at. Their concerns have to be considered.” (interview with Hans-Ulrich Jakob, 2016)

Until today the communication in the sectoral plan process was not enough structured and too reactive in Switzerland (Jan Schenk, personal communication, 2016). The directly affected individuals are not yet directly represented in the support group deployed by the Swiss Federal Office of Energy (SFOE) (see chapter 2.3.1.2.). They are just represented by the canton and not by a representative of a specific region (like someone from a regional planning association).

A project advisory council is a measure to take the interests of the different stakeholders into account. Representatives from the regional environmental organisations, affected municipalities, interest associations and directly affected land owners are members of this council (Jan Schenk, personal communication, 2016). Jürg Schildknecht (interview, 2016), member of the project advisory council of the project “Mörel – Ulrichen”, states:

“The project advisory council is an essential progress in the involvement of stakeholders. Recommendations formulated by the council are taken into account for the process of decision making.” (interview with Jürg Schildknecht)

This participation measure is normally used during the construction project phase (sometimes as well in the project approval procedure). A special form of an advisory council could be also a useful measure to involve affected regions during the sectoral plan process (Jan Schenk, personal communication, 2016).

Our interview data suggest that before and during the project approval procedure the concerns of the directly affected land owners should be considered.

“The land owner should be informed early and have the chance to discuss the routeing on his land if he does not agree with the projected solution.” (interview with Eva-Maria Kläy, 2016)

Our results show that participation can be a big lever if it is well done. Bettina von Kupsch says:

“The participation is a big lever if it is done well. The spirit of a joint decision finding process should evolve.” (interview with Bettina von Kupsch, 2016)

This spirit of a joint decision finding process may increase the acceptance. Our results suggest that the participation possibility should be perceived by the stakeholders that it has an influence on the acceptance.

4.6. Synthesis

The disclosure of need for the grid plan and its line projects is a prerequisite for acceptance and the stakeholder dialogue in the affected regions (see chapter 4.1) (see figure 11). According to the results, affected stakeholders are only willing to discuss about possible solutions for a line project if they understand the need of a project. Besides the disclosure of need, affected stakeholders have three main concerns (see figure 11): landscape disruption (see chapter 4.3.1), health risks (see chapter 4.3.2) and property value loss (see chapter 4.3.3). These three perceived risks have to be minimized to reach acceptance.

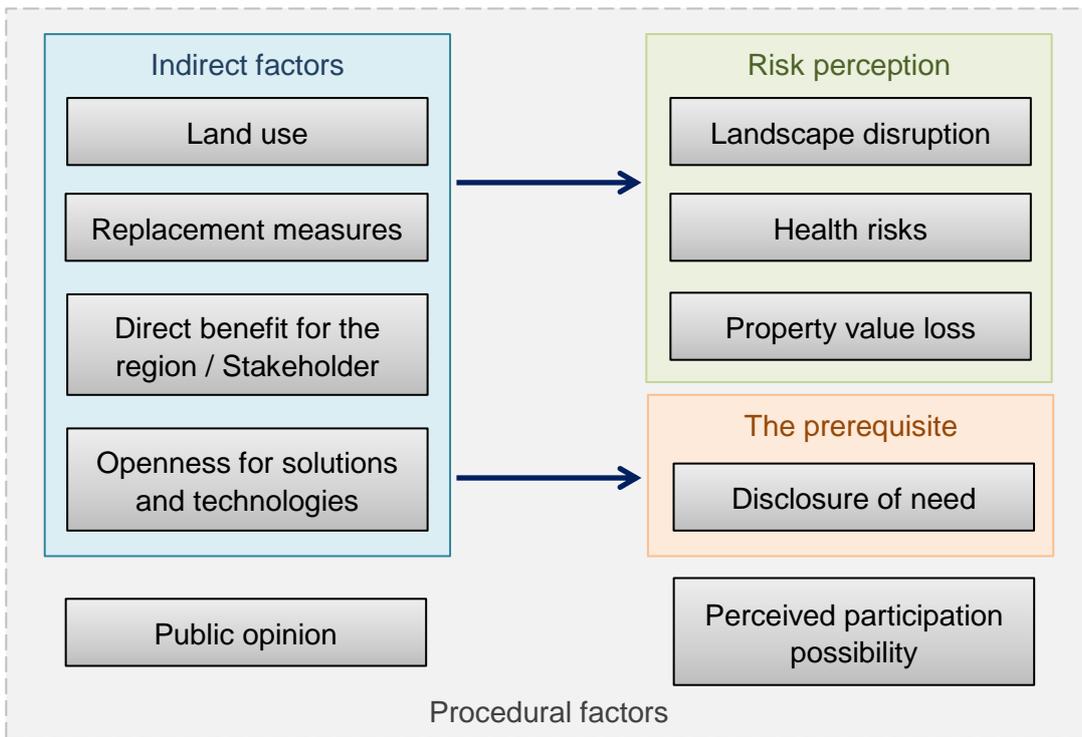


Figure 11: Systematic representation of the acceptance influencing factors (arrows symbolise influences of the indirect factors on the risk perception and the prerequisite)

According to the interview data, landscape disruption and health risks are more important than property value loss. Landscape disruption and health risks influence each other. The data suggest that the visibility of a transmission line may have a direct influence on the perception of health risks. Landscape has an impact on the health (Liebefeld-Leist and SL-FP, 2009). Therefore, the disruption of landscape through a power line may have a negative impact on the health.

Health risks due to the magnetic field of a transmission line are a local phenomenon (see figure 12). A small distance to the power line (approx. until 100 m), these health risks are perceived as relevant by the directly affected individuals. The group of opponents with this argument is therefore always a minority. Landscape disruption is a local and regional influence provoked by the transmission line (see figure 12). The interviewees suggest that the visibility of a power line has to be minimized locally for each directly affected land owner and for an entire region. On the regional level, recreational areas that are important to the inhabitants, protected cultural and nature landscapes can be affected by a transmission line. These landscapes can also have a national importance (see BAFU, 2016). Because of the regional and local relevance of landscape disruption, the group of opponents with this argument against a line project can be big. This group can be partly mobilised by the local group against the health risks.

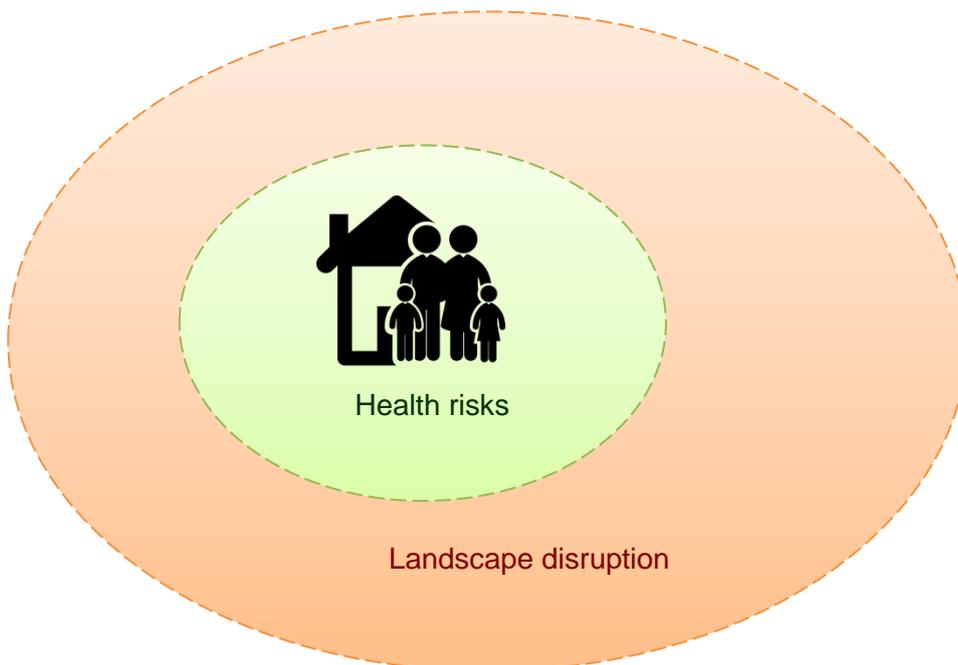


Figure 12: Spatial dimension of acceptance (Icon made by Freepik.com)

According to the interviewees, the property value loss is caused by the health risks and landscape disruption. Measures to decrease the health risks and the landscape disruption therefore also solve the problem of property value losses. A part of the group of opponents with this argument does not have a problem with the landscape disruption and the health risks but is not willing to accept a decrease in the value of their property.

The indirect factors “land use and bundling of infrastructure” (see chapter 4.4.2), “replacement measures” (see chapter 4.4.3), “openness for different solutions and grid technologies” (see chapter 4.4.1) and “direct benefit for the region or the stakeholder” (see chapter 4.4.4) influence the prerequisite “disclosure of need” and the three factors of the risk perception (see figure 11). A positive public opinion (see chapter 4.5.1) and a high (by the affected stakeholders) perceived participation possibility (see chapter 4.5.2) are a good environment for the acceptance of the stakeholders (see figure 11).

5. Discussion

Our results (see above) suggest that:

- The disclosure of need increases the understanding for the grid plan and for a particular line project.
- The disclosure of need increases the acceptance for the grid plan and for a particular line project but it exists criticism related to the timing where the need is disclosed.
- The main issues of power lines formulated by Cain and Nelson (2013) are also valid for Switzerland. Furthermore, indirect acceptance influencing factors like “openness for different solutions and technologies” and procedural factors like “perceived participation possibility” were identified in the Swiss context.

5.1. Disclosure of need

We identified the “disclosure of need” as a prerequisite for the acceptance of all stakeholders. Cain and Nelson (2013) and SFOE (2015) did not identify the disclosure of need as a factor for acceptance. This finding is in line with the results of a not yet published study in Germany (Hildebrand, 2015). RGI (2012) identified the question about “needs for grid” also as fundamental for the grid development. According to RGI (2012), an early engagement with stakeholders on the need for grid expansion can ameliorate the stakeholder dialogue in later in the process. In the past, Transmission System Operators did not often involve public in the determination of need phase (RGI, 2012). Furthermore, stakeholders have concerns whether the alternatives to grid expansion are considered sufficiently (RGI, 2012). RGI (2012) states therefore that it is important to explain the drivers of grid expansion. Our results support these findings.

5.2. Risk perception

We found out that the risk perception in form of the factors “Landscape disruption”, “Health risks” and “property value losses” is mainly relevant for the acceptance of the affected stakeholders. Cain and Nelson (2013) also identified risks of health and safety, impact on aesthetics (here landscape disruption) and property value losses as main drivers of opposition at the individual level. According to Cain and Nelson (2013) the risk perception is very important. Perceived risks can differ largely from actual risks and the perceived risks are often more important than the actual risks. Undetectable risks such as the potential risk from the magnetic field are less accepted than detectable risks. Furthermore, involuntary risks that are not under personal control are less acceptable to most people than voluntary and controllable risks. These findings of Cain and Nelson (2013) have to be specially taken into account for the factor “health risk”.

A study of the perspectives of local citizens affected by a proposed overhead transmission line to connect new nuclear power at Hinkley Point in Southwest England (Cotton and Devine-Wright, 2013) identified health risks as the main concern of the directly affected citizens, more important than the landscape disruption (“visual intrusion”). According to Cotton and Devine-Wright (2013) the proximity of homes and schools to transmission lines is a key issue. “Safe” distances from overhead lines of 60 m up to 600 m were discussed. The study of Lienert, Suetterlin et al. (2015) identifies landscape disruption as the main acceptance influencing factor. The

study suggests informing directly affected individuals about the visual impact of alternatives like underground power lines as a measure against opposition. In the case of Switzerland we did not identify health risks from electric and magnetic fields as more important than landscape disruption or vice versa but, according to our interview data, the intensity of opposition due to perceived health risks can be higher because the own health is in danger. We found furthermore out that the landscape disruption does not only play an important role on the local level but also on the regional (and partially national) level whereas the health impacts are only important if the “safe” distance to the home of the directly affected individual is not reached (see figure 12).

5.3. Indirect factors

Our results identify “Openness for different solutions and grid technologies” as an important indirect influencing factor for acceptance. Cotton and Devine-Wright (2013) also identified the openness for different solution and grid technologies as an important factor for the public support of a line project. According to Cotton and Devine-Wright (2013), the justification of the chosen solution in the context of other alternatives (like cabling in the case of an overhead line) is crucial. Concerning the grid technologies, Devine-Wright, Devine-Wright et al. (2010) found in a nationally representative study of UK adults out that the realisation of a new power lines as underground cables (and not overhead lines) was strongly supported, regardless of the costs. In Switzerland, we also found out that the acceptance for underground lines is higher than for overhead lines (see chapter 4.3.2). There is the nationally active interest association HSUB whose fundamental goal is to achieve the cabling of all power lines.

The study of Lienert, Suetterlin et al. (2015) finds out that optimisations of existing power lines and the introduction of new technologies, which allow for increased capacities without changing the appearance of the line itself, have a higher acceptance than the construction of new lines. According to our results, “Land use and the bundling of infrastructure” is an important indirect factor. Above described finding of Lienert, Süttererlin et al. (2015) does not only take into consideration that existing lines often go through residential areas where generally the acceptance according to our results is very low whereas new lines pass through peripheral areas where the acceptance is higher (see chapter 4.4.2). According to our results, the dismantling of an existing line in a residential area has a positive influence on the acceptance of the directly affected land owners.

Replacement measures are a Switzerland specific factor (see Swissgrid, 2016f). Our results show that the cabling of overhead lines of a lower voltage level is a very accepted replacement measure. According to our results, the acceptance can be positively influenced by replacement measures.

According to Lienert, Suetterlin et al. (2015), a discussion of line projects in the context of the energy transition can help to increase the perceived benefit associated with the power line which consequently leads to higher public acceptance. As explained above (see chapter 4.4.4), our results show that direct benefit is an important indirect factor for acceptance. The energy transition context (contribution of the line projects to the Energy Strategy 2050) is also important for the need discussion (see Federal Council, 2013a) (see chapter 4.1).

5.4. Procedural Factors

We identified “public opinion” and “perceived participation possibility” as procedural factors. Cain and Nelson (2013) also identified the lack of information and notification as a reason for opposition and the creation of community-based protest organisation (here interest associations). Residents feel ignored and excluded. We derive from same findings in Switzerland that the perceived participation possibility is an important procedural factor for acceptance. If directly affected individuals perceive that the planning and permitting process is fair, they are more likely to participate and to accept the results even if they run against their interests (Cain and Nelson, 2013). Cain and Nelson (2013) point out that social interaction plays an important role in the development of individual attitudes. A perceived risk can be amplified due to social interaction. We derived “public opinion” (including the influence of local opposition groups) as a second important procedural factor.

5.5. Limitations of the study

In the quantitative approach of this study, several limitations were identified. On the national grid plan level (survey before and after two big conferences), only participants of the events were included in the data. Furthermore, a big part of the respondents just answered before or after and this data could not be used for the comparison of before and after. The distribution of representatives of the different stakeholder groups of the sample is not representative for the national level (45 % of the participants work in the electricity sector and around 20% are students). On the line project level (survey on the end of three information events of the project Bickigen – Chippis), the sample is incomplete. Only a part of the municipalities affected by the project participated in the events. Furthermore, the participants were asked about the perceived increase of understanding and acceptance due to the event. It was not possible to measure before and after the event like on the national level. Concerning the acceptance the participants were asked about the acceptance change due to the event. At the event, not only the need was discussed but also project details were presented. Therefore, the change in the acceptance can also be partly triggered by the other explanations. On the national and on the line project level, we measured the acceptance by asking if the respondent support the grid expansion/line project. Support is stronger than acceptance, the results are therefore by trend conservative (Batel, 2013). The quantitative approach of this study has some limitations. Nevertheless the quality of the data is sufficient to validate the hypotheses.

We identified three limitations of the qualitative interview method. The interviewees from the line project level are from two exemplary line projects and the findings can be just partially generalised. In other regions, other for the region specific characteristics may occur. The interviewees are influenced by the past. In the past, some project owners acted in a very top-down way without fully taking into account the concerns of affected stakeholders. Furthermore, we interviewed experts (people who are experts in their topic and who are familiar with the subject power lines) and not lay people. Maybe, lay people could give further inputs. The qualitative interviews allowed us despite the limitations to identify the important acceptance influencing factors for the affected stakeholders in Switzerland.

5.6. Further research and implications for the practice

Now we know which factors can foster acceptance in a Swiss context, we still do not know how much influence each factor has for example in which kind of projects, in which phase of a project and for which stakeholder. Further research should focus on this question.

We do not know either how these factors can be addressed in an efficient way. An important question is which communication and participation measures address which acceptance influencing factors and how much.

An essential question for the Transmission System Operator and from the perspective of the Swiss economy is also how the costs due to opposition can be reduced. This leads to the following research question: What is the value of participation in line projects and how many and which types of participation and communication measures are necessary to reach an optimal economic benefit for Switzerland (speeding up the planning and permitting procedures, social acceptance)?

Acceptance on the grid plan level is also important. Further research could also focus on this level. The following questions need to be answered: How important is the acceptance of national stakeholders? What impacts do the Energy Strategy 2050 (specially the Electricity Grid Strategy) and national politics have? How much influence do national stakeholders and the acceptance on the national level have on the acceptance on the regional and local level?

Our results have also implications for the practice. Acceptance is the fundamental objective of the communication and participation process of a line project. The acceptance influencing factors are the levers to reach acceptance. The communication of the Swiss Transmission System Operator Swissgrid has to address these factors with different participation and communication measures. A grid communication toolkit for the will be implemented. Swissgrid will try to address the factors defined here in order to increase acceptance. The most important factors were therefore defined for each project phase, each communication measure and each stakeholder group. The toolkit is an interactive communication concept connected with an event calendar which includes feedbacks and learnings from all events. The communication and participation measures will be improved steadily with the help of the toolkit and feedbacks from the stakeholders.

6. Conclusion

The most important acceptance influencing factors for Switzerland were identified in qualitative semi-structured interviews. Our results are in line with current research. Landscape disruption and health risks are the main issues of power lines, followed by property value losses. Furthermore, the indirect factors “direct benefit for a region or a stakeholder”, “openness for different solutions and grid technologies”, “Land use and bundling of infrastructure” and “replacement measures” and the procedure factors “public opinion” and “perceived participation possibility” are important acceptance influencing factors.

All factors identified here except “disclosure of need” were at least indirectly discussed in the literature (see for instance SFOE, 2015). Our findings show that the disclosure of need is a fundamental factor for acceptance. This factor is fundamental because stakeholders are not willing to accept a line project and to discuss about solutions if they do not understand the need of it. Our quantitative results show that the disclosure of need increases the understanding of the need and the acceptance for the grid plan and for its line projects on a national and regional level. The qualitative results suggested that the disclosure of need is a prerequisite for acceptance. Further research is necessary concerning the influence of each factor (e.g. in each project phase, for each stakeholder group) and about possible communication and participation measures to address the factor.

We conclude that each of the acceptance influencing factors identified here has to be considered and addressed to reach higher acceptance for line projects. The Swiss Transmission System Operator Swissgrid, national and cantonal authorities have to take into account these factors for the communication and planning process of the grid plan and the line projects to avoid public opposition and project delays. It is crucial to start the dialogue with the stakeholders concerning the disclosure of need. If the affected stakeholders understand the need, they are more willing to discuss about possible solutions.

The disclosure of need for grid expansion and the other factors identified in this thesis can help to increase the acceptance of power line projects and may lead to less project delays. These projects may be realised on time and therefore lead to a quicker and better integration of renewable energies and a faster decarbonisation of the electricity sector. The realisation of grid expansion projects within the time schedule is crucial to reach climate change mitigation targets in Europe. Also in Switzerland, the timely realisation of power line projects is highly relevant to reach the goals of the Energy Strategy 2050 set by the Federal Council.

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9. Appendix

A1: Normality tests for the quantitative analysis on the national grid plan level

Table 9: Normality tests for the quantitative analysis on the national grid level

Shapiro-Wilk	Before the event			After the event		
	Question no.	Statistic	df	Sign.	Statistic	df
1	.85	51	.00	.80	51	.00
2	.86	54	.00	.78	54	.00
3	.88	54	.00	.86	54	.00
4	.80	52	.00	.74	52	.00
5	.42	58	.00	.58	58	.00
6	.77	57	.00	.75	57	.00
7	.70	57	.00	.74	57	.00
8	.73	57	.00	.71	57	.00
9	.50	57	.00	.32	57	.00
10	.90	55	.00	.89	55	.00
11	.91	54	.00	.90	54	.00
12	.88	56	.00	.88	56	.00
13	.91	58	.00	.90	58	.00
14	.91	54	.00	.90	54	.00

A2: Exemplary questionnaire of the interviews (Version for municipalities)

1. Was ist das Hauptproblem bei Höchstspannungsleitungen? Warum kann die Akzeptanz für Netzprojekte nicht vorhanden sein?
2. Wie sollte auf dieses Hauptproblem/diese Hauptprobleme eingegangen werden?
3. Wie würde für Sie eine optimale Einbindung in ein Netzbauprojekt aussehen? Wie stellen Sie sich diese vor?
4. Wie schätzen sie Ihre Partizipationsmöglichkeit heute ein? Unter Ihren bisherigen Erfahrungen mit der Netzprojektkommunikation der Swissgrid, werden Ihre Erwartungen erfüllt? Wenn nicht, was fehlt? Was würden Sie sich zusätzlich noch wünschen?
5. Was für eine Rolle spielt die Landnutzung (z.B. Industriezone, Landwirtschaftszone, Naturschutzgebiet etc. sowie Bündelung von Infrastrukturen wie z.B. Autobahnen mit Hochspannungsleitungen) bei der Leitungsführung? Wo finden Sie eine Leitung eher akzeptabel, wo eher nicht?
6. Wie wichtig ist das Verständnis der Notwendigkeit eines Projektes für Sie? Anders gefragt: Akzeptieren Sie ein Projekt mehr, wenn Sie wissen, warum dieses notwendig ist?
7. Welche Rolle spielen Kompensationsmassnahmen wie z.B. der Rückbau von bestehenden Leitungen für Sie?
8. Welche Informationen zu einem Netzbauprojekt wünschen Sie an einer Veranstaltung?
9. Was denken Sie, weshalb das Interesse an den Netzbauprojekten regional unterschiedlich ist?

A3: Interviewees per stakeholder group

Table 10: Interviewees per stakeholder group

Name	Organisation	Stakeholder group
Pierre-Alain Graf	Swissgrid	Project owner
Philippe Hans Meuli	Swissgrid	Project owner
Fritz Hug	Swissgrid	Project owner
Heinrich Zimmermann	Swissgrid	Project owner
Theo Varonier	FMV	Project owner
Bettina von Kupsch	Former Swissgrid	Project owner
Jan Schenk	Swissgrid	Project owner
Jeanine Glarner	Former Swissgrid	Project owner
Professor Göran Andersson	Power Systems Laboratory, ETHZ	Research
Georg Klingler	Greenpeace Switzerland	Environmental organisation
Raimund Rodewald	Swiss Foundation for Landscape Conservation (SL-FP)	Environmental organisation
Eva-Maria Kläy	Pro Natura Oberwallis	Environmental organisation / directly affected individual
Jürg Schildknecht	HSUB	Interest association / directly affected individual
Hans Kneubühler	HSUB / VSLR	Interest association / directly affected individual
Hans-Ulrich Jakob	Gigahertz	Interest association
Franz Arnold	Municipality Spiez (BE)	Affected municipality
Marianne Müller	Municipality Inden (VS)	Affected municipality
Priska Inniger	Municipality Kandersteg (BE)	Affected municipality
Rainer Bacher	Bacher Energy AG / ETHZ	Electricity sector / research
Rita Bolliger	Former swisscleantech	Electricity sector

A4: Excursus about participation

According to Fiorno (1990), there are three arguments for participation. The substantial argument is that lay people (e.g. directly affected individuals) see problems, issues and solutions that expert miss. The normative argument says that “citizens are the best judge for their own interests” and participation is therefore needed from the democratic point of view. The instrumental argument is that lay participation makes risk decisions “more legitimate and leads to better results”. In this study the primary objective of participation is to reach acceptance. Therefore, the instrumental argument is the nearest to describe the reason for participation in this study.

Participation measures include in this study all measures to involve stakeholders in power line projects. These measures can be information events, informal meetings, project advisory councils etc. Participation measures should reach all stakeholders that are relevant for the project.

According to Fiorno (1990), the participation theory suggests that lay people like directly affected individuals can participate. It says further that their concerns have to be taken seriously and their inputs have to be considered in the planning. Citizens should have a possibility to discuss on the same level with officials and experts. Face-to-face discussions have to be possible over the project phases.

There is a paradox phenomenon in the participation process over the different project phases. This paradox of participation lies in the relation between the participation possibility and the engagement and interest of the affected individuals on the scale of the project phases. At the beginning of a project, the possibility to take ideas from affected stakeholders into account is very high but the interest of the stakeholders is very low. The interest is low because the degree of abstraction is high and the realisation is far in the future. This fact makes it difficult to engage stakeholders for an involvement in the early stage of a planning process (e.g. planning territory definition in the sectoral plan process). With the progress of the planning process the interest and engagement increases and the participation possibility decreases (see Figure 13). The project is more and more concrete. The degree of affection increases (Albrecht et al., 2013).

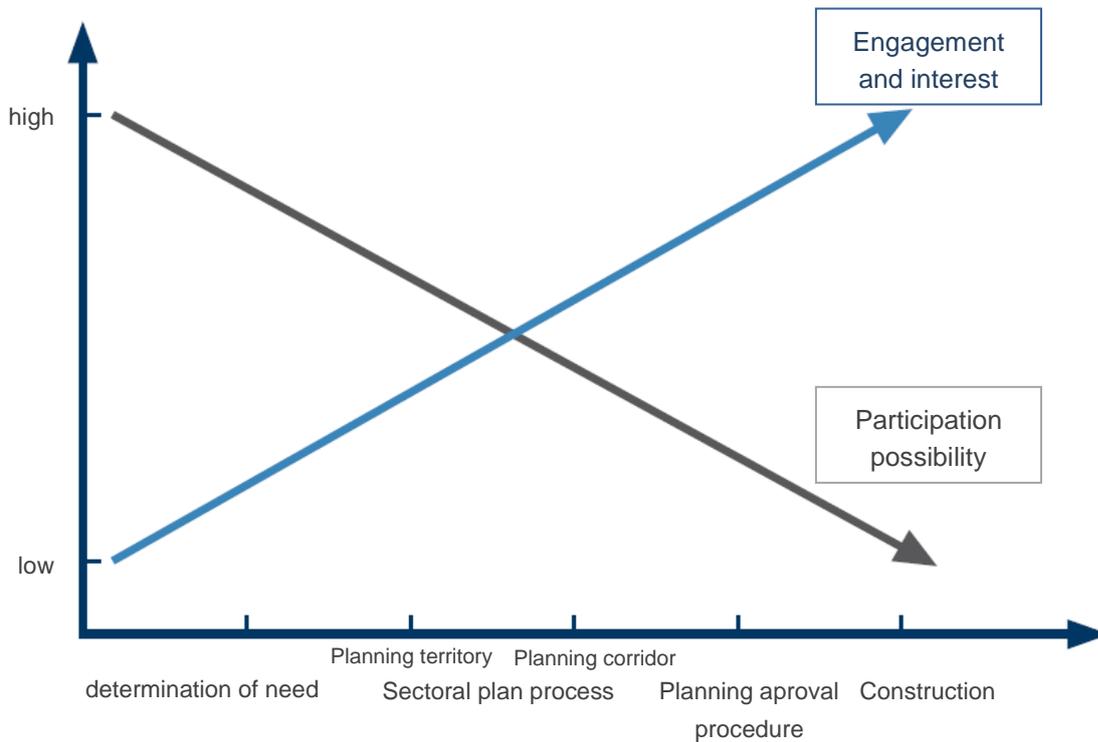


Figure 13: The participation paradox (graphic adapted from Albrecht et al. (2013))

A solution for this issue is to inform as soon as possible and as comprehensive as possible about the project. It is important that the degree of abstraction is not too high (Albrecht et al., 2013).

A5: Excursus about old world vs. new world

There is a paradigm change in the electricity transmission sector according to Pierre-Alain Graf (interview, 2015), former CEO of Swissgrid. In the old world, a technically optimized grid was constructed that allows no critical operating situations. In the new world, critical operation situations are accepted if they can be handled and if the construction of a new line, that is more expensive than the handling of these critical situations can be avoided. Today an economically optimized grid will be constructed.

Furthermore, today everyone has electricity at home. In the old world the power line brought the electricity. In the new world, electricity is a matter of course. The affected stakeholders are more sensitive and engaged. They question more often a line project. It is therefore crucial to have good reasons for a project. A transparent disclosure of need plays an important role (interview with Göran Andersson, 2016).

A6: House of Acceptance

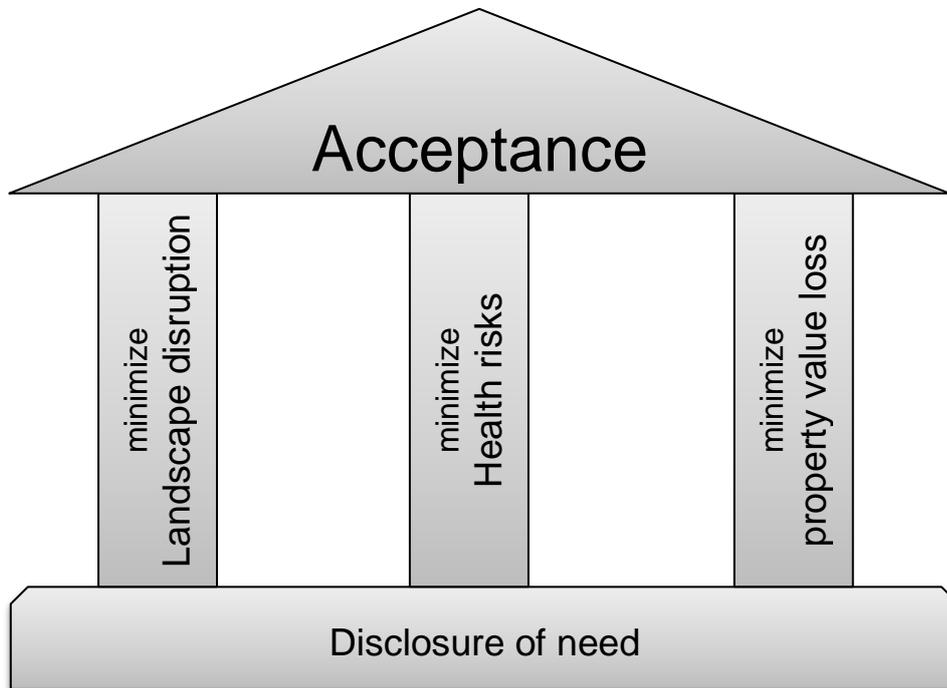


Figure 14: Conceptual dimension of acceptance: The house of acceptance

A7: Short description of the acceptance influencing factors

➤ Disclosure of need

It is crucial that the stakeholders understand that and why a line project is necessary. The quantitative results show that the disclosure of need increased the understanding of the need and the acceptance for the grid plan and its line projects on the national level and on the regional level of each line project. In the interviews, all stakeholders confirm that the proof of the need for a line project is a prerequisite for acceptance. They also say that possible solutions can be discussed as soon as the need is proven.

After the “disclosure of need”, the affected stakeholders have **three main concerns** that have to be minimized:

➤ Landscape disruption

The power line is an intrusion in the landscape. It can be very disturbing for the affected stakeholder. The main objective for this factor is to minimize the visibility of a power line and to integrate the line into a landscape with the greatest possible care.

➤ Health risks

Directly affected individuals are afraid of possible negative effects on their health due to the power line. The main issue is the magnetic field. Studies show that a correlation between the magnetic field of power lines and childrens leukaemia could be possible.

➤ Property value loss

The land owners do not want a financial loss caused through a power line. Landscape disruption and potential risks can decrease the value of their property.

Health risks are a local phenomenon. Only directly affected individuals in direct proximity have this concern. The intensity of opposition due to health risks can be very high. Landscape disruption is relevant on the local but also on the regional level. The affected stakeholders do not want a disruption of their recreational environment. Because of the regional importance of the landscape disruption the biggest possible group of opponents can be mobilised with this argumentation.

Apart of these direct influencing factors, four **indirect factors** are identified. These factors influence the three main concerns and the fundamental factor “disclosure of need”.

➤ Openness for different solutions and grid technologies

The project owner has to be open to different solutions and grid technologies to reach acceptance. Different solutions have to be discussed with the stakeholders.

➤ Land use and bundling of infrastructure

The land use plays an important role for the acceptance. Power lines are least accepted in residential areas. Furthermore, protected landscapes and recreational areas have a high value for affected stakeholders. The bundling of different infrastructures (e.g. power lines with different voltage level, power lines together with motorways) has a higher acceptance than the siting of a new line in a pristine landscape.

➤ **Replacement measures**

The idea of replacement measures is to compensate the landscape disruption caused by the transmission line. One form of compensation is for example a cabling of a line with a lower voltage level or afforestation in the region of the line project. Replacement measures can increase acceptance if a direct benefit for the region and the stakeholders is visible.

➤ **Direct benefits for the region or the stakeholder**

If the line project produces a direct benefit for a region or a stakeholder, the acceptance for the project is higher. A direct benefit can be jobs for the region because of a new power plant. But also the dismantling of an old line or a distribution line in a residential area caused by the project is a direct benefit. Furthermore, if it is possible to make clear the benefit of the power line on the national level and as a result the positive consequences for the stakeholder, the acceptance could increase.

Two **procedural factors** are important during the whole planning and permitting process:

➤ **Public opinion**

Public opinion has a big influence on the acceptance of the directly affected individuals. The support of local politics and authorities and the involvement of interest associations, environmental organisations and the local press is very important.

➤ **Perceived participation possibility**

The stakeholders want to be involved in the planning and permitting process of a power line. It is crucial that they perceive that they can participate in the decision finding process.

The Swiss Transmission System Operator Swissgrid has to take all these acceptance influencing factors into account to reach the acceptance for line projects. The goal of stakeholder participation and communication measures is that the acceptance could be increased by addressing these factors. The disclosure of need has to be included into each measure because of its fundamental character.

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I hereby declare that this written work is original work which I alone have authored and written in my own words, with the exclusion of proposed corrections.

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An evaluation of the acceptance increasing factors for transmission lines in Switzerland**

Author(s)

Last name

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Joshu

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