

# IMPROVE – Enhancing demand-side energy reduction through informative billing strategies

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**Abstract.** In Switzerland, most of the information available on the energy bills corresponds to the minimum legal requirements imposed by national regulations. Such a scarcely understandable information does not motivate consumers to reflect on their level of energy consumption. A more user-friendly information presentation on the energy bill may induce increased awareness, laying the grounds for behaviour changes required to achieve the goals of the Energy Strategy 2050 of the Swiss Federal Council. The aim of the IMPROVE project was to explore how both consumers and energy utilities evaluate and perceive the importance of introducing enriched information on the energy bill to encourage households to reconsider their energy consumption levels.

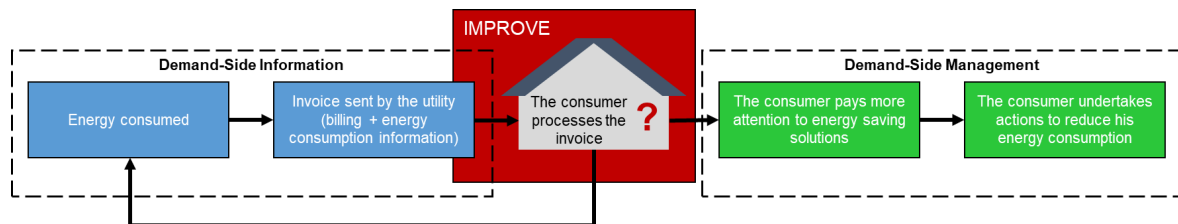
## 1. Introduction

The Swiss Energy Strategy 2050 aims to increase the use of renewable energy and the energy efficiency of buildings, mobility, industry and appliances. An additional important element of this strategy is the reduction of the energy demand in Swiss households, which requires a change in energy consumption behaviour. An important driver for promoting the change of energy consumption behaviour of private households can be seen in the information available to the consumer. Providing them with the proper information, coupled with tips on how to reduce their energy consumption, their awareness on their level of energy consumption could increase and they could be encouraged to adopt energy-saving measures [1, 2, 3, 4]. In this framework, we conceived the IMPROVE project, with the aims of:



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- Understanding the type and level of information currently provided to household consumers through energy bills (Demand-Side Information, see Figure 1).
- Identifying current Demand-Side Information best practices, which allow consumers to better assess their level of energy consumption.
- Exploring the level of satisfaction of possible Demand-Side Information innovative solutions, from both the consumers' and the utility companies' points of view.



**Figure 1.** Boundaries of IMPROVE with Demand-Side Information and Demand-Side Management.

## 2. Scientific methodology

To achieve the project goals, several activities were conducted, such as literature reviews, interviews and surveys.

In particular, best practices on Demand-Side Information in Switzerland and abroad were collected, through a literature review, two surveys respectively targeting Swiss and foreign energy utilities, as well as a direct collection and analysis of energy bills. Overall, 91 energy bills in Switzerland and 175 from abroad were analysed, in order to identify and characterise current practices, main informative contents and design elements.

Based on the findings of such analyses and on a literature review on the factors affecting household energy consumption behaviour, current Demand-Side Information best practices were identified and a number of enhanced Demand-Side Information elements for energy bills were identified as the potentially most effective ones to raise the consumers' understanding on their energy consumption. In particular, six different information layouts for improved energy bills were developed, helping consumers to have a better evaluation of their energy consumption level.

A satisfaction survey including these new elements was then conducted on a panel of consumers from eleven Swiss energy utilities that were involved in the project, with the objective to provide a better insight of the current energy bill information and assess the acceptance of enhanced energy bills at national level.

The survey targeting household consumers involved 3047 participants and allowed to evaluate their opinion on the type of information currently available in their energy bill and to gauge their interest among the six improved billing layouts.

Such a survey allowed to assess the Swiss household consumers' interest on enhancing the information available on their energy bill, and to rank the proposals of enhanced energy bills. Additionally, the implementation potential of such proposals for enhanced information was assessed through a dedicated survey targeting all Swiss energy utilities (response by 48 utilities) and through three focus group interviews with the eleven utility companies partners in IMPROVE. These activities allowed to explore the utilities' viewpoint on the six improved bill layouts, according to a cost-benefit approach and accounting for the feasibility of their implementation. The outcome of project activities consisted in the development of recommendations for the Swiss energy utilities suggesting improvements of their energy bill from the consumers' point of view, and indicating possible pathways for future implementation of improved energy billing.

### 3. Results obtained

The activities above have led to the following main findings.

#### 3.1. Consumers' point of view

As mentioned, the national survey targeting household consumers (n = 3047) aimed at evaluating their satisfaction regarding the information currently available on their energy bill. It has shown that:

- Over 90% of consumers currently receive paper bills.
- Almost half of the consumers spend less than five minutes to read their energy bill.
- Only 14% of the consumers receive a qualitative or quantitative information to position their energy consumption. And 75% of the remaining consumers are interested to receive such additional information.
- Information about one's own consumption and energy costs is of great interest to the consumer. Two thirds of them wish to compare their energy consumption with equivalent households of the neighbourhood and are willing to put into place energy-saving actions if their consumption is above average.
- Two thirds of the consumers who would receive additional information regarding their level of energy consumption declare they would be inspired to reduce their consumption.

In summary, current bills (see Table 1) contain little information that could rise consumers' awareness on their energy consumption. Despite a good understanding of the current energy bill, consumers are interested in receiving enhanced information about their level of energy consumption, including a reference energy consumption (for instance the average energy consumption of their neighbours), to encourage them to implement energy saving actions.

<b>A. Use of electrical net (incl. system services)</b>		<b>Total CHF</b>
Base rate for use of electrical net (if applicable)	CHF/month	Total CHF
Power rate for use of electrical net (if applicable)	CHF/kW	Total CHF
Energy rate for electrical net	Rp./kWh	Total CHF
<b>B. Energy supply</b>		<b>Total CHF</b>
Base rate for electrical energy (if applicable)	CHF/month	Total CHF
Power rate for electrical energy (if applicable)	CHF/kW	Total CHF
Energy rate	Rp./kWh	Total CHF
<b>C. Taxes and activities for communities</b>	<b>Rp./kWh</b>	<b>Total CHF</b>
<b>D. Federal taxes for promotion of renewable energy and protection of waters and fishes</b>	<b>Rp./kWh</b>	<b>Total CHF</b>
<b>E. Naming of metering point</b> (e.g. CHXXXXX01234500000000000000XXXXX)		<b>Number</b>

**Table 1.** Minimal federal billing requirements by ElCom Switzerland, 2014.

#### 3.2. Utilities' point of view

In order to assess the point of view of the Swiss energy utilities, a national survey and some workshops were conducted, with the specific aim of evaluating their motivations and the involved costs/benefits for enhancing information on their energy bill. The survey was answered by 48 utilities and its outcome can be summarized as follows:

- The three main motivations to improve the information in the bill are 1) consumer satisfaction, 2) need for transparency and 3) promotion of utility's energy consulting services.
- Utilities agree on the need for more user-friendly visualisations of energy data (even if associated to higher costs) and segment-oriented, comparative statistics. A graphical illustration of energy consumption data would be beneficial in terms of consumer satisfaction, fidelity and reputation.

- The availability of high frequency energy data is difficult due to a low smart meter coverage and its slow dissemination. Many years are in fact still required in order to get all Swiss households connected to a smart meter: the market penetration of smart meters is expected to reach 80% by the end of 2027 [5].
- The energy utilities are putting efforts in the development of their web portals and are mostly reluctant to change bill contents, as it is a complex internal process involving different services within the company and is characterized by indirect costs, when the bill layout development is outsourced.
- Currently, for energy utilities, the easiest data computation to deliver is the change in energy consumption over a given billing period and historical comparison of annual consumption data.
- The utilities are more confident in taking into account the weather correction than profiling consumer segments based on different socio-economics or location.

In summary, the energy utilities are aware of the consumers' need for additional energy information on their consumption and are interested in providing them with information allowing comparisons with reference energy consumptions. In particular, they agree upon the fact that a more user-friendly, graphical visualisation of energy consumption data may be of advantage from the consumer's point of view. However, their capability of retrieving the necessary data (e.g. socio-demographic) to make billing information more personalised and segment-oriented is limited due to privacy and the slow diffusion rate of smart meters.

In addition, the slow smart meter rollout along with limitations regarding household data access due to personal privacy are also issues to consider when developing a methodology for defining and benchmarking different consumer segments. In contrast, some foreign energy utilities have already overcome these issues and are already offering enhanced energy bills to allow consumers to compare their level of energy consumption with a reference energy consumption. These examples might lead Swiss energy utilities to rethink some aspects of their communication strategy, if not business model, and to find rapid solutions for the near future.

### 3.3. *The six enhanced energy bill proposals*

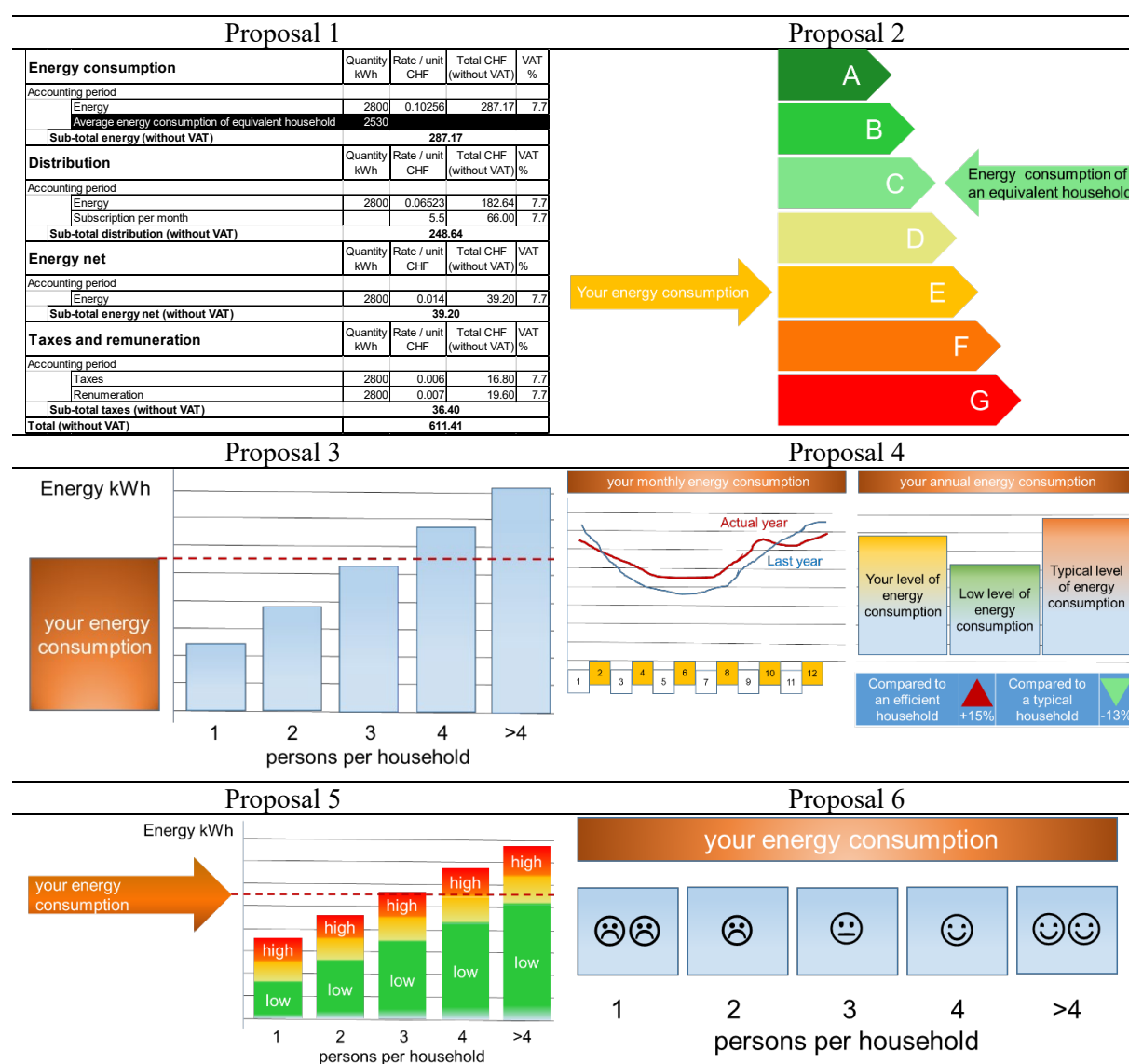
To explore the consumers' interest in additional energy information on the bill, six different layouts (see Table 2) have been designed, based on best practices observed in the literature and the collected bills. The goal was to present a selection of proposals covering a range of different levels of information detail, as well as different possible layouts (e.g. diagram, table, etc.). This led to the following six layouts (see Table 2):

- Proposal 1: is based on the minimum legally required tabular format for the electricity bill, with one additional element indicating a reference level of energy consumption (marked in inverse colour).
- Proposal 2: applies the idea of a label of energy efficiency classes, currently used for electrical appliances or cars (category A to G). It includes the corresponding energy consumption category of the households and a typical energy consumption reference.
- Proposal 3: presents a bar diagram, with five typical energy consumptions of a household, with one to five occupants, and the household energy consumption.
- Proposal 4: presents the time evolution of the energy consumption of the current and previous year. In addition, the energy consumption of the household is compared with an average energy consumption of households and with a typical household having a low energy consumption.
- Proposal 5: is similar to proposal 3, however the energy consumption for each number of occupants is further detailed, with a range for low, middle and high energy consumption household.
- Proposal 6: does not provide any data on the energy consumption of the household, but only an emoticon (from very happy to very sad) depending on the number of occupants.

The acceptance of these six proposals has been gauged through both the consumer's satisfaction survey and the utilities' survey.

From the consumers' point of view, Proposal 6 (emoticon) and Proposal 1 (tabular format) are the least preferred layouts. While Proposals 2 to 5 present the highest levels of understanding, with a similar percentage of "excellent" and "good" answers. Proposal 4 is associated with the highest rate of consumers "interested" or "very interested" (65%) to help them to position their energy consumption. From the utilities point of view, Proposal 1 (tabular format) has been rated as the most likely to be implemented, as it requests only a slight modification of the existing layout. Proposal 6 is unlikely to be implemented because it is found too judgmental towards the consumer. Proposal 4 comes second, although only feasible for utilities providing smart meters, otherwise reporting frequency of the energy consumption has to remain annual.

In summary, Proposal 4 could be a possible layout to help the consumers' and the utilities' interests to converge, especially when smart metering is available. This first viable step to improve consumer's awareness in their energy consumption, would lead to a bill enhancement with a comparison of the past energy consumption over a given period, with a climatic correction, such as the ambient temperature for heating consumption or daylight availability for lighting consumption.



**Table 2.** Proposals for improved billing information for residential households.

#### 4. Final considerations

So far, the energy bill (paper or digital) is the only systematic link between consumers and their energy utility. Currently, it mostly provides only the mandatory information on their energy bill. Consequently, Swiss bills are often very similar in terms of content and presentation format. However there is a clear demand from the consumers for additional information about their level of energy consumption. Even if the first motivation for the utilities to enhance the bill information is related to the consumers' satisfaction, there is a clear gap between what the consumers are expecting in terms of energy related information on the bill and what is currently provided by the energy utilities. Even if for utilities the cost of enhancing the energy bill may be a barrier, for the national energy policy the potential induced energy saving might be interesting. Currently, the tendency among the Swiss energy utilities is to focus on the Demand-Side Management rather than the Demand-Side Information. The improvement of the energy bill is not a priority for them, as opposed to their web portal. So, the use of the energy bill to raise consumer's awareness on their energy consumption level and to encourage them to save energy will be difficult to achieve rapidly, due to the reluctance of the energy utilities to change the content of the energy bill.

Therefore, in order to achieve the Swiss Energy Strategy 2050 objectives, the improvement of the bill's information should be promoted either from the regulatory authorities (such as ElCom) or might come from the opening of the energy market that will raise the competition between utilities. Indeed, when analysing foreign energy bills, especially in countries with liberalised energy markets, it has been noticed that energy bills are more user-friendly for customers (e.g. providing graphical information on the household energy consumption level, overview of consumption evolution, etc.). Indeed, with the rise of energy costs or when the time of a total liberalised energy market will come, the Swiss utilities providing improved energy related information on their bill will have a competitive advantage to retain existing consumers or to gain new ones, especially with respect to foreign energy utilities already providing such improved energy bills.

#### References

- [1] Wilhite, H. and Ling, R. (1995). Measured energy savings from a more informative energy bill, *Energy and Buildings* 22, 145-155.
- [2] Fischer, C. (2008). Feedback on household electricity consumption: a tool for saving energy? *Energy efficiency*, Vol. 1(1), 79-104.
- [3] Faruqui, A., Sergici, S., Sharif, A. (2010). The impact of informational feedback on energy consumption—A survey of the experimental evidence. *Energy*, 35(4), 1598-1608.
- [4] Foster, B. and Alschuler, E. (2011). The State of the Utility Bill, Research Report Number B111, American Council for an Energy-Efficient Economy, ACEEE. \$
- [5] Swiss Federal Council, May 23rd 2018, SR734.71 Stromversorgungsverordnung, Paragraph 31e <https://www.admin.ch/opc/de/classified-compilation/20071266/index.html>
- [6] Citherlet S, Eicher S, Padey P, Burger B, Cellina F, Carabias V and Tomic U 2017; IMPROVE – Unfolding next generation demand-side information (DSI) models; annual report 2017; <https://www.aramis.admin.ch/Grunddaten/?ProjectID=38621>
- [7] Bichsel J, Kunz D, Padey P, Citherlet S, Eicher S, Cellina F, Castri R, Tomi U and Carabias V 2018. IMPROVE – Unfolding next generation demand-side information (DSI) models; final report November 2018;

#### Keywords:

Energy consumption reduction, demand-side information, energy supply, billing information