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# Equally supportive but for different reasons: Investigating public support for national energy transition goals vs. their implementation

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**Abstract**

Energy system transitions in democracies requires to reconcile national interests and central planning with the public's preferences. To find ways of making public support for national energy strategies and technological implementation more aligned, this article investigates public support for the Swiss national energy strategy and two specific technological measures that are part of it: expansion of hydropower and deep geothermal energy. We address two research questions. First, how does public support for a national energy transition strategy differ from public support for the specific technology endorsed in the energy transition strategy? Second, are there differences in the factors influencing public support for these technologies? We investigate these questions empirically with a survey (n=640) focused on understanding the roles that energy expectations, future orientation, knowledge, and trust play in generating support for these two policy levels and between technologies. We find that while general support for an energy transition is well explained by above factors, this is true only to a much lesser extent for technology support. One conclusions is that while political ideologies play a role for the support of general energy transition goals, the support of energy technologies does not seem to be an issue that is politicized (yet?).

Many countries, especially in Europe, are under public pressure to secure the domestic energy supply while simultaneously undertaking large-scale energy system transitions (e.g., Brunix et al. 2013). Historically, such decisions concerning national energy systems were made technocratically, even in democratic societies (e.g., Laird 1990). However, a supportive public has become a key factor in energy system planning and implementation (e.g., Wüstenhagen et al. 2007; Devine-Wright 2007), from siting nuclear used-fuel repositories (e.g., Krütli et al. 2010; Moser et al. 2014; Stauffacher et al. 2015; Lund 2000) to building wind farms (e.g., Wüstenhagen et al. 2007; Jones and Eiser 2010). Hence, in order to realize an energy system transition of such scale and complexity in a democratic setting, countries must reconcile national interests and central planning with the public's preferences.

Many empirical studies deal with public support related to energy policies (e.g., Wüstenhagen et al. 2007; Devine-Wright 2007; Dermont et al. 2017; Stoutenborough and Vedlitz 2016; Batel et al. 2013; Petrova 2013). These studies identify a wide number of contextual (e.g., benefits, risks, fairness, and spatial proximity) and psychological factors (e.g., place-attachment, trust, and individual values) that shape public support. However, many of these studies also find that while there may be public support for

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a specific national policy goal, specific implementation measures required to attain that same goal usually receive much lower approval (e.g., Devine-Wright 2007; Demski 2011). While some of these instances may be explained by personal affectedness (e.g., the "Not In My BackYard" (NIMBY) phenomenon (e.g., Bosley and Bosley 1988; Wolsink 2000), others appear to be more nuanced.

Unlike current studies, we consider two potentially important aspects of public support simultaneously: 1) the policy level (e.g., national energy strategy and specific technological implementation) and 2) the expectations that the public has about the future energy system. For example, at the national energy strategy level, more importance may be placed on energy security while at the technological implementation level, the focus may be on prices; thus, the public may support incompatible policies and policy measures. Likewise, how the public views the future may have important implications for policy support. Though visions and individual expectations have not been given much attention in studies of public support for energy, from research in other fields these factors are known to shape how different actors make decisions (e.g., Truffer et al. 2008; Budde et al. 2012; Upham et al. 2014; Bakker 2011).

To find ways of making public support for national energy strategies and technological implementation more aligned, this article investigates public support for the national energy strategy in Switzerland (Energy Strategy 2050 (ES2050)) and two specific technological measures in ES2050: expansion of hydropower (HP) and Deep Geothermal Energy (DGE). We address two main research questions. First, how does public support for a national energy transition strategy differ from public support for the specific technology policies endorsed in the energy transition strategy? Second, are there differences in the factors that influence public support for the two technologies, one mature, well-known technology—HP—and the other a relatively new, unknown technology—DGE? We investigate these questions empirically with a survey focused on understanding the roles of expectations about the energy system, consideration of future consequences, knowledge, and trust in democratic and scientific institutions play in generating support on these two policy levels and between technologies.

# 1 Background

## 1.1 The case of Switzerland

The current political situation in Switzerland offers a prime illustrative case to study the issue of public support for an energy transition in more detail. First of all, Switzerland has a long tradition of direct democracy, meaning that voters can express their preferences about energy policies or infrastructure projects at the ballot box. Therefore, to enact policies and laws, the Swiss government must build public support for its initiatives. Furthermore, in May 2017, the country narrowly passed ES2050 into law. While the public supported this energy transition overall, the necessary steps to implement it are neither clear nor without controversy.

The key goals of the ES2050 are to substantially reduce energy demand, to gradually phase-out all of the operating nuclear power stations, and to dramatically increase the share of renewable energy technologies—wind, solar, biomass, DGE, and HP. However, to replace the base load capacity currently provided by nuclear energy, Switzerland essentially has the choice between expanding production from HP and DGE and increasing imports of electricity and gas (in order to fuel gas-fired power plants). However, increasing electricity or gas imports compromises ES2050 national energy security and $CO_2$ targets (Schweizer Bundesrat 2012). In addition, there is empirical evidence that electricity imports are highly unpopular among the Swiss population compared to a further development of domestic energy sources (IWÖ, University of St. Gallen 2018). For these reasons, we focus on HP and DGE in this study. ble HP and DGE present two technologies that support the goals of the ES2050, yet they highlight interesting contrasts: In Switzerland HP is a mature, well-known and well-developed technology (Tabi and Wüstenhagen 2017),[1] while DGE is a less-known and trusted technology still in the pilot phase for electricity production. Though not enough to cover all base load needs, there are opportunities to increase HP capacity by raising the height of some existing dams and building new dams in locations where glaciers are retreating (periglacial hydropower).[2] However, an increased usage of HP resources would require compromises with respect to environmental regulations and landscape preservation (Barry et al. 2015; Gurung et al. 2016). DGE shows significant potential,[3] but to the extent it is known, DGE is

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[1] In 2015, HP provided around 2/3 of Swiss electricity demand (Bundesamt für Energie 2017).

[2] Additional capacity for large HP plants could be up to 2500 GWh per year (7.5% additional capacity) (Bauer et al. 2017).

[3] Recent estimates suggest that up to approximately 20% of the current nuclear capacity could be replaced by DGE (Bauer et al. 2017).

controversial due to two DGE pilot projects in the cities of Basel and St. Gallen that had to be stopped because of induced seismic activity.

## 1.2 Theory and Hypotheses

From the literature, it becomes clear that there are many factors that shape an individual's support of energy policies, technologies, or projects. However, the relevance of these factors depend on the context, including—inter alia—the spatial level, the temporal distance, and the concreteness of the issue in question. Considering that we want to draw comparisons between general energy transition support and that of two technologies on a national level for the Swiss case, not all of these factors make sense to include. For example, while there are regional differences in terms of their HP and DGE potential, we expect that personal affectedness only plays a minor role. Considering all of this, this study focuses on the following potential determinants of public support: expectations, future-orientation, trust in institutions, political leaning, and knowledge.

In the field of transition studies, the idea that expectations influence decision-making by key actors and hence shape transitions is well established (Truffer et al. 2008; Bakker 2011; Budde et al. 2012; Upham et al. 2014). In the field of energy research, the concept of (guiding) visions has received a lot of attention as a "central means of mobilizing social actors and the co-ordination of dispersed agency" (Späth and Rohracher 2010).

Important components of successful visions are both appeal and technical feasibility (Trutnevyte 2014). Yet, a range of visions can be defined under a single policy goal. Lilliestam & Hanger 2016 show that even among expert advocates of 100% renewable electricity systems, there can be irreconcilable differences between the energy futures they have in mind. So far, there is little empirical research on how distinct lay people's expectations about the energy future shape these individuals' support of energy policies and technologies.

Yet, other streams of research, such as the *Mental Models Approach* (Morgan et al. 2002; de Bruin and Bostrom 2013), consider individuals' preferences as being integrated into a mental narrative or set of complementary beliefs. Therefore, the decision to support or oppose a policy, technology, or project may be tightly linked to how it conforms to a held narrative. Hence, we expect that *people who assume that the future energy system looks quite different than the status quo would be more supportive of an energy transition and also of HP and DGE, which are required to achieve such a transition.*

As most energy policy proposals and energy technology planning horizons are focusing on long-term outcomes, personality traits that describe how individuals conceptualize and deal with distant future outcomes may be important in acceptability evaluations (Moser et al. 2014). Research in other fields, such as health-related or pro-environmental behavior, have shown that not only issue-specific expectations play a role for individuals' opinions but that also their general future orientation matters (Hoot and Friedman 2011; Daugherty and Brase 2010; Schultz 2001). Thus, we expect that *forward-looking individuals will tend to be generally supportive of an energy transition. Whether such individuals are also more supportive of renewable energy technologies, however, may depend on the extent that they mentally link those technologies to the general goal of an energy transition.*

Trust has been recognized as an important determinant of support and acceptance for infrastructure projects, technologies and policies in energy and other areas (see, e.g., Perlaviciute and Steg 2014; Wüstenhagen et al. 2007; Boholm 2004; Gupta et al. 2012). Trust may come in different forms, such as trust in experts, individuals, organizations, or authorities, whose relevance may be different depending on the issue in question. As the issue of the general energy transition is tightly linked to the ES2050 in Switzerland, we expect that *trust in authorities may be a key determinant of support.* Meanwhile, technology support might rather depend on trust in scientific expert communities. This might be particularly true for DGE because HP has, over decades, proven itself as a relatively reliable and safe technology in Switzerland.

Even though there are various arguments to support an energy transition toward renewables (including reducing import dependence, offering economic opportunities or concerns about resource depletion), the issue is tied to climate change. This topic is in and by itself highly controversial—representing a liberal/conservative divide (Krick 2017; Markard et al. 2016). Hence, we expect that *politically liberal-minded individuals tend to be supportive of an energy transition. On a technology level, the relationship may also turn out to work the other way round as building energy infrastructure requires tradeoffs with environmental protection goals, which, in Switzerland, is particularly true for HP.*

Research on public opinion and decision-science has shown that public support for policies rely partially on citizens' knowledge about the issue (Stoutenborough and Vedlitz 2016; Kellstedt et al. 2008).

By knowledge, we mean the subset of beliefs that can be labeled accurate or inaccurate, based on its congruence with reality (Lupia 2013). There has been increasing attention on the role of knowledge on policy promotion, particularly in technical policy domains, such as public health (e.g., Nestle and Jacobson 2000; Armstrong et al. 2006; Bryant 2002), where understanding of scientific findings can play a significant role. Energy policy is an intriguing policy domain, where certain discussions are highly politicized, while specific implementation of technologies require a high level of technical understanding. Furthermore, it is reasonable to expect that issues related to technologies that have been around for decades could be more politicized, compared to newly-debated technologies. Therefore, one might hypothesize that *citizens rely more on knowledge when they must evaluate a "newer" technology such as DGE, compare to politically-debated national transition goals and the mature technology of HP.*

Energy technologies have a range of specific characteristics. For example, HP dams inevitably entail environmental impacts on aquatic ecosystems or the risk of dam failures. However, research suggests that even identical energy technology characteristics are often perceived differently by people (Perlaviciute and Steg 2014). Therefore, subjective assessments of energy technology characteristics may play a role for their acceptability, even if they might not be fully in line with more objective technology assessments, e.g. concerning environmental impacts or risks from dam failures. Because of the differences in maturity between HP and DGE in Switzerland, we expect that *there is also a difference in how these technologies are perceived and that this impacts public support for them.*

In summary, one can say that we hypothesize that energy system expectations, future orientations, knowledge, and trust in democratic and scientific institutions will influence support for national-level energy policy differently than at the specific technology-measure level. What is more, we argue that, as we shift our focus from a general to a more specific policy target, relatively context-invariant factors, such as future orientation, political ideology and trust in political institutions will gradually lose their explanatory power for support. Instead, factors that provide richer contextual reasoning, such as expectations about the future energy system, knowledge, and technology assessment may pick up their weights.

# 2 Methods

In order to address these questions, we designed an original survey that allows us to distinguish participants' general energy transition support and their energy technology support (for HP and DGE) and measure our hypothesized explanatory factors. The remainder of the section describes the recruitment strategy and sample, the survey structure and content, and our data analysis strategy.

## 2.1 Recruitment of Survey Participants

The online survey was programmed using the software package Unipark[4]. In December 2017, before being finalized, the survey was pretested .[5] For the finalized survey, German-speaking Swiss residents between the age of 18 and 70 were recruited via an online panel, Respondi[6]. The panel members received an invitation to participate in the study, with a small incentive of 0.75 Euro credited upon completion of the survey. The survey was in the field between December 13 and 20, 2017. Our sample based on the online panel is a convenience sample but closely approximates the characteristics of the Swiss population in terms of age and gender, as we screened participants by quota on these two dimensions at the beginning of the survey.[7]

## 2.2 Survey Flow

Contingent on respondents' agreement to take part in the survey, and the clearance by the quota screening, they were randomly assigned to one of two survey flows. Half of the respondents were assigned to a flow focusing on HP whereas the other half focused on DGE. The decision to split up the survey was made based on the experiences from the pretest, keeping it as short as possible in order to minimize negative impacts of survey fatigue on data quality (Galesic and Bosnjak 2009). *Figure 1* provides an overview of the survey flow. The beginning and the end of both survey flows were identical (highlighted by white

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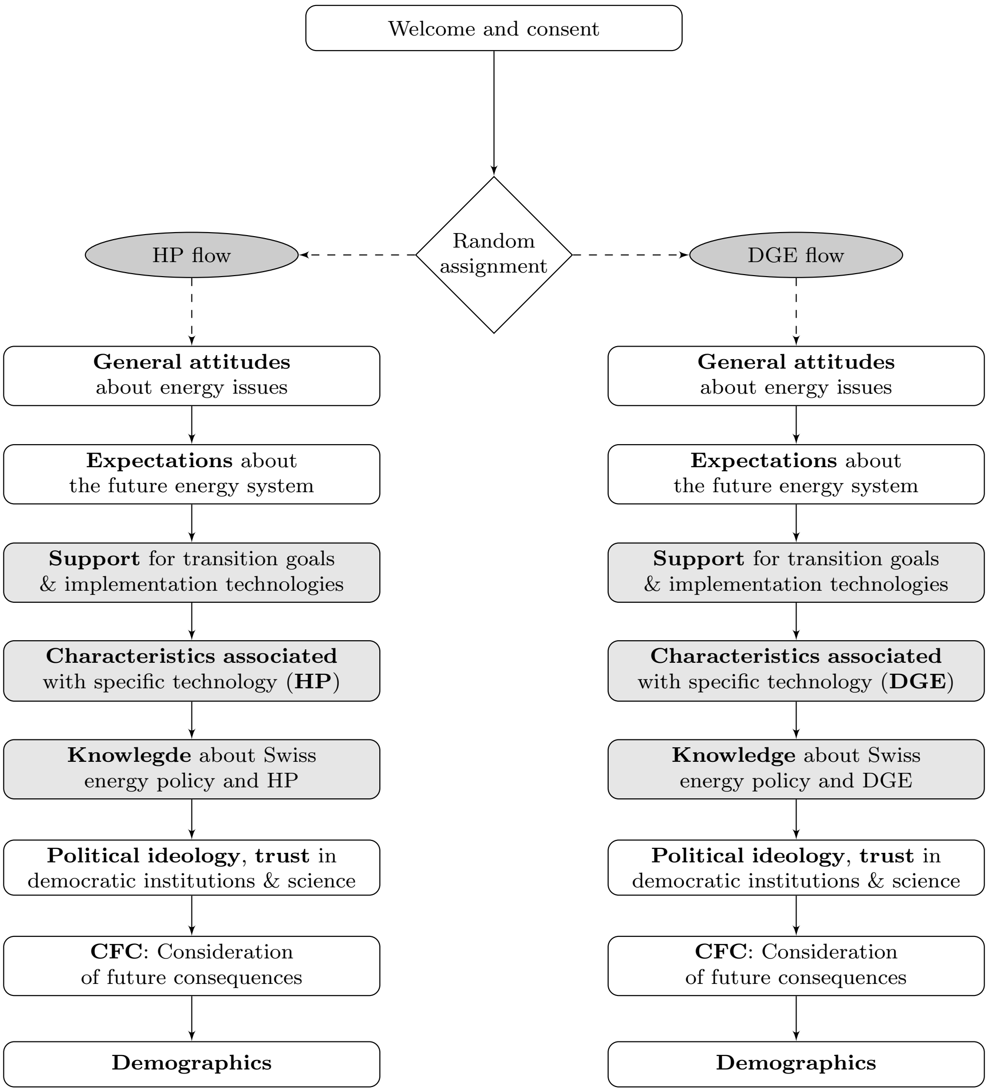
[4] https://www.unipark.com/en/

[5] Pretest was with a convenience sample of $N = 76$, consisting of students and personal acquaintances of the authors.

[6] https://www.respondi.com/EN/

[7] Five age categories were defined per gender. Once a quota was filled, additional respondents belonging to the category were screened out.

**Figure 1:** Summary of survey flows



*Note: Shaded boxes = Item blocks specific to each energy technology (HP or DGE). White boxes = Common survey items across the two implementation technologies.*

boxes). Only the three technology-specific blocks in the middle (shaded boxes) focused on either HP or DGE, depending on the flow assignment. The sequence of survey blocks is as follows.[8]

**General attitudes about energy issues** asks a broad battery of questions regarding participant's general attitudes on energy, such as the level of interest in energy-related topics, their stance with respect to energy-related trade-offs, and preferences for different energy generation technologies. In particular, it contains an item to measure participants' general support for an energy transition (dependent variable).

**Expectations about the future energy system** attempts to capture respondents' vision of the energy system, i.e. how they expect it to change until 2050 in comparison to today. All items refer to characteristics of the energy system that play a role in the current debate about the Swiss energy transition. However, some of them represent continuous developments (e.g., share of renewables) while others represent changes in frequencies of events (e.g., blackouts).

**Support for measures to expand production from HP/DGE** captures the individual-level support of a number of measures that propose to expand the production capacity of a specific technology (i.e., HP or DGE, depending on flow assignment).

**Technology characteristics** measures respondents' intuitive associations towards energy technologies (HP and DHE respectively). This should give indications towards how different technologies are perceived by the public, e.g. in terms of their familiarity and riskiness.

**Knowledge about Swiss energy policy and HP/DGE** measures the level of citizens' understanding of the technology given. This consists of a battery of factual questions to measure an objective knowledge level as well as questions eliciting a self-stated knowledge level about the technology. In both survey flows we also included an item on self-stated knowledge about Swiss energy policy in general.

**Political ideology, trust in democratic institutions, and trust in science** includes several items measuring participants ideology (e.g. party affiliation, political leaning) and trust in key actors and institutions with respect to energy (e.g. politicians and science).

**Consideration of future consequences (CFC)** includes a set of 12 items that measure how much a participant is considering distant future consequences in general, which provides a complement to the more energy specific expectations.

Finally, the survey ends with a block measuring **Demographic characteristics** of participants.

## 2.3 Sample Characteristics

In total, 643 respondents completed the survey[9], out of which 3 observations were dropped. An observation was dropped if the following two criteria were met: the participant (i) completed the entire survey in under 5 minutes and (ii) clicked-to-complete, i.e., choosing the same answer for every question. The final number of observations we work with is 640: 334 for HP and 306 for DGE.

For these respondents, the median duration was 16.3 minutes, and 90% of respondents completed the survey within the reasonable duration of 31 minutes. In terms of age and gender, our sample does compare well to the Swiss population (see *Table 1*). According to the Swiss Federal Statistical Office 2017, the Swiss population has an average age of 42.1 years and a share of 50.3% women. While the 22.7% of people with a university degree in the sample is low compared to the 27% in the Swiss population (Swiss Federal Office of Statistics 2017), the distribution of political party affiliations represents the latest national election results quite accurately (Parteistärke im Nationalrat 2015).

*Table 1* includes the summary statistics for some of the main demographic control variables. The two survey flows are balanced; t-tests confirm that the groups are not statistically different on average over these variables.

## 2.4 Regression Equations

### 2.4.1 National Policy vs. Individual Technology Support

To test whether respondents' expectations of the energy future, attitudinal relationship to the future in general, and political leaning differentially influence their support of policy measures, we estimate a Pooled Ordinary Least Squares (OLS) model. We exploit random variation in assignment to the two survey flows to identify the differences in support by technology and support for the energy transition in general. Though, by design of our survey and quota sampling our survey groups are balanced, we include demographic and observable control variables to improve precision of our estimates. Our linear model is shown below:

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[8] Survey participants did not see survey-block labels.

[9] Completion rate of 82.5%.

**Table 1:** Summary statistics of control variables

| | DGE Version | HP Version | | T-Test | |
|---|---|---|---|---|---|
| | Mean | Mean | Mean Diff | T-Stat | P-Value |
| Male | 0.52 | 0.50 | 0.03 | 0.69 | 0.490 |
| | (0.50) | (0.50) | (0.04) | | |
| Age | 45.01 | 44.38 | 0.47 | 0.39 | 0.697 |
| | (14.89) | (15.26) | (1.20) | | |
| Votes in CH | 0.64 | 0.67 | -0.03 | -0.87 | 0.387 |
| | (0.48) | (0.47) | (0.04) | | |
| Children | 0.51 | 0.47 | 0.04 | 0.99 | 0.322 |
| | (0.50) | (0.50) | (0.04) | | |
| Political Leaning | 3.10 | 3.06 | 0.04 | 0.46 | 0.645 |
| | (0.98) | (0.96) | (0.08) | | |
| Higher Edu | 4.90 | 5.00 | -0.12 | -1.06 | 0.287 |
| | (1.39) | (1.41) | (0.11) | | |

Note: (1) P-values for 2-sided hypothesis tests, $H_0$: Diff = 0. (2) "Higher Edu" = Proportion of respondents with a university degree. (3) "Votes in CH" = Proportion of respondents who are granted voting rights. (4) "Children" = Share of respondents with at least one child

$$Y_i = \alpha + \mathbf{Eexp}_i\boldsymbol{\beta}_1 + \beta_2 CFC_i + \beta_3 politics_i + \mathbf{trust}_i\boldsymbol{\beta}_4 + \beta_5 SA_i + \mathbf{X}_i\boldsymbol{\beta}_6 + \epsilon_i, \tag{1}$$

where $Y_i$ is the policy support outcome variable. $Y_i$ takes on values for support of the energy transition, HP technology expansion, and DGE expansion in Switzerland. We regress these three different outcome variables on a standard set of energy system expectations, $\mathbf{Eexp_i}$; the literature-derived measure of "Consideration of Future Consequences", $CFC_i$; and the political leaning of the respondent, $politics_i$. We furthermore control for trust in democratic institutions, democratic leaders, and science, $\mathbf{trust_i}$; a self-assessment of knowledge about energy topics, $SA_i$; and a vector of demographic control variables, $\mathbf{X_i}$, including age, age-squared, gender, education level, interest in energy topics, whether the person has children, and eligibility to vote in Switzerland.

Our main coefficients of interest are $\beta_1$, $\beta_2$, and $\beta_3$,which correspond to how respondents view the future Swiss energy system — how they think the sector will evolve, their personal attitudes and behaviors regarding future consequences, and political leaning, respectively.

### 2.4.2 Hydropower vs. Deep Geothermal Energy Support

To test the effect of sources of support for the two implementation technologies, we estimate the following equation.

$$\begin{aligned} Y_i = \gamma + \mathbf{Eexp}_i\boldsymbol{\delta}_1 + \mathbf{CFC}_i\boldsymbol{\delta}_2 + \delta_3 politics_i + \mathbf{semantics}_i\boldsymbol{\lambda}_1 \\ + \mathbf{trust}_i\boldsymbol{\delta}_4 + \delta_5 SA_i + \mathbf{X_i}\boldsymbol{\delta_6} + \varepsilon_i, \end{aligned} \tag{2}$$

where the variables remain approximately the same, but we add in a vector of semantic variables, $semantics_i$. These survey questions ask respondents to place technologies on a 7-point scale between two contrasting words; for example, *expensive* and *inexpensive* or *risky* and *safe*. We are interested in the previous coefficients of interest on $\mathbf{Eexp_i}$, $CFC_i$, and $politics_i$, and the coefficients on $semantics_i$. We hypothesize that there will be differences in how the respondents view the two technologies and what aspects are relevant to determine their level of support for each respective technology.

## 2.5 Regression Variables

If not specified otherwise, all items used a 7-point Likert scale, from 1 = don't agree to 7 = agree. B provides a full list of survey items verbatim. Composite scales were constructed with a regression method, using an item-specific weight, computed in factor analyses (FA). A detailed outline of the item selection, associated reliability scores, and factor loadings is provided in C.

### 2.5.1 Dependent Variables

The regression analysis consist of three different dependent variables. *ET Support* (energy transition support) indicates the support for an energy transition as a policy goal while *HP Support* and *DGE Support* represent the level of support for the respective technologies. Each of the three variables consists of a single item.

### 2.5.2 Independent Variables

For **Consideration of future consequences** we included the 12-item CFC scale following Strathman et al. (1994) in our regression model. In line with recent research (Joireman et al. 2008; Schultz 2001; Arnocky et al. 2014), we use the two-dimensional CFC scale, which distinguishes between *CFC Future* and *CFC Immediate*. *CFC Future* consists of five items and indicates the extent to which individuals consider the potential distant outcomes of their behavior and how strongly they are influenced by these potential outcomes. The second subscale, *CFC Immediate*, consists of 7 items and measures to what extent respondents are influenced by immediate outcomes of decisions and actions.

**Energy system expectations** items were adapted from Gregorowius et al. 2015 but in line with the goals of the Swiss ES2050, the year 2050 was given as a reference instead of 2030. Participants were provided a 7pt scale on which the middle represented a situation like today (e.g., 4 = electricity prices remain the same), whereas the two endpoints would refer to a clear increase or decrease (e.g., 1/7 = electricity prices are considerably lower/higher than today). For the regression, we compiled two variables. Variable 1, *Expect innovation*, is based on the following items that represent developments in line with the Swiss ES2050 goals: How the efficiency of processes, machines and gadgets will evolve, how the share of electric vehicles will develop, and how much renewable energy technologies will contribute to the energy supply in 2050. Variable 2, *Expect shortage/conflict*, consists of the items that measure the expectations towards energy related conflicts with neighboring countries, conflicts within the Swiss society over energy infrastructure developments, and the prevalence of power outages.

**Political ideology, trust in democratic institutions, and trust in science**For *Political Leaning*, as the Swiss political landscape comprises a large number of political parties, we used a 5-point left/right scale as a proxy for one's political predisposition. *Trust in dem(ocratic) institutions* were constructed as a composite measrue of 3 items: respondents' confidence in the Parliament, in the Head of the Energy Ministry, and whether they perceive that their vote matters. For *Trust in science*, participants were asked directly about their trust in science, as well as in democratic institutions.

**Knowledge** We constructed both self-assessed and objective measures of knowledge. First, respondents were asked how knowledgeable they consider themselves about Swiss energy policy (*Self-Assessment Energy* in regression models). The item wording was intentionally kept broad, in order to avoid triggering association with any specific energy technology. This measure uses a 10-point scale from Not At All (1) to Very (10). In addition, we constructed two objective composite knowledge measures for each technology: one about HP- or DGE-related issues specifically in the Swiss context (composite of 4 items), and the other about general characteristics of respective technology (composite of 6 items).[10] As listed in Table 8 in C, the final scores are proportions of correct answers, ranged between 0-1. In the main regression models, the self-assessment measure was used, while we also used objective knowledge measures about each technology in robustness regressions.

**Technology characteristics (HP/DGE)** Using a set of bipolar semantic differential items (7-point scales), respondents were asked to place an energy technology (DGE or HP) on a scale between two antithetic words. Contrasting word pairs that are used in the regression are *familiar* vs. *unfamiliar*, *Swiss* vs. *un-Swiss*, *natural* vs. *artificial*, *inexpensive* vs. *expensive*, and *safe* vs. *risky.*

## 3 Descriptive Statistics

Unless specified otherwise, (i) agreement to an issue refers to values of 5 or more on the 7-point Likert scale whereas disagreement refers to values of 3 or below (a value of 4 is interpreted as undecided) and, (ii) results refer to the full sample (HP and DGE flow).

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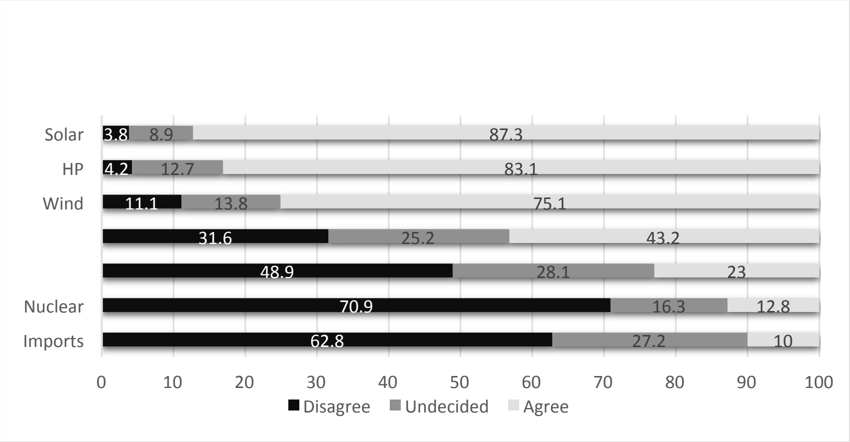
[10] As our study refers to currently debated energy policy goals, we were able to construct objective knowledge scores, as well as self perceptions. Note that, when empirical studies of policy acceptance refer to a hypothetical policy, scholars cannot measure objective knowledge, as one cannot define the "reality" to which the belief should correspond Kachi et al. (e.g., 2015).

**Figure 2:** Share of respondents agreeing and disagreeing to the question "In order to guarantee Switzerland's future electricity supply, new plants of the following energy type are to be built" (n=640)



## 3.1 Electricity Supply Preferences

Overall, the need for an energy transition is widely accepted. Almost 60% of respondents think that an energy transition is necessary and only 10% disagree. Moreover, over half of them think that whenever possible, local energy resources should be utilized and are also willing to accept changes in the landscape that may be induced by the development of renewable energy technologies. In general, there is high support for all renewable energy technologies (see *Figure 2*). The most popular electricity supply options are solar, wind and hydropower. All of them are approved by more that 75% of all respondents, with only a minor share opposing it. DGE is the renewable energy technology that gets the least supported (43.2% agreement). Electricity imports (62.8% disagreement) and nuclear power (70.9% disagreement) are perceived very negatively. DGE also displays a high share of undecided respondents (25.2%), as do electricity imports (27.2% undecided) and gas (28.1% undecided).

## 3.2 Support for HP and DGE expansion options and corresponding technology perceptions

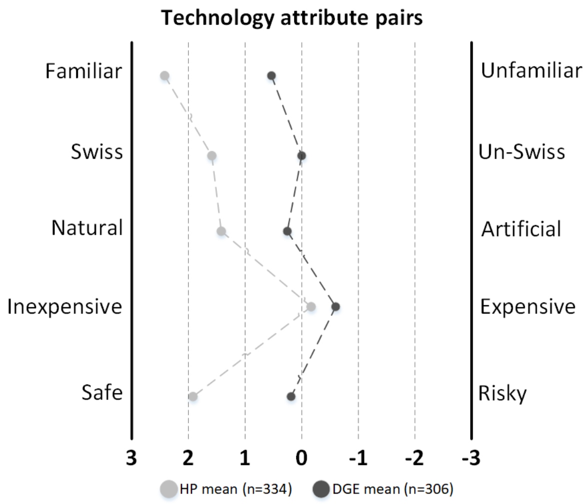
In line with the results in section 3.1, over 83% of respondents generally support measures to increase HP production. For HP, the support of two specific implementation variants (heightening existing dams, building new dams in glacial retreat zones (i.e., periglacial construction) is markedly lower (69% and 63%, respectively). In case of DGE, about half of the respondents (49% agreement) generally support measures to increase production. Compared to that, one implementation variant receives stronger support (DGE projects in rural areas are supported by 56% of respondents), the other receives less (DGE projects in urban areas, 34%.) *Table 2* summarizes the mean support levels (on a 7-point scale) of the aforementioned items.

**Table 2:** Average support for general expansion of HP/DGE as well as different implementation variants (7-point Likert scale)

| | **Support Type** | **Mean** | **SD** | **N** |
|---|---|---|---|---|
| HP Support | In General | 5.49 | 1.192 | 334 |
| | Construction of New Dams | 4.89 | 1.409 | 334 |
| | Heightening Existing Dams | 5.03 | 1.449 | 334 |
| DGE Support | In General | 4.24 | 1.752 | 306 |
| | Projects in Urban Areas | 3.66 | 1.760 | 306 |
| | Projects in Rural Areas | 4.40 | 1.764 | 306 |

Furthermore, HP and DGE are also perceived differently by respondents. The technology attribute comparison (see *Figure 3*) shows that HP is perceived as being more *familiar*, *Swiss*, *natural*, *inexpensive* and *safe* than DGE.

**Figure 3:** Associative assessment of technology characteristics for HP (n=334) and DGE (n=306), using semantic differentials (7-point scale)



## 4 Regression Results: Analysis of Differentiated Drivers of Public Support

We estimate two conditional correlation equations to answer our empirical questions. In *Equation 1*, we use three different policy support outcome variables: support for (1) the national energy transition strategy and support for two concrete measures to implement the national strategy: (2) expansion of the use of HP and (3) the expansion of the use of DGE. These correspond to *Models 1, 3,* and *5* in the main results, see *Table 3*. These three models include the same set of independent variables for comparability across conditional correlations. *Equation 2* includes additional independent variables to explain individual technology support. As evident from closer inspection, the models controlling for additional preferences (*Models 2* & *4*) explain more variation in the measure of public support for the different technologies.

**Table 3:** Impact of general attitude, future visions, and knowledge on support for general and specific energy policies in Switzerland.

| *Dependent variable* | HP Support | | DGE Support | | ET Support |
|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
| | Eq. (1) | Eq. (2) | Eq. (1) | Eq. (2) | Eq. (1) |
| CFC Future Std. | 0.0400 | 0.0469 | -0.1595* | -0.1004 | 0.3686*** |
| | (0.1042) | (0.0539) | (0.0742) | (0.0816) | (0.0463) |
| CFC Immediate Std. | 0.0065 | 0.1168* | 0.0335 | 0.0204 | 0.0078 |
| | (0.0525) | (0.0466) | (0.0818) | (0.0828) | (0.0435) |
| Expect Innovation Std. | 0.0984 | -0.0097 | 0.0006 | 0.0666 | 0.2406*** |
| | (0.0638) | (0.0589) | (0.1017) | (0.0635) | (0.0254) |
| Expect Shortage/Conflict Std. | -0.1270** | -0.0705 | 0.0875 | 0.2062** | -0.0465 |
| | (0.0415) | (0.0401) | (0.1447) | (0.0707) | (0.0405) |
| Trust Demo Institutions Std. | 0.0701 | 0.0506 | 0.1361 | 0.0902 | 0.0611 |
| | (0.0575) | (0.0307) | (0.1058) | (0.0696) | (0.0409) |
| Trust Science | 0.1166 | 0.0745 | 0.3525** | 0.3088*** | -0.0530 |
| | (0.0713) | (0.0388) | (0.0961) | (0.0736) | (0.0430) |
| Political Leaning | 0.1468* | 0.0833 | 0.1326 | 0.0520 | -0.3428*** |
| | (0.0676) | (0.0659) | (0.1626) | (0.0843) | (0.0733) |
| Knowledge measures: | | | | | |
| - Self-Assessment Energy | 0.0211 | -0.0025 | -0.1913*** | -0.1744*** | -0.1277*** |
| | (0.0442) | (0.0363) | (0.0416) | (0.0245) | (0.0245) |
| Technology-associated characteristics: | | | | | |
| - Swiss | | 0.1681*** | | 0.0761* | |
| | | (0.0418) | | (0.0312) | |
| - Natural | | 0.2589*** | | 0.2873*** | |
| | | (0.0296) | | (0.0477) | |
| - Safe | | 0.1586* | | 0.2976*** | |
| | | (0.0704) | | (0.0359) | |
| - Familiar | | 0.0863 | | 0.0961* | |
| | | (0.0552) | | (0.0458) | |
| - Inexpensive | | 0.0227 | | 0.1110 | |
| | | (0.0501) | | (0.0551) | |
| Controls | Yes | Yes | Yes | Yes | Yes |
| Adj. R-Squared | 0.079 | 0.343 | 0.210 | 0.545 | 0.417 |
| Observations | 329 | 329 | 298 | 298 | 627 |

Note: Standard errors are clustered at the canton level. Control variables include gender, age, age-squared, parent, whether respondent can vote in Switzerland, whether respondent has spent majority of time in a canton with a large share of DGE or HP, education, whether respondent is interested in energy topics, prefers local sources of energy, and if they support importing energy. $^{*}p<0.05$, $^{**}$ $p<0.01$, $^{***}p<0.001$

## 4.1 Support for National Energy Strategies versus Technological Implementation

To grasp the overall picture, we first interpret the results by comparing *Model 1, 3* and *5*, which focus on the effects of beliefs and ideology. Our overall findings confirm the point of departure of the present research: the factors that help explain the variation in support for the three outcome variables do not show a distinct pattern when conditioned on this base set of variables, neither between support for the general transition strategy and specific measures *(Model 5* vs. *Model 1* & *3*) nor between the two specific measures (*Model 1* vs. *3*). This result suggests that at the national energy strategy level different variables explain support than at the local, implementation level. The difference in the *Adjusted* $R^2$ supports this finding: *ET Support* (0.417), *HP Support* (0.079), and *DGE Support* (0.210).

Still, we can draw more concrete inferences from this first conditional correlation: *CFC Future* scores are a significant factor in explaining support for the national transition strategy. As the respondents' *CFC Future* score increases by one standard deviation from the mean, support for general energy transition goals (*ET Support*) increases by 0.369, which corresponds to a 6% increase in support ($p < 0.001$).[11] This stands in contrast to support for specific implementation measures (*Model 1* & *3*). There, estimates are either significant only on a much weaker level or they are not significant at all. Consideration of immediate consequence (*CFC Immediate*) neither explains support for the energy transition nor for energy technologies. Thus, individuals' tendency to consider future consequences is primarily responsible for determining their support for general transition goals.

We have two main findings regarding respondents' expectations on how the energy system will evolve in the future. As their beliefs in the expansion of renewables, electric mobility, and technology efficiency (*Expect Innovation*) increases by one standard deviation from the mean, support for the energy transition improves by 3% ($p < 0.001$) (*Model 5*). No such effect was found for support of HP or DGE (*Model* 1 & *3*). Beliefs related to various concerns about the future energy system (*Expect Shortage/Conflict*)—i.e., shortages in electricity supply and conflicts among neighboring regions and countries—reveals a different picture. It is associated only with HP—support for HP expansion is 2% lower ($p < 0.05$) among those who are one standard deviation more concerned than the mean.

Though classic political science literature suggests that policies may not be approved by citizens unless they have confidence in their own government (see Section 1), none of the support variables seem to depend on *Trust Demo(cratic) Institutions*, a composite measure of respondents' trust in the Parliament and the head of the Energy Ministry, and a measure of whether respondents believe their vote matters.

On the other hand, self-stated *Political Leaning* (from left (1) to right (7)), which indicates where a subject places itself on the political spectrum, has a significant effect on support for general transition goals. As one moves toward the right by one unit, the support score decreases by 0.343, which corresponds with a 6% decrease. We find no such effect on DGE support while there is a positive effect on support for HP with a substantially lower estimation precision.

However, we see that support for DGE increases by 6% as trust in science (*Trust Science*) increases by a standard deviation from the mean (*Model 3*), no such effect was found for national transition strategies or HP. This result stands in interesting contrast to the effect of *Political Leaning* (from left (1) to right (7)), hinting at a higher level of politicization and traditional Swiss preferences toward HP and national goals, compared to DGE.

Finally, respondents' own assessment of knowledge about Swiss energy issues *Self-Assessment Knowledge* (10-point scale: none to a lot) is negatively associated with support for the national transition strategy and the expansion of DGE, but not HP expansion. One-unit increase in self-assessed knowledge leads to a 2% and 3% decrease in support for national transition goals and DGE, respectively. In other words, the more respondents believe they know, the less they support DGE and the energy transition.

This first set of comparisons among *Model 1, 3,* and *5* provides us with a broad insight into the differentiated public support for general transition goals versus specific technologies. Additionally, we consider more potential drivers of public support for the two implementation technologies: perceptions of technologies.

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[11] As all our dependent variables are 7-point scales, we interpret that, for instance, 0.369 increase on this scale as $(0.3686/(7-1)) \times 100 \approx 6\%$.

## 4.2 Support for Technological Implementation: The "Mature and Known" versus the "Newer and Unknown"

We estimate *Equation 2*, which now includes respondents' perceptions of five characteristics that are often referred to in the context of implementation technologies in Switzerland. *Model 2* and *4* in *Table 3* summarize our findings. Overall, the explained total variance of both *HP Support* (*Model 2*) and *DGE Support* (*Model 4*) become more than twice as large compared to the previous specification, which brings them to a level comparable to that of *ET Support* (*Model 5*).[12]

Out of five included technology-specific characteristics (all measured on a 7-point scale: higher score indicates more agreement with characteristic), *Swiss*, *Natural*, *Safe* are significant factors in explaining support for both technologies. The relative importance of these three characteristics differs slightly between the technologies, but one's perception of the technology as "natural" seems to be important for both. A unit increase in *Natural* boosts the support of the respective technology by 4% (HP) and 5% (DGE). Interestingly, respondents' perceptions of safety is twice as important for supporting DGE than HP.

Finally, after controlling for five technology-associated characteristics, it becomes evident that the roles of forward-lookingness, expectations, and trust are different between the two technologies. In fact, support for HP depends on none of the belief variables (including *knowledge*), except for *CFC Immediate*, which is weakly significant (*Model 2*). In contrast, two types of beliefs—*Expect Conflict/Shortage* and *Knowledge*—stand out as important drivers for support of DGE, and *Trust Science* remains important as well.

Taken together, we can see that the variables included in our conditional correlations matter. That is, more and different factors contribute to respondents' support of individual technologies than for an overarching national energy strategy. We also see that across technologies, respondents' condition their support based on differing expectation, forward-looking, knowledge, and trust factors.

# 5 Discussion

The goal of this study was to understand better how a set of explanatory factors differentially affect support for different energy policy goals. In particular, the study explored determinants of public support for an energy transition and for technology specific support for DGE and HP, the two primary options to replace the base load power currently provided by nuclear power in Switzerland. A discussion of the key findings follows.

## 5.1 Determinants of energy transition support

We find that the our model, which includes individuals' future orientation, their expectations about the future energy system, knowledge, and trust in political and scientific institutions, does provide a fairly good explanation of the variance in general support for an energy transition. This is generally in line with other studies, finding, for example, that high CFC individuals tend to be pro-environmental (Hoot and Friedman 2011; Arnocky et al. 2014) and that beliefs and vision with respect to a specific issue can inform opinions - both in energy (e.g., Lilliestam and Hanger 2016, Trurnevyte, 2012, Blumer, 2016) and other fields (e.g., de Bruin and Bostrom 2013, Morgan, 2002). What is more, our results show that the political leaning of participants corresponds to their position with respect to an energy transition. This is in line with the situation in many countries around the world, where the debate about climate change and the need for an energy transition is quite polarized, following a fault line between liberals and conservatives (Markard et al. 2016; Krick 2017). However, one surprising finding is we did not find any effects of trust—neither in political institutions nor in science.

## 5.2 Technology support decreases with level of detail

With respect to the general technology preferences, our results compare well to other studies in Switzerland (e.g., Dermont et al. 2017; IWÖ, University of St. Gallen 2018). This means that HP is among the most preferred electricity generation technologies with nuclear power being the least popular one, as is the option of increasing imports. Meanwhile, DGE falls somewhere in between, but is still seen positively by a majority of respondents. Yet, we also find that general support for a technology tends to be higher

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[12] The reported values in *Table 3* are *Adjusted R-squared* values, meaning that they are not necessarily inflated simply because of the larger number of included explanatory variables.

than support for implementation variants of the same technology. For instance, the support for increasing HP production is higher than that of heightening a dam or building a new plant in a periglacial area. One explanation for this is that when bringing up more concrete implementation variants of a technology its negative implications become more salient (e.g. trade-offs with environmental goals). In fact, it is a common pattern that support for renewable energy technologies is highest when there is little or no contextual information available (Demski 2011).

The results of our regression analyses point towards a similar direction, as the set of factors that turned out to be important predictors of support for the energy transition are much less effective in explaining support for specific technology, DGE and HP: Neither how an individual sees the (energy) future nor their political leaning plays a role for technology support. This may suggest that participants in general did not link these technologies and the more abstract issue of an energy transition, i.e. see them as separate issues. However, adding perception of technology characteristics to the model does improve its explanatory power considerably, particularly for DGE. This is in line with construal level theory (Liberman and Trope 1998, e.g.,), which suggests that attitudes can be best explained by factors on a corresponding level of abstraction and that desirability plays a bigger role for decisions with distant rather than near future outcomes. Accordingly, long-term perspectives might help people to make choices that are more in line with their core values (Spence et al. 2012).

## 5.3 Technological context matters

Our results do not only show differences between support for an energy transition and technologies. We also find key differences within the technology level, reflecting that HP and DGE differ in many respects. What is striking is that the model barely explains any variance for HP support, while for DGE, it works relatively well. One explanation is that HP has been such an integral part of the Swiss energy system for more than a century that most Swiss people have a very differentiated and personal opinion of it, which is shaped by personal experiences and past political debates. For DGE, in contrast, factors that seem to be connected to support include trust in science, knowledge, and the perception of its risks. There are several possible explanations for these patterns. One may be that it may be less intuitive for lay people to grasp the core concept of how DGE projects produce electricity (Trutnevyte and Ejderyan 2017). Consequently, it might make sense for people to rely on scientific expertise in the case of DGE. Furthermore, the media coverage of DGE might also have played a role, following the stop of two pilot projects in urban areas after inducing seismicity (Hirschberg et al. 2015; Stauffacher et al. 2015). An interesting finding, which might be related to this, is that there is considerably more support for DGE in rural areas.

## 5.4 Critical reflection

To compare how HP and DGE support relate to each other among the same respondents, it would have been preferable to give both technologies to all participants. However, this would have made the survey considerably longer, which might have had negatively affected the data quality. This is why we deliberately opted for a split survey flow. Another limitation of this study is that it is not suitable to draw direct conclusions for energy policy support, as the sample is not representative of the Swiss population of eligible voters. For example, we only covered the German part and we did not separate the voting population from the residents. However, the study does provide insights into mechanisms for support of energy policies that need to be further analyzed in future studies. In particular, we advocate for more studies that look at the determinants of energy policy support on different levels, as well as their interactions.

# 6 Conclusion

Public support for energy, as well as differentiated support for general and specific policies goals—especially in relation to the notion of NIMBY—have been the focus of much research. The most significant contribution of the present study lies in our findings that identify some of the sources of such differences in support. Our study finds that an individual's evaluation of national energy transition goals significantly depend on his or her political ideology. Moreover, we find that it also depends on one's forward-looking trait, expectations about the innovative aspect of the future energy system, and self-reported knowledge on energy-related issues. What is astonishing is that none of these seem to matter significantly when it comes to one's support for a specific implementation technology.

Our findings have some policy implications—energy policy communities ought not assume that gaining public support for general transition goals automatically leads to support for concrete measures considered under the same transition goals. More concretely, selling the overall transition goals might resemble many other policy campaigns, in that political ideology and citizens' interests in positive future images can cause greater policy approval rates. At the same time, citizens tend to rely on their perceptions of more concrete policy characteristics when asked to evaluate a specific energy technology.

One might be tempted to draw an even stronger conclusion that support for concrete energy transition measures is not driven by political ideology, but rather driven by their evaluations of specific technology characteristics. However, we should be cautious about jumping to such a firm conclusion quite yet. There are at last two competing explanations for our present findings. One is that, indeed, when it comes to policy support for concrete measures, people rely more on their cognitive evaluations of policy characteristics, rather than on their implicit affiliation to certain political leaning. The other explanation, and perhaps somewhat inconvenient for the policy communicators involved, is that individuals would anyway use a heuristic like political ideology in evaluating concrete transition-related policy measures as well (just as they do for the general support) but for some reasons, they have failed to connect the general transition policy that they claimed to support with concrete measures for transitions considered within.

So far, from our robustness analysis that shows that the support for energy transitions is not systematically correlated with concrete technology support, the latter mechanism is still "in the game". However, our findings so far can only provide these two concrete hypotheses, and this question certainly deserves further empirical studies in the future.

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# A Supplementary Regression Results & Robustness

**Table 4:** Impact of general attitude, future visions, and knowledge on support for dge specific energy policies in Switzerland. Controlling for whether respondent believes an energy transition is needed in Switzerland – "Need ET."

| | HP Support | HP Support | DGE Support | DGE Support | ET Support |
|---|---|---|---|---|---|
| CFC Future Std. | 0.0382 | 0.0275 | -0.1441 | -0.0958 | 0.3686*** |
| | (0.1107) | (0.0578) | (0.0809) | (0.0903) | (0.0463) |
| CFC Immediate Std. | 0.0063 | 0.1154* | 0.0326 | 0.0200 | 0.0078 |
| | (0.0526) | (0.0491) | (0.0829) | (0.0826) | (0.0435) |
| Expect Innovation Std. | 0.0970 | -0.0263 | 0.0076 | 0.0688 | 0.2406*** |
| | (0.0635) | (0.0535) | (0.1000) | (0.0612) | (0.0254) |
| Expect Shortage/Conflict Std. | -0.1266** | -0.0659 | 0.0878 | 0.2063** | -0.0465 |
| | (0.0422) | (0.0389) | (0.1455) | (0.0712) | (0.0405) |
| Trust Demo Institutions Std. | 0.0699 | 0.0480 | 0.1401 | 0.0914 | 0.0611 |
| | (0.0576) | (0.0309) | (0.1067) | (0.0680) | (0.0409) |
| Trust Science | 0.1167 | 0.0751 | 0.3493** | 0.3079*** | -0.0530 |
| | (0.0716) | (0.0376) | (0.0952) | (0.0748) | (0.0430) |
| Political Leaning | 0.1491 | 0.1082 | 0.1240 | 0.0494 | -0.3428*** |
| | (0.0746) | (0.0789) | (0.1609) | (0.0872) | (0.0733) |
| Knowledge measures: | | | | | |
| - Self-Assessment Energy | 0.0219 | 0.0061 | -0.1956*** | -0.1758*** | -0.1277*** |
| | (0.0466) | (0.0392) | (0.0417) | (0.0248) | (0.0245) |
| Technology-associated characteristics: | | | | | |
| - Swiss | | 0.1704*** | | 0.0759* | |
| | | (0.0410) | | (0.0308) | |
| - Natural | | 0.2648*** | | 0.2874*** | |
| | | (0.0295) | | (0.0482) | |
| - Safe | | 0.1590* | | 0.2968*** | |
| | | (0.0718) | | (0.0362) | |
| - Familiar | | 0.0833 | | 0.0970* | |
| | | (0.0576) | | (0.0458) | |
| - Inexpensive | | 0.0205 | | 0.1110 | |
| | | (0.0506) | | (0.0553) | |
| Controls | Yes | Yes | Yes | Yes | Yes |
| Adj R-Squared | | | | | |
| Observations | 329 | 329 | 298 | 298 | 627 |

Note: Standard errors are clustered at the canton level. Control variables include gender, age, age-squared, parent, whether respondent can vote in Switzerland, whether respondent has spent majority of time in a canton with a large share of DGE or HP, education, and whether respondent is interested in energy topics.*p<0.05, ** p<0.01, ***p<0.001

**Table 5:** Impact of general attitude, future visions, and knowledge on support for hp specific energy policies in Switzerland — Controlling for income scale.

| | HP Support | DGE Support | ET Support |
|---|---|---|---|
| CFC Future Std. | 0.0586 | -0.0915 | 0.3717*** |
| | (0.0800) | (0.0767) | (0.0481) |
| CFC Immediate Std. | -0.1455* | -0.0608 | 0.0393 |
| | (0.0554) | (0.0962) | (0.0486) |
| Expect Innovation Std. | 0.1029 | -0.0710 | 0.2750*** |
| | (0.0726) | (0.0946) | (0.0312) |
| Expect Shortage/Conflict Std. | -0.2042*** | 0.1083 | -0.0788* |
| | (0.0421) | (0.1683) | (0.0372) |
| Trust Demo Institutions Std. | 0.0440 | 0.1174 | 0.0140 |
| | (0.0609) | (0.1309) | (0.0565) |
| Trust Science | -0.0079 | 0.3128** | -0.0277 |
| | (0.0568) | (0.0946) | (0.0666) |
| Political Leaning | 0.1696* | 0.0451 | -0.3670*** |
| | (0.0723) | (0.1801) | (0.0983) |
| Income | 0.0221 | 0.0068 | -0.0099 |
| | (0.0504) | (0.0859) | (0.0165) |
| Knowledge measure: | | | |
| - Self-Assessment Energy | 0.0261 | -0.2209*** | -0.1068** |
| | (0.0451) | (0.0342) | (0.0294) |
| Controls | Yes | Yes | Yes |
| Adj R-Squared | 0.067 | 0.194 | 0.413 |
| Observations | 250 | 222 | 472 |

Note: Standard errors are clustered at the canton level. Control variables include gender, age, age-squared, parent, whether respondent can vote in Switzerland, whether respondent has spent majority of time in a canton with a large share of DGE or HP, education, income, and whether respondent is interested in energy topics. *p<0.05, ** p<0.01, ***p<0.001

**Table 6:** Impact of general attitude, future visions, and knowledge on support for general energy policies in Switzerland.

| | HP Support | HP Support | DGE Support | DGE Support | ET Support |
|---|---|---|---|---|---|
| CFC Future Std. | 0.0400 | 0.0469 | -0.1595* | -0.1004 | 0.3686*** |
| | (0.1042) | (0.0539) | (0.0742) | (0.0816) | (0.0463) |
| CFC Immediate Std. | 0.0065 | 0.1168* | 0.0335 | 0.0204 | 0.0078 |
| | (0.0525) | (0.0466) | (0.0818) | (0.0828) | (0.0435) |
| Expect Innovation Std. | 0.0984 | -0.0097 | 0.0006 | 0.0666 | 0.2406*** |
| | (0.0638) | (0.0589) | (0.1017) | (0.0635) | (0.0254) |
| Expect Shortage/Conflict Std. | -0.1270** | -0.0705 | 0.0875 | 0.2062** | -0.0465 |
| | (0.0415) | (0.0401) | (0.1447) | (0.0707) | (0.0405) |
| Trust Demo Institutions Std. | 0.0701 | 0.0506 | 0.1361 | 0.0902 | 0.0611 |
| | (0.0575) | (0.0307) | (0.1058) | (0.0696) | (0.0409) |
| Trust Science | 0.1166 | 0.0745 | 0.3525** | 0.3088*** | -0.0530 |
| | (0.0713) | (0.0388) | (0.0961) | (0.0736) | (0.0430) |
| Political Leaning | 0.1468* | 0.0833 | 0.1326 | 0.0520 | -0.3428*** |
| | (0.0676) | (0.0659) | (0.1626) | (0.0843) | (0.0733) |
| General attitudes: | | | | | |
| - Prefer Local E | 0.0728 | 0.0573 | 0.0068 | -0.0001 | 0.1718*** |
| | (0.0434) | (0.0329) | (0.0726) | (0.0401) | (0.0416) |
| - Should Import | -0.1150* | -0.0393 | 0.0348 | 0.0035 | -0.0479 |
| | (0.0422) | (0.0291) | (0.0538) | (0.0610) | (0.0402) |
| Energy Interesting | 0.0024 | 0.0370 | 0.4505*** | 0.3167*** | 0.3153*** |
| | (0.0543) | (0.0558) | (0.0763) | (0.0558) | (0.0357) |
| Technology-associated characteristics: | | | | | |
| - Swiss | | 0.1681*** | | 0.0761* | |
| | | (0.0418) | | (0.0312) | |
| - Natural | | 0.2589*** | | 0.2873*** | |
| | | (0.0296) | | (0.0477) | |
| - Safe | | 0.1586* | | 0.2976*** | |
| | | (0.0704) | | (0.0359) | |
| - Familiar | | 0.0863 | | 0.0961* | |
| | | (0.0552) | | (0.0458) | |
| - Inexpensive | | 0.0227 | | 0.1110 | |
| | | (0.0501) | | (0.0551) | |
| Knowledge measures: | | | | | |
| - Self-Assessment Energy | 0.0211 | -0.0025 | -0.1913*** | -0.1744*** | -0.1277*** |
| | (0.0442) | (0.0363) | (0.0416) | (0.0245) | (0.0245) |
| Demographic Characteristics: | | | | | |
| - Male | 0.0026 | -0.2662* | 0.1479 | 0.0108 | -0.0660 |
| | (0.1063) | (0.1198) | (0.1838) | (0.1427) | (0.0900) |
| - Age | -0.0058 | 0.0095 | -0.0801* | -0.0477* | 0.0013 |
| | (0.0303) | (0.0240) | (0.0328) | (0.0212) | (0.0208) |
| - Age Squared | 0.0001 | -0.0001 | 0.0008* | 0.0005 | 0.0000 |
| | (0.0003) | (0.0002) | (0.0004) | (0.0002) | (0.0002) |
| - Votes in CH | 0.0417 | -0.0532 | 0.0680 | 0.1361 | -0.0410 |
| | (0.1419) | (0.1390) | (0.2360) | (0.1338) | (0.0858) |
| - Higher Edu | 0.0215 | 0.0399 | 0.0822 | 0.0815 | -0.0540 |
| | (0.0316) | (0.0340) | (0.0552) | (0.0437) | (0.0549) |
| - Children | 0.0517 | -0.0112 | 0.2783 | 0.1549 | -0.0096 |
| | (0.1500) | (0.1699) | (0.2238) | (0.1301) | (0.1180) |
| - Live in DGE Canton | | | -0.3225* | -0.1633* | |
| | | | (0.1384) | (0.0790) | |
| - Live in HP Canton | -0.0963 | -0.1365 | | | |
| | (0.1190) | (0.1122) | | | |
| Adj R-Squared | 0.079 | 0.343 | 0.210 | 0.545 | 0.417 |
| Observations | 329 | 329 | 298 | 298 | 627 |

Note:Standard errors are clustered at the canton level. *p<0.05, ** p<0.01, ***p<0.001

# B Survey Item Wording

Please contact the authors for inquiries about survey item wording.

# C Summary of the Item Aggregation Procedure

**Table 7:** Item aggregation methods

| **Composite Measures** | **Aggregation Method** |
|---|---|
| CFC Future<br>CFC Immediate<br>Expect Innovation<br>Expect Shortage/Conflict<br>Support HP Combo<br>Support DGE Combo<br>Trust Demo Institutions | We used confirmatory factor analysis (CFA) to validate the measurement model for each construct (see left). Then items were aggregated via a regression with weights computed based on factor loadings. All executed by Stata. |
| General HP Knowledge<br>CH Specific HP Knowledge<br>General DGE Knowledge<br>CH Specific DGE Knowledge | We computed the composite knowledge scores as a simple proportion of correct answers in each knowledge category (see left). In each knowledge item, a correct answer gives 1, incorrect 0. |

Note: "CFC" = Consideration of future consequences, "HP" = Hydropower, "DGE" = Deep geothermal energy "CH specific" = Swiss-specific.

Some of the variables included in the regressions are composite measures, constructed from multiple survey items. This section describes the procedure of item aggregation.

## C.1 Composite Knowledge Scores

As Table 8 summarizes, knowledge scores were created as a simple proportion of correct answers in each of the four knowledge categories, General HP Knowledge, CH Specific HP Knowledge, General DGE Knowledge, and CH Specific DGE Knowledge.

Our goal is to measure varying levels of participants' factual understanding of each technology as broadly as possible, by introducing questions of varied difficulty levels and varied aspects of the given technology. In other words, we expect that some perform well on certain aspects of the technology, while others perform well on other aspects of the technology, not only due to the item difficulty but also due to simply what aspects of the technology respondents have been familiar with. Therefore, our aim is not to cerate a final score in which participants' performance on items are highly correlated with each other. It is for this reason that we compute a simple proportion of correct answers, not an average score weighted by relative empirical "contribution" of items as we did for the other (non-knowledge) composite measures.

Knowledge of each energy technology was measured by 10 items in total, within which 6 were questions about general characteristics of a given technology, and 4 were questions about Swiss-specific situations related to the given technology. As HP and DGE are different energy production technologies and the Swiss-specific circumstances regarding the two technologies are also very distinct, it is simply not possible to use parallel items to measure participants' knowledge about both technologies. However, we paid attention to the following two aspects as we constructed knowledge items.

1. The number of questions at each difficulty level (low, med, high) is equal between HP and DGE.
2. As much as possible, we measure the same type of factual understanding related to the technology. For example, for both technologies, we asked whether the said technology is considered renewable, and how much of production capacity increase is estimated to be possible in Switzerland.

In order to incorporate these two considerations as objectively as possible, and in order to ensure the accuracy of our factual knowledge items, we consulted with energy technology experts at the PSI (Paul Scherrer Institut) of Switzerland. See Table 8 for survey items included in each of the composite knowledge measures. See Table **??** in B for the exact wording of the knowledge items.

**Table 8:** Items Included in the Composite Knowledge Measures

| **General HP Knowledge** (`know_hp_gen`) | |
|---|---|
| **Items included:** | |
| `hp_jahreszeit_y_n_correct` | `hp_negauswirkungen_y_n_correct` |
| `hp_m_erneuerbar_correct` | `hp_m_muss_correct` |
| `hp_m_energiequellen_correct` | `hp_m_effizient_correct` |
| **CH Specific HP Knowledge** (`know_hp_ch`) | |
| **Items included:** | |
| `hp_600analgen_y_n_correct` | `hp_60prozent_y_n_correct` |
| `hp_pumpbatterie_y_n_correct` | `hp_50prozent_y_n_correct` |
| **General DGE Knowledge** (`know_dge_gen`) | |
| **Items included:** | |
| `dge_toxisch_y_n_correct` | `dge_erneuerbar_y_n_correct` |
| `dge_m_wo_correct` | `dge_m_muss_correct` |
| `dge_m_in_was_correct` | `dge_m_welchekatastrophen_correct` |
| **CH Specific DGE Knowledge** (`know_dge_ch`) | |
| **Items included:** | |
| `dge_haushalte_y_n_correct` | `dge_kkw_y_n_correct` |
| `dge_gibtbereits_y_n_correct` | `dge_abgebrochen_y_n_correct` |

Note: ‘HP” = Hydropower, “DGE” = Deep geothermal energy,“CH specific” = Swiss-specific.

## C.2 Other Composite Measures

As Table 8 indicates, the structure of all the other composite variables were validated, using confirmatory factor analysis (CFA), and the items were aggregated via a regression with weights computed in the CFA. All were executed by Stata.

The following Table 9 reports (i) the included survey items, (ii) the standardized Cronbach’s $\alpha$ value (iii) the number of eigenvalues greater than 1, and (iv) factor loadings, for each composite measure.

We based our choice of survey items (indicators) on the literature and theories. In order to verify the internal consistency among included survey items, we computed Chronbach’s $\alpha$, a measure of inter-item reliability that ranges between 0-1. The Chronbach’s $\alpha$ values for most of our measures are well within the conventional “admissible” range of 0.7-1, indicating that the included items (indicators) are reasonably clustered closely with each other as we hypothesized. The only $\alpha$’s scored lower than 0.7 were for CFC Future (0.66) Expect Innovation (0.68), and Expect Shortage/Conflict (0.62). Even these scores are not far from the conventional threshold of 0.7; therefore, instead of empirically adjusting the included items post-hoc, we proceeded with the initial set of items as we hypothesized based on the literature and theories. All the item groups returned only a single eigenvalue that is greater than 1, verifying that there is only one underlying factor beneath our choice of items as we hypothesized.

**Table 9:** Report of confirmatory factor analyses

| **CFC Future** (`cfc_future`) | |
|---|---|
| Chronbach’s $\alpha = 0.66$ | |
| Number of eignevalues $> 1 = 1$ | |
| **Item Included** | **Factor loadings** |
| `bc_cfc_1` | 0.57 |
| `bc_cfc_3` | 0.59 |
| `bc_cfc_5` | 0.57 |
| `bc_cfc_7` | 0.38 |
| `bc_cfc_9` | 0.49 |
| **CFC Immediate** (`cfc_im`) | |
| Chronbach’s $\alpha = 0.79$ | |
| Number of eignevalues $> 1 = 1$ | |
| **Item Included** | **Factor loadings** |
| `bc_cfc_2` | 0.45 |
| `bc_cfc_4` | 0.63 |
| `bc_cfc_6` | 0.57 |
| `bc_cfc_8` | 0.15 |
| `bc_cfc_10` | 0.83 |
| `bc_cfc_11` | 0.62 |
| `bc_cfc_12` | 0.84 |
| **Expect Innovation** (`expect1`) | |
| Chronbach’s $\alpha = 0.68$ | |
| Number of eignevalues $> 1 = 1$ | |
| **Item Included** | **Factor loadings** |
| `b_es2050_erneuerbar` | 0.58 |

| | |
|---|---|
| `b_es2050_geraete` | 0.58 |
| `b_es2050_fz` | 0.64 |
| **Expect Shortage/Conflict** (`expect2`) | |
| Chronbach's $\alpha = 0.62$ | |
| Number of eignevalues $> 1 = 1$ | |
| **Item Included** | **Factor loadings** |
| `b_es2050_stromausfaelle` | 0.14 |
| `b_es2050_epolkonfl` | 0.68 |
| `b_es2050_gesellschkonflikte` | 0.62 |
| **Support HP Combo** (`support_hp_combo`) | |
| Chronbach's $\alpha = 0.83$ | |
| Number of eignevalues $> 1 = 1$ | |
| **Item Included** | **Factor loadings** |
| `b_support_trift` | 0.74 |
| `b_support_grimsel` | 0.78 |
| `b_support_grundaetzlich` | 0.77 |
| **Support DGE Combo** (`support_dge_combo`) | |
| Chronbach's $\alpha = 0.92$ | |
| Number of eignevalues $> 1 = 1$ | |
| **Item Included** | **Factor loadings** |
| `c_support_dge_stadtgebiete` | 0.81 |
| `c_support_dge_land` | 0.89 |
| `c_support_dge_general` | 0.93 |
| **Trust Demo Institutions** (`trust_di`) | |
| Chronbach's $\alpha = 0.71$ | |
| Number of eignevalues $> 1 = 1$ | |
| **Item Included** | **Factor loadings** |
| `bc_vertrauen_einfluss` | 0.40 |
| `bc_vertrauen_parlament` | 0.84 |
| `bc_vertrauen_doris` | 0.78 |