TRANSITIONS PATHWAYS AND RISK ANALYSIS FOR CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGIES

D3.2 Context of 15 case studies:

Switzerland: Nuclear exit

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1 COUNTRY CASE STUDIES OF THE HUMAN INNOVATION SYSTEM (HIS): THE ENABLING ENVIRONMENT FOR SUSTAINABILITY

This case study focuses on renewable energy in the Swiss context. The driver is the post-Fukushima exit from nuclear power, which is to be replaced with mostly domestic renewable electricity. At the federal level, the political and legislative centrepiece is the Energiestrategie 2050 (ES2050 - Energy Strategy), which envisions covering Swiss electricity demand with new domestic renewables.

Switzerland has one of the wealthiest economies on earth, and already has an almost carbon-free electricity supply because of its many hydropower plants. Due to the unique Swiss system of direct democracy, many actors play key roles in any future expansion of wind, solar and hydropower. As a result, large amounts of political discussion and academic research have been carried out for this renewables transition over the last five years, and the process of defining and implementing the ES2050 is still ongoing.

This case study will present the Swiss electricity sector, first by discussing the broader country context, then by explaining the specific elements of the electricity sector including the life cycle of the electricity sector along with the corresponding policy mix and enabling environment.

1.1 Research questions for the Swiss case study

The overarching research question for the Swiss case study is: "**How can we keep the lights on in Switzerland and increase the share of renewable electricity?**" This is informed by the Swiss Energieperspektiven 2050, a policy document that, for all its 900+ pages, is fairly vague on the exact pathways that are available to make an electricity system that is largely nuclear- and carbon-free (BFE, 2013).

The research questions we pose are as follows:

1. How can we affordably minimise intermittency risks, given dispatch possibilities and potential (daily and seasonal) generation?

2. Which options for high-voltage electricity transmission would Swiss voters find acceptable, and which are the perceived benefits and fears for each technology?

3. What are the dominant perspectives of stakeholders in relation to infrastructure change due to Swiss renewables transition?

4. Which electricity supply options would Swiss voters find acceptable and how strong are their opinions?

1.2 Introduction to the general Swiss energy context

Considerable research has been done on the future of the Swiss electricity system as a result of the Energiewende policies, under the umbrella of the ES2050. Much of this work builds on the earlier measures and goals that came out of the Energieperspektiven 2035 process. The goals for 2035 were overtaken by the Fukushima Daiichi nuclear disaster in 2011.

1.2.1 Policy overview

In the wake of the nuclear disaster in Japan, the Swiss government decided in November 2011 that existing reactors would be used until no longer serviceable, and then replaced by other sources. At this time, there are five reactors in four nuclear power plants: Breznau 1 (1969), Breznau 2 (1972), Mühleberg (1972), Gösgen (1979) and Leibstadt (1984). Breznau 1 is the oldest active commercial nuclear reactor in the world, and its lifespan is now set to a maximum of 60 years. Mühleberg has had technical problems and is the first plant slated for closure in 2019.

The question of a nuclear phaseout has been put to Swiss voters before, with citizens' initiatives losing the vote in 1984, 1990, and 2003. A new referendum on an 'orderly nuclear phase-out' was announced for 27th November 2016, proposed by the Green Party and backed by several others. Electricity companies also withdrew plans to build 3 new reactors in October 2016 when the referendum was announced (SWI, 2016). Interestingly, the Swiss civil service continues to invest in nuclear power. In the energy research plan 2017-2020 of the Swiss government, nuclear is one of five focus areas for energy supply research, including work on new reactor concepts and technologies (Kaiser et al., 2016).

Turning off nuclear power could result in increased emissions of greenhouse gasses, if their capacity is replaced by fossil fuels. However, Switzerland has a policy to reduce its greenhouse gasses, summarised in its Intended Nationally Determined Contributions (INDC) for the Paris Agreement (Switzerland, 2016):

> "Switzerland commits to reduce its greenhouse gas emissions by 50 percent by 2030 compared to 1990 levels, corresponding to an average reduction of greenhouse gas emissions by 35 percent over the period 2021-2030. By 2025, a reduction of greenhouse gases by 35 percent compared to 1990 levels is anticipated. Carbon credits from international mechanisms will partly be used."

This was later clarified to mean a reduction of at least 30% compared to 1990 emissions to be achieved domestically, and up to 20% abroad.

The Energieperspektiven 2050 (EP2050) is the main interim document for setting out the ES2050 (BFE, 2013). Written by the consultancy firm Prognos AG, who wrote a similar document entitled Energiekonzept 2050 for the German government, it essentially functions as a White Paper.

In addition to climate and a nuclear phase-out, Switzerland intend to reduce its longstanding reliance on foreign fossil fuels, mostly oil for transportation and heating, as well as some natural gas. However, for all its length, the EP2050 report is vague on implementation: its main thrusts are efficiency, especially in buildings, e.g. replacing oil heating with more efficient heat pumps, and further electrifying transportation. This all comes together in a set of scenarios for electricity demand and production sources.

The Swiss electricity system therefore faces a turnaround; within a generation, nuclear power plants are to be replaced by renewable electricity. At the same time, electricity will become more prominent in the Swiss energy mix, particularly when electric cars enter the transportation market en masse. Many questions remain beyond this, for example on how to address the risks to energy security introduced by the new sources, and how the Swiss populace feel about them.

The first phase of the Swiss ES2050 has been passed into law by parliament in 2016. The Swiss parliament added several changes in the process, including a support package for hydropower, which has been economically less viable due to current low wholesale electricity prices. However, the new energy law is facing a popular challenge headed by one of the larger parties in parliament (see Überparteiliches Komitee gegen das Energiegesetz 2016).

Bundesamt für Energie (BfE - ministry for energy) is currently working on the next phase of the ES2050. The general goal is to replace Swiss nuclear power with Swiss domestic renewables, with a large role for (existing) hydropower and rooftop PV (Stakeholder interview #1, see section 1.5). Natural gas power plants and imports of foreign renewables are advocated as a stopgap measure in case domestic renewable capacity does not expand fast enough.

1.2.2 Natural resources and environmental priorities

Total energy consumption and emissions in Switzerland are mainly concentrated in private households and transportation, as seen in the table below. Oil products, i.e. petrol, diesel and heating oil, comprise most of these.

Table 1 Swiss total energy demand and CO_2 emissions by sector

Sector	Energy demand (PJ in 2010)	Energy demand (share in total)	CO_2 emissions (Gtonne in 2010)	CO_2 emissions (share in total)
Private households	272	33%	11.6	29%
Transportation	239	29%	16.8	43%
Industry	171	21%	5.6	14%
Services	149	18%	5.2	13%

Source: BFE 2013

Switzerland currently has an almost carbon-free electricity supply. This stems in part from its geography: the mountainous country has ample opportunity for hydropower of both the run-ofriver (ROR) and dam variety. In recent years, hydropower produced around 55% of the Swiss electricity mix, and nuclear power plants around 35% (BfE, 2016)1. Demand for electricity was some 57 TWh in 2015, and households, industry, and services use this electricity in fairly equal measure. Further detail can be found in the graphs and table below:

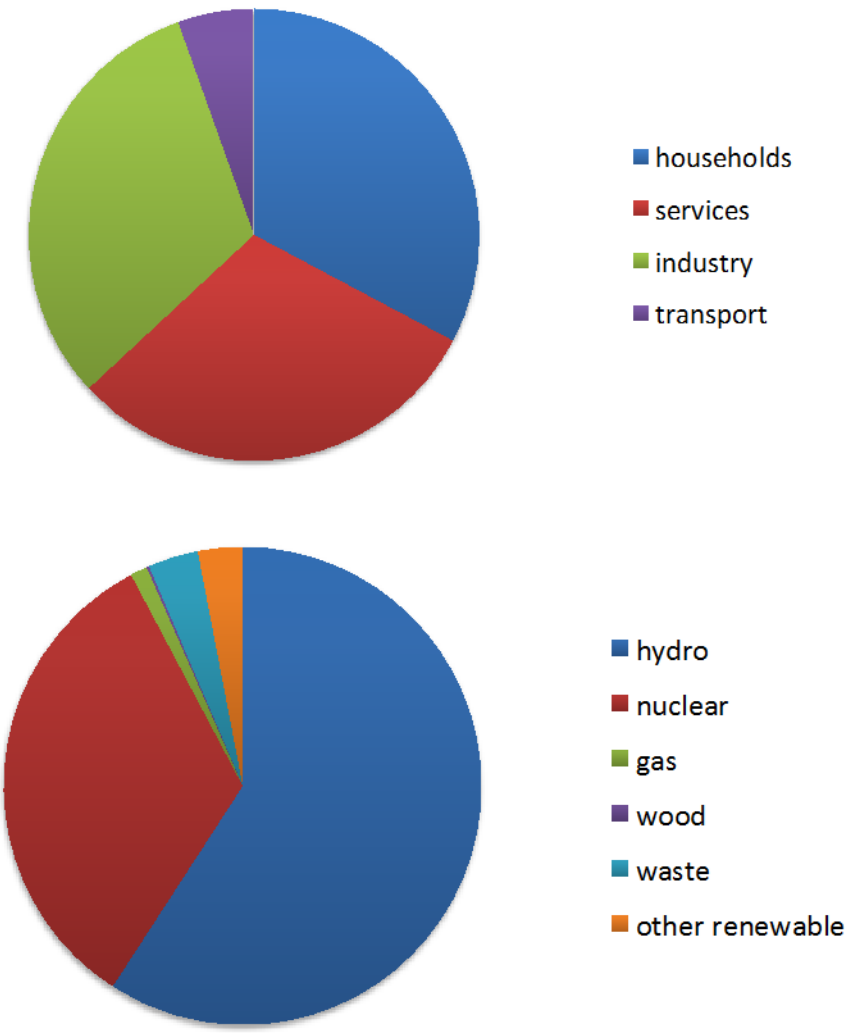

Figure 1 Electricity consumption by sector (top) and supply by source (bottom)

[1] Hydropower and nuclear production vary with available water, i.e. precipitation in a given year, and the outages at nuclear plants, due to scheduled maintenance or unforeseen problems.

Table 2 Swiss electricity demand by sector and supply by source

Demand sector	Share (%)	Volume (TWh)	Supply source	Share (%)	Volume (TWh)
Households	33%	18.8	Hydro	59%	39.5
Services	30%	17.4	Nuclear	31%	22.1
Industry	31%	18.0	Waste	3%	2.3
Transport	5%	3.1	Natural gas & biogas	1%	0.8
			other renewables	3%	2.0

source: BfE 2016

Because of the large share of nuclear and hydropower, Switzerland has relatively low CO_2 emissions per capita at 5.0 metrics tonnes per annum. The country emitted 39.6 million tonne of CO_2 in 2010, of which private households contributed some 29%, services 13%, industry 14%, and transportation 43% (excluding air traffic) (BFE, 2013).

Switzerland has no fossil hydrocarbons or uranium ore, and is therefore forced to import all of its natural gas and oil. Switzerland has some fossil energy resources in the form of potential for deep geothermal heat and power, but experiments in Basel and St. Gallen caused minor earthquakes that resulted in a public backlash. For this reason, geothermal does not play a major role in energy scenarios for Switzerland, except for some long-term scenarios.

In renewables, Switzerland has potential for hydropower to supply over half of the national electricity demand. However, most of this potential is already in use and there is little room to grow. Current estimates from BfE suggest a potential growth of 1500 to 3200 GWh/year, which is less than a 5% increase of existing generation (BfE, 2012). Based on the available knowledge, climate change will not cause a significant decrease in that potential, and may even make hydropower more flexible (Schaefli et al. 2007; Eusgeld et al. 2009, Knüsel in preparation).

Switzerland already produces some of its energy from waste and biomass, but the potential for expansion is considered to be small. Importing waste is not generally seen as desirable, and Swiss farming is mostly geared towards higher-value products for the domestic market instead of biomass for energy. Wood and biogas together (excluding municipal waste) are envisioned to produce some 10% of electricity in the EP2050, but its sourcing is conspicuously absent in the summary for policymakers (BFE, 2013).

The potential for wind electricity in Switzerland is considered to be fairly small. There are steady winds resources in a few areas, like the Rhine valley, but overall winds are very intermittent and the visual impact of wind turbines on the landscape is unpopular. Technical potential for PV is similar to southern Germany or Austria, with large roof areas that could possibly be used for PV, but there is considerable resistance to covering the roofs of traditional houses and buildings for aesthetic reasons. Rooftop PV is gaining in popularity in areas with modern buildings, in part because of high consumer electricity prices and a feed-in tariff (FIT) (Stakeholder interview #6, see section 1.5).

1.2.3 Economic priorities

Switzerland has the 40th largest economy in the world, with a total GDP of $483.1 billion in 2015 (Central Intelligence Agency, 2016). It is also one of the wealthiest economies, ranking 16th in the world with a GDP of 58,600 PP$ per capita. Economic growth was 1.8% in 2013, 1.9% in 2014 and 0.8% in 2015, which is better than many of its European neighbours. Switzerland experienced deflation of 1.1% in 2015, possibly the unintended result of the sudden appreciation of the Swiss Franc against the Euro in January 2015 after currency exchange rates controls were abandoned.

Tourism is a sizeable part of the economy, especially in parts of the countryside, but mostly caters to upmarket clientele because expenses are so high. For example, the ski resort hub of Interlaken has barely 6000 inhabitants, yet it has an airport, multiple 5-star hotels, and its shopping streets are lined with high-end brand boutique shops, attracting many Chinese, Arab and Russian tourists.

Electricity demand projections depend strongly on the policy scenario one subscribes to (Aebi, 2015). Extrapolation of current trends suggests a reduction of 11% of electricity use per capita by 2035. If further electrification of heating and transportation (e.g. electric cars) is assumed with a tightening of efficiency standards, electricity demand may change anywhere between -15.7% and +4.3% by 2035. This is similar to the ranges used in the Energieperspektiven 2050.

Electricity prices are high compared to the rest of Europe, but so are other costs of living and salaries, and high electricity bills do not seem to be a source of public debate. Energy is not a political priority per se. Switzerland has had regular referenda (one every six months in the last three years) about carbon footprint rules or emissions taxes, for example, but none have passed at a federal level. The overwhelming priority has been to not rock the boat too much on the economy, especially with several European neighbours in economic recession.

However, even though the political focus is mostly not on energy, political preferences in other areas still influence energy choices, such as views on the balance between public and private ownership of utilities and their ideal size (see also Lilliestam & Hanger 2015).

Considerable research has been done on the future of the Swiss electricity system as a result of the Energiewende policies, under the umbrella of the ES2050 (Abt et al., 2012; Erdin, Oettli and Zingg, 2012; Holzner, Michel and Schaffner, 2012; Kirchner et al., 2012; Baltensperger et al., 2013). Further research is underway in various institutes and financed, among other sources, by the Swiss National Science Foundation (SNF) in the national research programs, specifically NFP70 (Energy turnaround) with a budget of 37 million CHF and NFP71 (Managing Energy Consumption) with a budget of 8 million CHF (Swiss National Science Foundation, 2016). The Eidgenössische Energieforschungskommission (CORE - Federal Energy Research Commission) is focussed more on technology development. Other research programs provide additional funding, but less specifically targeted at energy policy.

1.2.4 Societal priorities perspective on climate change:

Switzerland has 8.2 million inhabitants as of mid-2016, split into 65% German, 18% French, 10% Italian, and 1% Romansch speakers (Central Intelligence Agency, 2016). Over 70% are nominally Christian. The country has high equality in income with a Gini index of 28.7 in 2012 (ibid, compare to an EU average of 30.9 and a global average of 38.1) but that belies a high inequality of assets owned.

The median age of the Swiss population is 42 years old, and life expectancy is over 80 years (ibid). Swiss are in school for 16 years on average (primary to tertiary education, ibid).

Views on climate change and what to do about it differ widely in Switzerland, from green party supporters who advocate stringent building codes and an accelerated transition to renewables to supporters of the Schweizerische Volkspartei (SVP – Swiss People's Party) who advocate continued use of nuclear power because of its perceived low cost and no changes in energy efficiency standards because they would cost the middle class money and reduce freedom of choice.

Switzerland has a strong interest in mitigating climate change because much of its tourism sector depends on landscape beauty and snow in winter. The agricultural sector is also likely to be affected from reduced rainfall in summer, though this has so far been compensated with additional irrigation (Jörin et al., 2016). Increased flooding and slope instability (e.g. rock slides) are also likely, but are considered a problem that can be solved by technical means.

The Swiss are very attached to their landscapes, also appreciate its utility for tourism. The idea of putting up large number of highly visible wind turbines is therefore met with mixed enthusiasm. Similarly, rooftop PV in quaint and picturesque old town centres is not appreciated.

Due to its unique democracy (see section 1.2.5, below), there seems to be a fairly low risk of a national government imposing its will on local communities without first gaining societal acceptance.

1.2.5 Politics of energy development priorities

The Swiss decision-making system is fairly unique in that Switzerland is a confederation with direct democracy. The confederation aspect (the country code CH stands for its Latin name of Confoederatio Helvetica) is reflected in a strong devolved government. The municipalities and cantons (analogous to provinces, counties, or states in other countries) retain a great deal of autonomy. For example, public holidays in Switzerland differ per canton.

This autonomy stretches into the electric sector in two ways, (1) the cantons have considerable discretion when implementing the national energy law, and (2) most of the utilities operating on the Swiss market are majority-owned by municipalities and cantons.

The direct democracy is exemplified in the Swiss system of Volksinitiativen (People's Initiatives). With a limited number of signatures (100,000 for a national initiative), any citizen can request a municipal, cantonal, or national government to consider a specific action. If the government will not implement it out of hand in some way, they can call a referendum on municipal, cantonal or national level to change policy. If a referendum passes, it becomes law in the same way as a constitutional change - parliament and the executive have no legal way of overthrowing the results.

The political landscape in Switzerland is strongly influenced by the Volksinitiativen, as it is effectively impossible for any minority or collection of interest groups to directly impose their will on a majority of the populace. As a result, the entire political culture is strongly disposed towards comprise and consensus-building. For example, the top executive decisions are made by a Federal Council of seven, who currently include members from four different parties, instead of having a single head of government.

The Swiss political culture, with its decentralised power dynamics and high political engagement, should lend itself to stakeholder learning processes (e.g. Schneider et al. 2009; Soland et al. 2013). A stakeholder learning process should, in theory, be able to deliver a compromise energy strategy that is supported by both citizens and science. However, past research has seen limited effect of interaction between scientists and stakeholders in forming an energy strategy (Trutnevyte, Stauffacher and Scholz, 2011; Trutnevyte, 2014).

Overall, the federal government leans to a more or less integrated strategy combining shares of various energy sources with landscape protection. Local communities seem to place greater emphasis on the integrity of the local landscape and natural environment. Stakeholders who stand to make money from renewable energy (including cantonal authorities who collect concession fees) tend to be in favour.

1.2.6 Conflicts and synergies of priorities

The Swiss have a strong interest and desire for energy independence, often expressed as a desire for electric autarky (Trutnevyte, 2014). This has some dissonance with the import of large volumes of natural gas and oil, and the import of uranium to fuel nuclear plants, and with recent efforts of utilities to invest in renewable electricity generation abroad. Regardless of the current realities of energy use, independence is an aspiration.

Switzerland also has one of the most reliable electricity supplies in the world right now, and its inhabitants see this as the right and proper natural state of things. It seems very unlikely that the Swiss are prepared to compromise on that reliability for the sake independence, climate or a nuclear phase-out.

To our knowledge, security of electricity supply has not been deeply addressed in Swiss studies, though electricity imports have been a small part of wider studies (Haldi et al., 2002; Trutnevyte, Stauffacher and Scholz, 2011; Büsser et al., 2013). We presume that this is largely because

Switzerland has thus far been self-sufficient in electricity generation, but the electricity supply options in the ES2050 suggest this cannot be the case if nuclear power is phased out.

Our research for this case study shows that reliability, climate neutrality, independence, landscape integrity and a nuclear phase-out cannot all be achieved at the same time, but that it is possible to replace the existing nuclear plants with a combination of domestic and imported renewables without infringing on reliability. If Swiss companies can invest in, buy a majority stake, or otherwise gain control over one or two dozen or so wind farms and/or CSP plants abroad, this system would insulate Swiss electricity supply from the intermittency of individual renewable power plants and the resulting fluctuations in prices on power markets.

The prevailing view is that the high attachment of the Swiss to their traditional landscape, and the large number of landscape and nature NGOs, make the construction of power lines, wind turbines, PV farms and conspicuous rooftop PV in historic centres likely to attract opposition. Several research projects are underway to address this directly, and most of the NFP70 projects include an 'acceptance' component.

Barriers to a successful renewables transition are summarised in table 3, below:

Table 3 Barriers to successful implementation of renewables sources

Barriers	**Hydropower in CH**	**Rooftop PV in CH**	**Utility scale wind/PV in CH**	**Offshore wind**	**Mediterranean CSP**
High investment costs	Compounded by low prices	Ameliorated by FIT	Compounded by low prices	Compounded by low prices	Compounded by low prices
Landscape / visual impact	Only for large hydro	Minor	Troublesome	Low population	Low population
Permitting	Nature compensation done	Building owner permission needed	Risky	Transmission line is risky	Transmission line is risky
Intermittency	Base load	Problematic	Problematic	More stable	Thermal storage
Energy independence	Contributes	Contributes	Contributes	Diversification	Diversification
Operational security	Distributed and stable	Distributed	Distributed	Stable	Stable

1.3 The Human Innovation System Narrative

1.3.1 Overview of the development of the Swiss electricity system

No past or current booms in renewable installation have taken place in Switzerland, unlike in Germany where subsidies have caused repeated surges in wind and PV construction, so the commercial business sector around installing PV and wind turbines is relatively small.

Furthermore, the relatively low potential for and issues in obtaining permission for utility-scale wind and PV mean that such projects are rare in Switzerland, to the order of magnitude of just one or two of such projects reaching serious planning per year in the country. Instead, the renewables quota that was introduced by the federal government has caused large utilities in Switzerland to invest into and buy stakes in utility-scale renewable projects abroad, including PV, CSP and wind farms (Stakeholder interview #7, see section 1.5).

On the other hand, rooftop PV installations are growing. This growth is due to rapidly falling prices in PV panel prices, relatively high consumer electricity prices, a FIT, and because only the building owners' permission is needed.

1.3.2 TIS life cycle: a cradle to grave analysis of the electricity sector

We analyse the Swiss renewable supply chain in this section of our case study, with an emphasis on hydro, PV and wind. The supply chain includes companies that physically make the equipment, but also actors that provide services, like research institutes, banks, regulators, etc. The figure below gives an overview of the elements in the Swiss renewables supply chain.

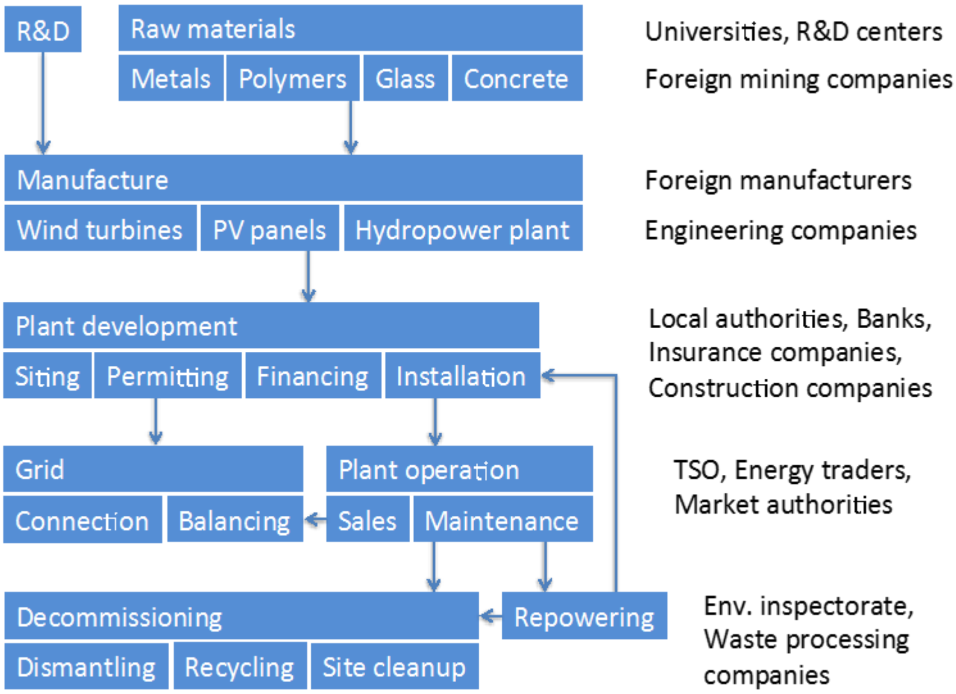

Figure 2 Approximate value chain of renewable energy in Switzerland. Blue boxes represent the elements of the supply chain and actors listed on the right facilitate the links next to them in the supply chain

The life cycle chain operating in Switzerland of PV and wind turbines is fairly limited: none of the resource extraction, transport, and manufacturing aspects the supply chains are in Switzerland. The relevant sections of the life cycle are therefore in installation and use, and possibly disposal of PV. Installation is generally ordered by building owners and local utilities in collaboration, and mostly contracted to small and medium enterprises (SMEs) with specialist knowledge. As we have not seem a large uptake of wind and PV in Switzerland and even less of that has reached end-of-life, decommissioning or repowering are not common practice (yet).

For hydropower, and the geothermal power that we discounted for political reasons, Switzerland has companies that span most of the life cycle. Such projects involve much larger and expensive equipment, and a large force of engineers, and are therefore the province of large construction consortia. Hydropower projects effectively have no end-of-life, with small plants closed for maintenance in winter when the streams that feed them dry up, and larger plants maintaining or replacing sections of their installed capacity at different times.

The electricity grid in Switzerland is owned either by municipal and cantonal utilities, in the case of the distribution grids, or the national transmission system operator, Swissgrid. Swissgrid was formed in 2005 and gradually assumed responsibility for all Swiss high voltage transmission lines, a process that was only completed in 2013. This makes Swissgrid one of the younger TSOs in the European grid system.

Decommissioning a nuclear power plants has never been done before in Switzerland, and therefore there is no industry as such. As noted in section 2.2.1, the Swiss federal government invests in nuclear research, and this research has the stated purpose of training engineers who can carry out the decommissioning of existing plants, as well as maintaining some research capacity in case of a major breakthrough in nuclear research.

1.3.3 Enabling environment: policy mixes in the socio-economic system

The main laws governing electricity are the Energiegesetz (energy law) and the Stromversorgungsgesetz (Electricity supply law). CO_2 emission reductions are governed by the CO_2-gesetz. Together with the Energieperspektiven 2050 as an aspirational guideline, these laws make up the official Swiss energy policy. These national laws are complemented and operationalised by Kantonale Energiegesetze (cantonal energy laws). As noted, Switzerland has defined both a renewable electricity quota and a FIT to stimulate adoption of renewable electricity sources in these laws, combining the stick and the carrot.

At the municipal level, many Swiss town and cities are Energiestädte (energy cities) meaning they have their own goal on energy and CO_2 emissions. For example, Zürich has committed itself via a local referendum to becoming a 2000 Watt society (e.g., people consume 2kW or less on average.

Also relevant are the Umweltschutzgesetz (environmental protection law) and the Bundesgesetz über den Natur- und Heimatschutz (federal law on the protection of nature and homeland). The main laws that apply are summarised in the table below:

Table 4 Swiss policy instruments that directly or indirectly impact the electricity sector

Energy	Energiegesetz Stromversorgungsgesetz	Kantonale Energiegesetz	Energiestädte
Climate	**CO_2-Gesetz**		
Environment	**Umweltschutzgesetz**		
Nature	**Bundesgesetz über den Natur- und Heimatschutz**		
everything	**Volksinitiativen**		

1.3.4 Enabling environment: government institutions

Among governmental institutions, national actors, like the Nationalrat (National council - lower house of parliament) and BfE, set targets but cantons and municipalities have to give permits. Research has shown that Swiss Cantons matter in the successful diffusion of energy policies, and must be supported in order to implement complex energy policies of national interest (Strebel, 2011; Strebel and Widmer, 2012).

Our own work similarly shows differences in interpretation of the official energy policy at national vs. cantonal vs. municipal levels. We surmise that these stem from ambiguities introduced at the time of policymaking, as the various (national) actors made compromises to build agreement around polices. These ambiguities essentially covered up differences in positions, and these differences are coming to light in the implementation phase.

We expect this dissonance to at least delay implementation of the ES2050 as well, and we find that there is no forum for the different levels of government to meet and resolve these ambiguities.

An overview of Swiss government institutions that are involved in the renewables transition is shown in the figure below.

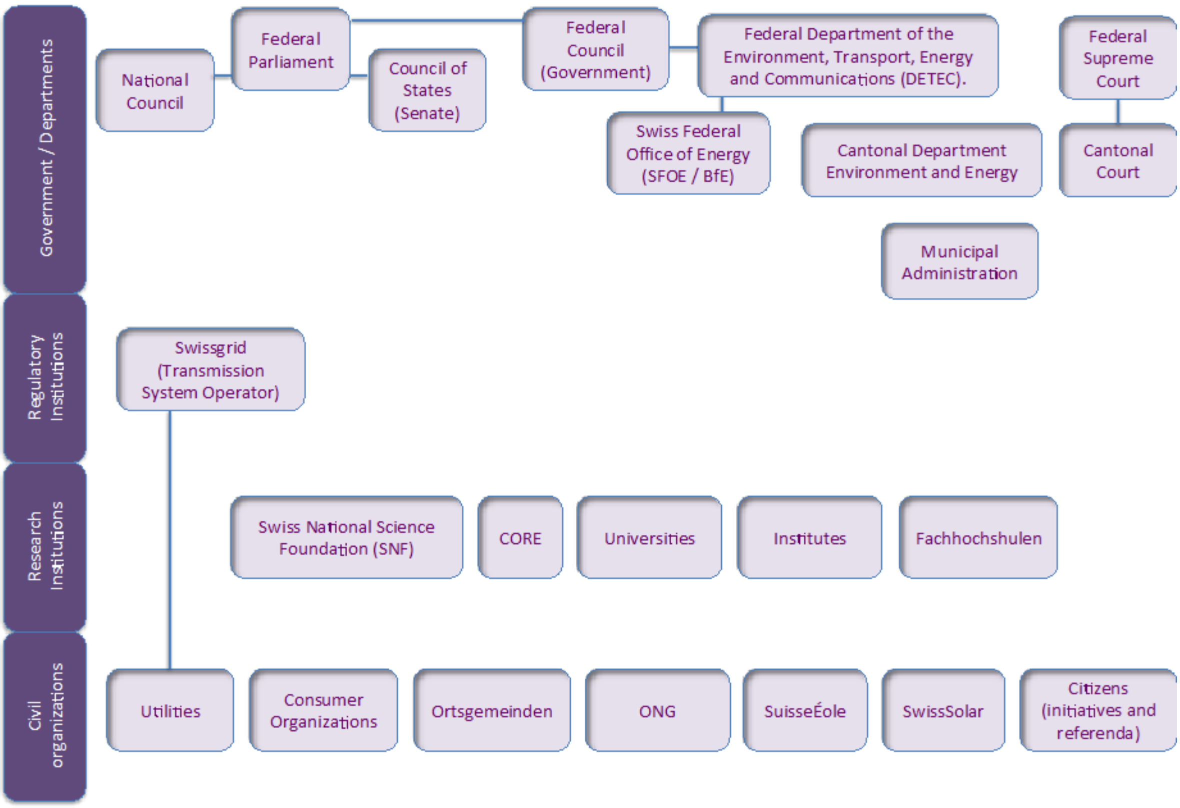

Figure 3 Overview of government institutions involved with Swiss renewables transition

1.4 The Innovation System map

The innovation system map below gives an overview of the stakeholder relations resulting from the completed subset of the intended case study interviews. Beside the national institutions, they primarily include the stakeholders in a small hydro project near Walenstadt (canton of St. Gallen). The final map will include stakeholders from two other (intended) renewables projects and more of the government institutions. The map will be continuously revised as we carry on our research and gain more insights through stakeholder engagement.

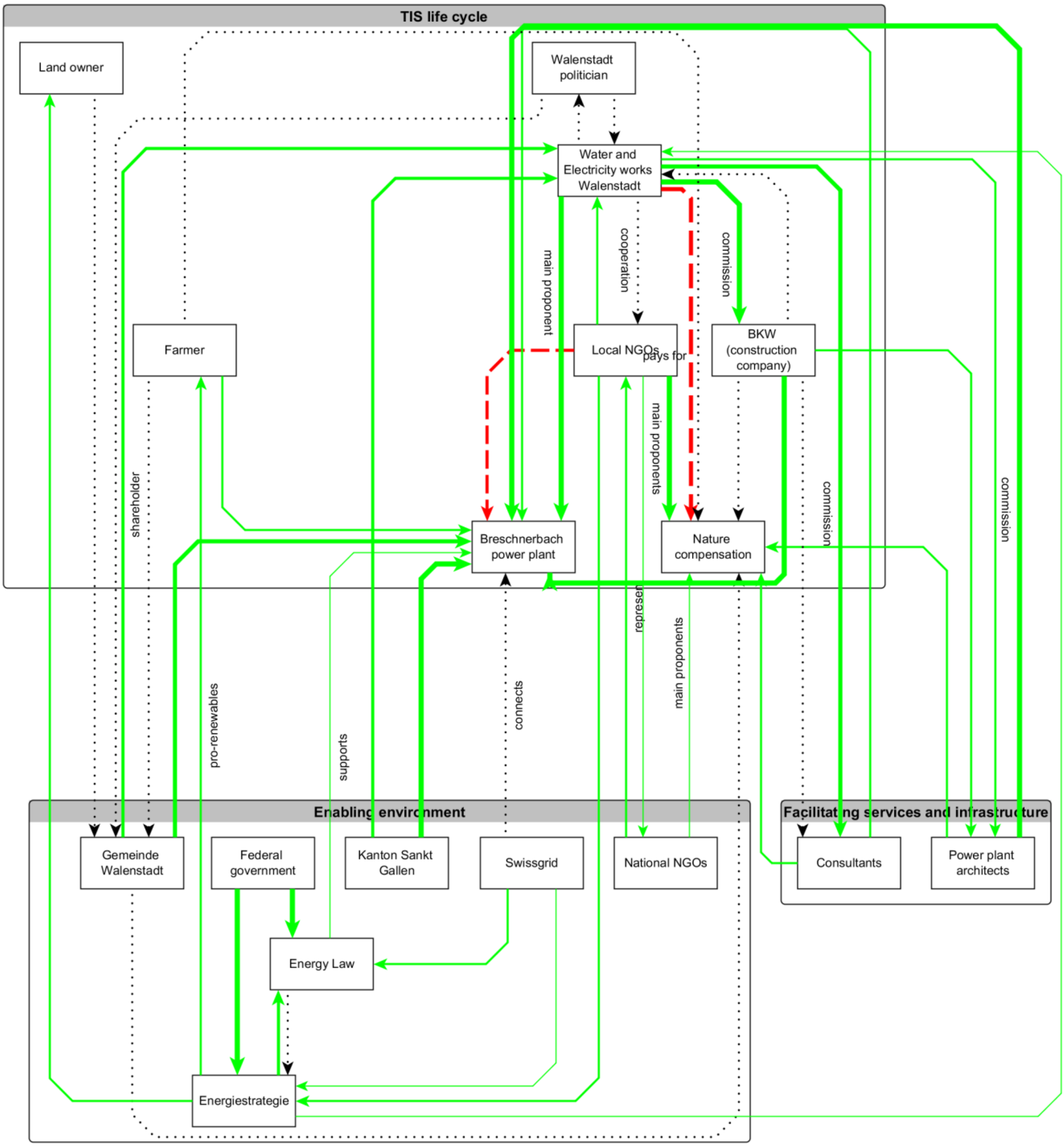

Figure 4 The provisional Swiss innovation system map

Switzerland has a variety of NGOs involved in the decisions around the ES2050, lumped together in the preliminary map above. Some are industry lobby groups like Swisselectric, which represents the large electricity producers that also own the nuclear power plants, and Solaragentur, which represents the PV installation industry. Other significant groups are nature and landscape organisations like WWF, Pro Natura and Aqua Viva and numerous local branches and independent groups that can engage as supporters or opposition to any construction of new plants.

We have found that these groups may get involved when their interests are not directly at stake, for example when Solaragentur joined the nature and landscape groups noted above to secure as much nature compensation as possible from the Breschnerbach small hydropower plant. We assume that Solaragentur intend to make small hydro more expensive compared to PV. Further to the side, Swisselectric lobby against government support for a transition to renewables, arguing that more renewables only lead to expensive and unnecessary overcapacity (e.g Piot 2014).

Switzerland is also home to many associations with a very narrow focus, such as an association to protect the forest in a particular valley. These are not by nature interested in climate change mitigation (or adaptation) policy but will take part in any local decisions, and therefore have considerable influence in siting and permitting procedures. One example is the Talgemeinschaft Sarganserland-Walensee, a local NGO that engaged in the decisions surrounding the Breschnerbach hydropower plant because it involved potential changes in landscape in their area.

1.5 Stakeholder engagement

As of writing, stakeholder contact has mostly been in the form of interviews. A survey among Swiss voters in spring 2017, and a workshop for practitioners and policymakers is scheduled for mid-2017.

Table 5: Stakeholder Engagement (provisional)

	Type of organisation*	Economic sector**	Type of engagement***
1	Government	Energy, Industry, Financial/trader, other	email, telephone & workshops
2	Research/consultancy	Energy, Households, Financial/trader, other	email, telephone & workshops
3	Utility	undefined	email, telephone & workshops
4	Business	Energy, Financial/trader, other	email, telephone & workshops
5	Utility	Energy, Financial/trader, other	email, telephone & workshops
6	Utility	Energy, Financial/trader, other	email, interview & workshops
7	Utility	Energy, Financial/trader, other	email, interview & workshops
8	Utility	Energy, Financial/trader, other	email & interviews
9	Business	Industry	email & interview
10	Government	undefined	email & interview
11	NGO	Environment	email & interview
12	Business	Environment	email & interview
13	NGO	Agric/Forest, Environment	email & interview
14	NGO	Environment,	email & interview
15	NGO	Agric/Forest, Environment	email & interview
16	NGO	Environment	email & interview
17	Research/consultancy	Environment	email & interview
18	Research/consultancy	Environment	email & interview
19	Business	Industry	email & interview
20	Utility	Energy, Financial/trader, other	email & interview
21	Government	undefined	email & interview
22	Government	Undefined	email & interview
23	Government	Energy, Environment, Financial/trader, other	email & interview
24	Business	Industry	email & interview
25	Business	Industry	email & interview
26	Government		email & interview
27	NGO	Agric/Forest, Environment	email & interview

* Government (national / subnational), research / consultancy, business, other (specify)
** Energy, Industry, transport, environment, agriculture / forest, financial / trader, other (specify)
*** Interview, focus group, workshop, survey etc.

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