Influence of Politics on the Energy Consumption of Residential Buildings in Switzerland

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Term Paper to the Lecture: Energy Economics and Policy

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Abstract

The Abstract will be written after completing the Term Paper.
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1. Introduction

Nearly 30% of the energy consumption [1] and over 20% of the CO₂ emissions [2] in Switzerland are a direct result of buildings. Last year my mother’s house, which was built more than 200 years ago, was renovated according to the Swiss standard for sustainable buildings called MINERGIE® (see Chapter 3.1) to save energy. Her interest in nature and sustainability of human acting motivated her to seek financial help from the support program (Förderprogramm) of the canton of Lucerne to accomplish this important upgrade. That gave me the input that politics and energy efficiency of buildings should be included in the topic of my term paper. When analyzing the influence of political decisions on low energy buildings in Switzerland, it became clear that a general evaluation criterion for different building types is still missing. For this reason, the focus for this work was restricted to legislation concerning residential structures. [3, p. 30] The fact that the residential buildings (resp. their heating and warm water production) uses 60% of the fuel (oil and gas) supported my decision.

The work is structured as follows: after this short introduction, an overview of the energy consumption of Switzerland is given (Chapter 2.1) and broken down to the contingent of residential buildings, which account for about 60% of the gross floor area in Switzerland. [4] Also in Chapter 1, a short overview of the political scene in Switzerland is given to help foreign readers understand the possible range of influence of the described political decisions. In the third chapter is an evaluation of political decisions on all levels of Swiss politics and their influence on the energy use of residential buildings. The most famous program for energy efficient houses at national level is called MINERGIE® (Chapter 3.1). Various support programs (Förderprogramme) exist between the cantons and their striking differences are described in Chapter 1. For the cities and municipalities, the label “EnergieStadt” is the highest honor regarding energy efficiency. Chapter 1 encloses the most important aspects of this label regarding residential buildings. After the final conclusion (Chapter 1), an outlook on related topics and comment on the future development of energy efficient buildings in Switzerland is given (Chapter 7)).
2. Switzerland: Energy consumption and responsibilities of the political levels

To understand the importance of the energy use of buildings, Chapter 2.1 contains an overview of the Swiss energy consumptions.

This paper should also be interesting for foreign students; therefore an overview of the relevant aspects of the political system in Switzerland can be found in Chapter 2.2.

2.1. Energy consumption in Switzerland

According to the Swiss Federal Office of Statistics, the overall end energy usage in Switzerland in the year 2009 amounted to 877'560 Terrajoules (TJ) [1]. In the upper panel of Error! Reference source not found. the development of total end energy usage in Switzerland from 1910 to 2009 is shown. It steadily increased since the mid-1940s and seems to have come to a stable level in the last few years.

Illustration 1: Total end energy usage in Switzerland, according to [1]
Switzerland: Energy consumption and responsibilities of the political levels

To analyze the recent development, the lower plot of Illustration 1 shows a more detailed view covering the last 20 years (1990 to 2009). Despite the fluctuations, an increasing tendency can still be observed and it is hard to predict whether or not this will change in the near future.

In the strategy for sustainable development from the federal council of Switzerland for 2008 – 2011, the goal to evaluate the way to a “2000-watt-society” was set, meaning that 2000 watt energy per capita should be the rule for future energy usage. [5, p. 13] 2000 watts per year corresponds to 63 GJ. With a population of about 7.8 million in Switzerland in 2009 [20], this sums up to 491.4 TJ which would, according to Illustration 1, correspond to a value from before 1970. Whether this is a realistic goal or not is not the topic of this term paper, but the Swiss government has demonstrated strong commitment to reducing the countries energy consumption. Illustration 2 shows the parts of the national energy usage of the consumer groups: household, industry, service sector and transportation/traffic. The residual part can be attributed to statistical impreciseness and other smaller groups such as the agricultural sector.

Illustration 2: End energy usage in Switzerland – 2009, according to [1]

The households were responsible for nearly a third of the end energy usage in Switzerland in 2009. Only transportation contributed more with 35%. The industry and service sectors are about 10% smaller and the rest of energy consumers are negligible. Illustration 1 shows the percentage of total energy consumption due to households. This suggests a quite stable period with little volatility for the coming years.
Switzerland: Energy consumption and responsibilities of the political levels

Illustration 3: Percentage of the households of the end energy use in Switzerland, according to [1]

In the four years from 2006 to 2009 the percentages of the end energy use in Switzerland originating from households differs only by 1%, and nothing implies this will change soon. It becomes clear that the emphasis on sustainable construction coupled with renovations of older buildings show great potential to reduce the energy used in Switzerland and politics should contribute to focusing the reduction of the Swiss energy use.

For politicians it is thus of utmost interest to initiate effective actions to reduce the energy use of buildings. Possibilities to assess this problem in Switzerland are discussed in the following chapters.

2.2. Political overview and responsibilities in Switzerland

2.2.1. Outline of the political scenery

The federal authorities of Switzerland are divided into three parts. Parliament, with its two chambers of the National Council and the Council of States, comprises the legislative part. The executive branch is represented by the Federal Council, which consists of seven people, and the Federal Administration. Among the seven Swiss federal offices, the one of Energy (SFOE) and the one for the Environment (FOEN) are especially important regarding buildings codes. The third part, the judiciary, is a compound of the Federal Supreme Courts, however they are not strongly involved in construction related regulations.

Furthermore, the Swiss nation is divided into 26 cantons (which are themselves divided into 2551 towns and communes) [6] and each of these also have rights to impose environmentally conscious sanctions on new constructions. Illustration 4 shows the areas of the cantons in Switzerland.
2.2.2. Responsibilities of the three powers (regarding sustainable building)

In the Swiss federal constitution sustainable development appears as one basic principle for nation and cantons. [5, p. 11; 8, Art. 2 Para. 2] The Federal Council released a strategy paper emphasizing that the “[…] cooperation with the cantons and municipalities is essential. Switzerland’s structure as a federal state means that cantonal and municipal administrations wield considerable power and influence in many areas of relevance to sustainability.” [5, p. 12] (see the following chapter for more detail) This part of the thesis gives an overview of the responsibilities on a national, cantonal and municipal level regarding energy efficient buildings.

2.2.2.1. National

The federal council publishes sporadic papers about “Sustainable Development in Switzerland”. After the two papers in 1997 and 2002, the third strategy paper was published in 2008, with the promise of a fourth to follow in 2012. [5] The federal council uses the following definition: “[…] development is sustainable if it guarantees that the needs of present generations can be met without compromising the ability of future generations to meet their own needs.” [5] The term sustainable construction was included for the first time in the third strategy paper [3]. Over 50 billion CHF per year is spent on construction, a third of which is from public contractors. To make sure this part is spent along the principles of our nation, a “sustainable real estate strategy” was announced in the paper. The national level mandates that its own buildings be sustainable and energy efficient, but also plans to increase pressure on the general construction sector to comply. [5, p. 22] “Consumers have an important part to play here, by demanding such sustainable products. The federal government sets an example
Switzerland: Energy consumption and responsibilities of the political levels

in its own consumer behavior, by purchasing products and realizing construction projects based on economical, environmentally friendly, healthy and socially responsible processes.” But the companies as well are requested to increase corporate social responsibility to ensure that state interventions can be kept to a minimum. [5, p. 21]

The federal council has expressed interest in setting up construction-related programs such as SwissEnergy and to determine regulations, norms and standards as the MINERGIE-ECO® (see Chapter 3.1.2). The strength of the SwissEnergy program is the “co-operation between the federal government, the cantons and municipalities, and numerous partners from trade and industry, environmental and consumer organizations, and public and private agencies.” [9] The program sets one point of focus on building modernization and another on energy-efficient appliances to improve the savings potential offered by modern household appliances and lightning. [5, p. 18]

As a key to successful implementation of the sustainability strategy, the federal council emphasizes the “transparency of state activities – and thus a proactive information policy”. [5, p. 43]

2.2.2.2. Cantonal

The federal council emphasizes the importance of “vertical integration of federal, cantonal and municipal efforts on sustainable development”. They emphasize that is the task of cantons and municipalities to adapt the national Sustainable Development Strategy and extend it adequately to their level of governance. [5] This as well is part of the Swiss federal constitution [8] Art.89, Abs.4. The responsibility to support technologies and products which are ready for the market lays at the cantons, while the federation needs to ensure future research and development. [10]

The 26 cantons decided to work together in the field of energy politics already in the early 1980s. In 1979 the EnDK (conference of energy directors of all the cantons) held its first meeting. After the first strategy of the cantons regarding energy politics in 2001, the second strategy was published 2005. It was thought as an extension of the EnergySwiss strategy (see previous chapter) and was written to increase the efficiency of the inter-cantonal work as well as of the federation regarding energy politics. For this term paper the partial strategy on buildings is highly relevant. The highest aim of this part of the strategy is a more economical and efficient energy usage among all cantons, both with fossil and renewable energy sources with the three core themes:
Switzerland: Energy consumption and responsibilities of the political levels

1) Modernization of the envelope of already existing buildings. This includes walls, floors, roof, and windows.
2) Increasing of the awareness of users towards the right behavior. Without this, the energy usage of the efficient buildings would stay high.
3) The remaining energy demand should be covered with waste heat and through renewable energies as much as possible. They entrust the responsibility to realize this third theme to the individual cantons. [11]

In Appendix A.1 an overview of the instruments of the cantonal energy policy in the field of buildings [11, p. 11] can be found (in German). “[…] of course also political activities build important instruments in the cantonal energy politics.” [11, p. 12]

In Appendix Error! Reference source not found. the strategy of the cantons regarding the conjoint energy policy can be found (in German) [11, p. 20]

The cantons emphasize in their strategy that they will need to work together closely with the municipalities especially during the execution of the planned actions. [11]

2.2.2.3. Municipal

This chapter will be written on the base of the Label “Energiestadt®”, [12].
3. The influence of Swiss politics on the energy use of residential buildings on the national level: MINERGIE®

3.1. The label MINERGIE®

MINERGIE® is an optional quality label for new built and modernized buildings in Switzerland. This trademark is supported jointly by the Swiss economy, the cantons and the federation. The main criterion MINERGIE® employs to quantify the quality of the construction, is the “specific end energy usage”. Since 1998, MINERGIE® is organized as a membership corporation with many individual members acting in cooperation with the federation, the cantons, the economy, and schools. [13] According to MINERGIE®’s website [13] they ensure at least three advantages of construction in all of their labels: higher comfort, improved conservation of value and significant reduction in energy usage.

In the following the content of the MINERGIE® program will be described. In Chapter 3.1.2 the five different labels will be defined and differentiated.

3.1.1. The requirements for the MINERGIE® standard

Five requirements are essential for each of the MINERGIE® standards:

- Primary requirements for the building envelope
- All year controllable air exchange
- MINERGIE®-boundary value (weighted energy coefficient)
- Certificate of the thermal comfort during the summer
- Additional requirements for each building category concerning lightning, industrial coldness (gewerbliche Kälte) and heat generation
- Limitation of the additional costs, compared to conventional objects of comparison, to 10%

Further details to these requirements would extend beyond the scope of this paper and can be found on the official website www.minergie.ch.

Returning the focus on residential buildings, the following table shows the official requirements for single- and multi-family houses to fulfill the MINERGIE® requirements.
The influence of Swiss politics on the energy use of residential buildings on the national level

<table>
<thead>
<tr>
<th>Category</th>
<th>Weighted energy coefficient</th>
<th>Primary requirement</th>
<th>Air-handling system</th>
<th>Additional requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For newly constructed buildings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habitation single-family house</td>
<td>38 kWh/m²&lt;sup&gt;1&lt;/sup&gt;, WW&lt;sup&gt;2&lt;/sup&gt;, El. V.&lt;sup&gt;3&lt;/sup&gt;, *&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Q&lt;sub&gt;b&lt;/sub&gt; ≤ 90% Q&lt;sub&gt;b,li&lt;/sub&gt;&lt;sup&gt;6&lt;/sup&gt;</td>
<td>preconditioned</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rec. for household appliances: EE class A&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
<tr>
<td>Habitation multi-family house</td>
<td>38 kWh/m²&lt;sup&gt;1&lt;/sup&gt;, WW, El. V., *</td>
<td>Q&lt;sub&gt;b&lt;/sub&gt; ≤ 90% Q&lt;sub&gt;b,li&lt;/sub&gt;</td>
<td>preconditioned</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rec. for household appliances: EE class A</td>
</tr>
</tbody>
</table>

| **For buildings constructed before the year 2000** |                     |                     |                     |                         |
| Habitation single-family house        | 60 kWh/m²<sup>1</sup>, WW, El. V., * | none                | preconditioned       | None                    |
|                                       |                             |                     |                     | Rec. for household appliances: EE class A |
| Habitation multi-family house         | 60 kWh/m²<sup>1</sup>, WW, El. V., * | none                | preconditioned       | None                    |
|                                       |                             |                     |                     | Rec. for household appliances: EE class A |

* Table 1 - MINERGIE® requirements for residential buildings, according to [13]

In here will be an Illustration of the number of new buildings according to the MINERGIE® standards per year and its explanation.

3.1.2. The five standards of MINERGIE®

**MINERGIE-P®**
**MINERGIE-A®**
**MINERGIE-ECO®**

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<sup>1</sup> SH: Space heating
<sup>2</sup> WW: Warm water
<sup>3</sup> El. V.: Electricity for the mechanical ventilation
<sup>4</sup> *: The energy expenditure for an optional improvement of the indoor climate (cooling, de- and humidification) is included in the MINERGIE®-boundary value
<sup>5</sup> Q<sub>b</sub> means the thermal heat, the energy to heat the rooms.
<sup>6</sup> Q<sub>b,li</sub> is the boundary condition of Q<sub>b</sub>
<sup>7</sup> EE class A: „Energie-Etikette Klasse A“; a Swiss certificate to guarantee the lowest energy use of the specified kind of machine
3.1.3. Influence of MINERGIE on the energy usage of residential buildings in Switzerland

As Illustration XY (End of Chapter 3.1.1) states, the number of energy efficient residential buildings in Switzerland has increased dramatically since the MINERGIE® label went into effect. However, Illustration 3 shows that the percentage of Switzerland’s end energy use due to households has remained around 30%. To come to a possible explanation of these two numbers, the development of the counted habitations in Switzerland needs to be factored in. As the overall number of buildings increased, that of residential-only structures did as well. In 1990 79.4% (or 1'026'117) of the total counted buildings were purely residential. This number increased in 2000 to 80.7% (or 1'179'278) and finally to 83.0% (or 1’347’309) in 2009.

While the number of residential buildings steadily increased, the end energy use of households fluctuated around 250 Petajoules (PJ) during the last 20 years. [1]

As seen in Chapter 2.1, the overall energy use of Switzerland was slightly increasing over this period. The following table now shows a combination of the overall energy use in Switzerland, the one of residential buildings and the number of residential buildings [1]. To compare the three years 1990, 2000 and 2009, the first is taken as the base year:
The influence of Swiss politics on the energy use of residential buildings on the national level

<table>
<thead>
<tr>
<th>Year</th>
<th>Overall energy use (TJ) [1]</th>
<th>Energy use of residential buildings (TJ)</th>
<th># Residential buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>798'510</td>
<td>240'720</td>
<td>1'026'117</td>
</tr>
<tr>
<td>1990 to 2000 (10 years)</td>
<td>+ 0.076%</td>
<td>- 0.002%</td>
<td>+ 0.149%</td>
</tr>
<tr>
<td>2000</td>
<td>859'290</td>
<td>240'210</td>
<td>1'179'278</td>
</tr>
<tr>
<td>2000 to 2009 (9 years)</td>
<td>+ 0.023%</td>
<td>+ 0.050%</td>
<td>+ 0.164%</td>
</tr>
<tr>
<td>2009</td>
<td>877'560</td>
<td>252'280</td>
<td>1’347’309</td>
</tr>
</tbody>
</table>

Table 2 – Overview of energy usage and residential buildings from 1990 to 2009

Here the effect of the MINERGIE® program will be described.

The biggest disadvantage of MINERGIE® is that two of the three „sustainability areas” defined by the federal council have not been fully integrated in this program, namely economy and society. It strongly emphasizes the environmental aspect of sustainability. But some paragraphs below in the input paper to sustainable construction in Switzerland, this critique is weakened a great deal by the statement that “… in the segment of private domestic architecture, […] is possibly satisfying covered with MINERGIE®-ECO”. [3, p. 30]
The influence of Swiss politics on the energy use of residential buildings on the cantonal level: cantonal support programs

4. The influence of Swiss politics on the energy use of residential buildings on the cantonal level: cantonal support programs

“Our the cantonal level, the sustainable development is positioned explicitly or implicitly in a lot of constitutions and directives.” [3, p. 8] The MuKEn describes the base regulations valuable for all cantons, as well as the additional optional regulations (Chapter Error! Reference source not found.). In 4.2, the examples of the two cantons are described and evaluated.

4.1. MuKEn – Model/Specimen Regulations of the Cantons in the Energy Area

In the MuKEn, unlike the optional MINERGIE® standard, minimal legal construction regulations are defined - but the cantons point out their active support of MINERGIE® as a standard. [11] The minimal legal construction standards are grouped into mandatory ones, which need to be applied by all cantons, and optional ones. The cantons should have the possibility to adjust their regulations to the peculiarities of their region and their budget, therefore the whole MuKEn is structured in modules. [10]

The HFM (harmonized support program) builds a recommendation for the cantons, based on the MuKEn and specifies the actions which need to be taken by them. An overview of the HFM structure can be found in Appendix A.3. A minimal subsidy by the support program is defined as follows: 10% of the additional costs and 10% of the additional investments, compared to the conventional construction, must be covered. This subsidy is understood as a reduction of the investment-barrier of sustainable techniques. The part of the federation is limited to 40% of the additional costs. [28] “While the cantons increased their own part of subsidies continuously, the part of the federation decreased slightly during the last years.” [www.endk.ch/kantone [31, p.3]] In 2008, the cantons spent 50 million and the federation 13.8 million to finance the cantonal support programs. Thus, the cantons invest much more into energy efficiency of buildings than the nation does. [www.endk.ch/kantone [31]]

The cantonal efforts (without MINERGIE®, wood, sun and heat pumps) resulted in an energy reduction of 155 TJ, compounded of electricity and a high share of fuels, in 2003 [11]. Unfortunately this calculation was no longer done in the following years.

An overview of the cantons and which construction projects are supported where can be found on the website of the Swiss Federal Office of Energy (SFOE).

Regula Müller
The influence of Swiss politics on the energy use of residential buildings on the cantonal level: cantonal support programs

4.2. Examples

It is not possible to analyze the efforts of all cantons within this term paper. In the following two chapters a closer look at the two cantons ---- and ---- regarding their policy for energy efficient buildings is given.

Kantonale Energiefachstellen (Linksammlung): http://www.endk.ch/energiefachstellen.html

4.2.1. First example

Will probably be Zurich as a more urban one.

4.2.2. Second example

Will probably be Lucerne as a more rural one from the Central Switzerland.
5. The influence of Swiss politics on the energy use of residential buildings on the cantonal level: communal actions

5.1. Communal politics for energy efficient buildings
Very different stages of communal politics can be found in Switzerland. They reach from a link to the cantonal program to such with a high interest in this topic which is signalized with the label “Energiestadt”.

5.2. Two examples
To gain the best possible overview with just two examples, the biggest town in Switzerland: Zurich, and a little village on the countryside of the canton Lucerne: Eich, are described in the following chapters.

5.2.1. The city of Zurich
Zurich got the label “Energiestadt” and is one of most advanced municipalities in Switzerland.

5.2.2. The village Eich
I wrote an Email to the responsible person for energy questions of Eich. Unfortunately I got no answer until now, such that this chapter could not be finished for the first draft.
Appendix

6. Conclusion

The conclusion cannot be written until all the other chapters are finished...
Appendix

7. Outlook

Is an outlook appropriate for a term paper? Should I include it in my Conclusion?
Appendix

8. Appendix

A.1. Overview of the instruments of the cantonal energy policy

Illustration 6 [11, p. 11]
Appendix

A.2. Strategy of the conjoint energy policy of the cantons

Strategie der gemeinsamen Energiepolitik der Kantone
für die zweite Hälfte von "EnergieSchweiz"
(2006 - 2011)

1. Senkung des Energiebedarfes durch Gebäudemodernisierung
   Klarer Schwerpunkt der gemeinsamen kantonalen Energiepolitik im Gebäudebereich bil-
   den Massnahmen zur Senkung des Energiebedarfes. Diesbezüglich liegt das grösste Po-
   tenzial bei der energetischen Modernisierung bestehender Bauten.

2. Bewusstseinsbildung in Bezug auf das Benutzerverhalten
   Energetisch gute Gebäude nützen nur beschränkt, wenn sich die Bewohner energetisch
   ineffizient verhalten. Ein zweiter Schwerpunkt der gemeinsamen kantonalen Energiepolitik
   im Gebäudebereich bildet deshalb die Förderung des Bewusstseins der Hausbewohner in
   Bezug auf das Benutzerverhalten.

3. Deckung des Restbedarfes mittels Nutzung von Abwärme und erneuerbarer Energien
   Höchstmögliche Deckung des verbleibenden Energiebedarfes im Gebäudebereich mitt-
   tels Abwärme und erneuerbaren Energien. Diesbezüglich liegt es an den einzelnen Kan-
   tonen die aufgrund ihrer Strukturen sinnvollen Schwerpunkte zu setzen.

4. Kriterien
   Die Massnahmen, die zur Umsetzung der Strategie gewählt werden müssen folgende Kri-
   terien erfüllen:
   ⇒ Energetisch hohe Wirksamkeit;
   ⇒ Gutes Kosten-/Nutzen-Verhältnis;
   ⇒ Einfache Vollziehbarkeit (Vollzugstauglichkeit);
   ⇒ Eignung, um Breitenwirkung zu erzielen;

5. Vorbildhaltung
   Kantonale und von Kanton subventionierte Neu- und Umbauten sind vorbildlich auszu-
   führen. Insbesondere muss hier ein Standard erreicht werden, welcher möglichst den
   Grundsätzen von MINERGIE entspricht und die Anforderungen der SIA Norm 380/4 "Elekt-
   rische Energie im Hochbau" erfüllt.

6. Wirkungsanalyse
   Die Massnahmen sind laufend einer Wirkungsanalyse zu unterziehen.

7. Strukturen der EnDK/EnFK
   Die Strukturen der EnDK/EnFK sind laufend den veränderten Bedürfnissen anzupassen,
   damit eine wirkungsvolle Aufgabenerfüllung gewährleistet ist.

8. Interne Mitwirkung in der EnFK
   Die Mitglieder der EnDK stellen sicher, dass ihre Energiefachstellen-Mitarbeiter in den Ar-
   beitsgruppen der EnFK aktiv mitwirken können und ordnen eine solche Mitwirkung falls
   nötig ausdrücklich an.

Illustration 7 [11, p. 20]
Appendix

A.3. Overview of the harmonized support program of the cantons

Illustration 8 [10, p. 20]
**Bibliography**


Bibliography

