MSc HES-SO en Business Administration

Orientation :
Management et Ingénierie des Services

ENERGY CONSUMPTION BEHAVIORS

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*« Le spécialiste des sciences sociales est comparable à un pêcheur,
qui a délimité sa zone de pêche, c'est-à-dire son sujet de départ et
son terrain, mais qui ne sait pas quel poisson il va attraper. »*

E. Carr (1988)

Attestation

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Nyon, August 31, 2012.

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Acknowledgments

Abstract

This paper focuses on end-user energy consumption behaviors with the objective to gather information in order to give more explicit knowledge about demand side. The author chose to adopt a qualitative method for the first part so as to collect an in depth comprehension of energy consumption behavior. Semi-directive interviews addressed different energetic topics such as water, heating, electricity but also communication and population knowledge about energy issues. A quantitative survey through a questionnaire completed the qualitative part with the objective to confirm or invalidate the hypotheses of the first part. The aim of the paper is to provide energy models with more precise elements about demand, as at the moment it is estimated through non-behavioral parameters such as Gross Domestic Product or demography. The author concludes this paper by proposing lines of thought in order to build guidelines to enable the introduction of behavioral components in the models.

Key Words: Energy consumption, behavior, energy models, semi-directive interviews, quantitative survey

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ETSAP	Energy Technology System Analysis Program
GERAD	Groupe d'études et de recherche en analyse des décisions
IEA	International Energy Agency
MARKAL	MARket ALlocation
RES	Reference Energy System
TIMES	The Integrated MARKAL-EFOM System

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1. Introduction

Since the 1973 oil crisis, concerns about energy issues never stopped growing. Many models have been developed to evaluate energy resources but also consumption. After Fukushima's 2011 accident, debates about nuclear energy have been more virulent than ever and most of European countries re-thought of ways to leave this type of production because of risks that is associated to it. In Switzerland, nuclear represents around 40% of consumption[1] currently produced by five central. In 2011, Swiss government set up not to replace old central so country should be nuclear free by 2034. At the same time, the Swiss Federal Office of Energy considers that consumption should grow from 58.6 TWh in 2011 to 86.3 TWh in 2050[2]. Of course, all those elements forced government to re-think energy policies and scenarios and their plan is to set up more sustainable energy policies and encourage renewables.

1.1. Aim of Study

Developed under the aegis of the Energy Technology Systems Analysis Program (ETSAP) of the International Energy Agency (IEA), the TIMES/MARKAL family of models takes into consideration technological and economic data to build energy scenarios. Such scenarios are important decision tools and are currently used worldwide[3] with specialists continually working on data collection and model improvement.

Aim of study is to keep on with previous researches on way to include social behavior in TIMES/MARKAL model. This paper will try to explain some of end users' energy consumption behavior through both qualitative and quantitative methods.

First part will consist in semi-directives interviews. This qualitative method will help to get in depth findings about elements that influence interviewee's behavior. Analysis will enable the author to highlight motivation and habits of respondents regarding their energy consumption. Based on qualitative results, research hypotheses will be issued.

Second part will be using a quantitative methodology. A survey will be addressed to Geneva area's inhabitants in order to confirm or deny research hypotheses issued in the first part, but also from previous work done at the Geneva School of Business Administration (Haute Ecole de Gestion de Genève). The author will process analysis using SPPS, a statistic program.

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[1] RTS.CH. RADIO TELEVISION SUISSE website, *Les projets de barrages soumis à examen sont nombreux en Suisse, Téléjournal* 19 :30, 21.05.2012 (accessed May 21, 2012)
[2] Ibid.
[3] ETSAP website: http://www.iea-etsap.org/web/applicationGlobal.asp (accessed May 1, 2012)

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The aim of this paper is to focus on end user consumer to understand their behavior's influence on regional or global energy consumption. In fact, individual behaviors have often been neglected in diverse studies on energy problem. The objective is to give real understanding key of those behaviors, propose tools to build effective communication on energy issues and provide guidelines to integrate behavioral components in the model.

1.2. Scope and Limitation of Study

The study will focus on end-users in order to understand their behavior, factors that influence them and possible area of change. In fact, in Switzerland in 2011, household's account approximately for one third of total final energy consumption[4]. Study has been addressed to the Geneva area population but author will try to implement them in the TIMES-Canada model.

Limitation remains in the accuracy of data collected and ability to integrate them directly in the model. In fact, at the end of the paper, author will present preliminary research on how to find relevant data, starting from the model.

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[4] OFFICE FEDERAL DE L'ENERGIE OFEN. *Statistique globale suisse de l'énergie 2011*, p.4

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2. Literature Review

In this section, the author briefly presents the TIMES/MARKAL energy-economy model that data collected are willing to supply and main limitations of such models by outlining the strong sociological dimension characterizing energy consumption and the behavior of consumers. Author will present a few papers that already analyzed consumption structure and potential of saving and how politics and companies communicate to end users in order to lower energy consumption. Initiatives developed by energy suppliers will be presented as well and this section will conclude on studies that analyzed action affecting energy consumption in order on enhance the relevance of a sociological approach to the existing TIMES/MARKAL family of models.

The MARKAL (an acronym for MARKet ALlocation) family of models has been developed under the aegis of the Energy Technology Systems Analysis Program (ETSAP) of the International Energy Agency (IEA). Firstly built at a country level and then extended to groups of countries bound by international trade, some models also assess smaller area and are defined at regional, city or community level. Cubizolle et al. (2007) presented their development of a specific SOCIO-MARKAL model for Nyon area, a mid-sized city in Switzerland whereas GERAD (Groupe d'études et de recherche en analyse des decisions) developed TIMES-Canada[5], a model that addresses the whole country. TIMES (an acronym for The Integrated MARKAL-EFOM System) is a new version of the model which offers new possibilites. It defers in some aspects with MARKAL but general idea is the same.

TIMES/MARKAL model includes variables, equations and in equations including all data of a Reference Energy System (RES), namely energy sources, conversion technologies, technologies meeting demand and useful demand to satisfy which makes it a bottom-up technology-based dynamic linear programming (LP) model (Lavigne and Fragnière, 2011).

Figure 2.1. Partial view of a simple Reference Energy System
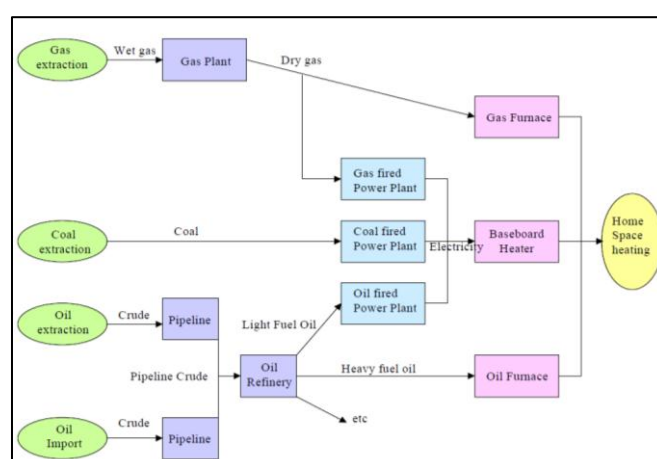
Source : LOULOU, Richard, GOLDSTEIN Gary, NOBLE Ken. *Documentation for the MARKAL Family of Models [on line]*. 2004, p.13

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[5] VAILLANCOURT, Kathleen et al. *Recent Developments in the Energy Model TIMES-Canada: Focus on the Unconventional Gas Production Until 2050*. ETSAP WORKSHOP, Athens, 2011 (accessed August 20, 2012)

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TIMES/MARKAL models allows researchers and decision makers to face multiple choices situations and develop long-term energy scenarios. Goal of TIMES/MARKAL models is to determine the optimum energy mix and networks that can meet a specific demand, subject to user-defined constraints (Weijemars, Taylor, Bahn, Das and Wei, 2011). Full description of TIMES/MARKAL family of models can be found on the ETSAP website[6].

Even if TIMES/MARKAL models take into consideration several external factors, consumer's behavior has not yet been introduced as an important factor to determine energy efficiency, savings, and emission reduction (Kanala, Turin and Fragnière, 2012). In the early 2000, EURECO project showed a 38% potential of reduction for electricity consumption in household's, mainly by very common intervention (European Community, Assessment of the Potential Electricity Savings, 2002 cited in Desmedt, Van Beal and Vekemans, 2009). A few years later, a report of the United Nations Environment Program (UNEP, 2008) showed that 80% of total energy consumption takes place during the use of buildings. Such results highlight the importance of household's energy consumption and behavior. In France, the CREDOC (2011) realized a survey and showed that 93% of French people think that their individual behavior can have an impact on environment and 78% admit that they could do more or better with their lifestyle to look after sustainable development.

The growing use of electronic devices and time spent on using them shows us the importance of educating people. Beside that there are some elements which make it difficult to influence or even evaluate. Faburel (2004, cited in Rocci 2007) points out three major tensions brought by climate change: (1) social, with a gap between individual and collectivity; (2) spatial, between local and global; (3) temporal, between short and long term. Moreover, Boulanger (2007) has developed the concept of energy efficiency barriers to try and explain the gap between economic efficiency and effective behavior.

Regarding sensitization to energy issues, some authors focused on communication tools and how it reaches people. Desmedt, Van Bael and Vekemans (2009) have shown that they are numerous but hardly catch any attention. Moreover, Bottrill (2007) has shown that tools used to promote energy conservation lack the ability to give people advice to accurately monitor their energy use and provide them with meaningful feedback and guidance for modifying their energy consumption. Rydin et al. (2007) and Nye and Burgess (2008) insisted on the importance of engaging root practice(s) and the context in which those practices take place. Gyberg and Palm (2009) identified four different categories of material: (1) individual choices; (2) creating incentives; (3) creating a measurable world; (4) technological improvements. In between, they also show important facts and limitations for each categories, namely (1) alternatives are limited, and the information and knowledge about them varies greatly; (2) incentives focusing on price have limited influence (Aune, 2004 cited in Gyberg and Palm 2009); (3) to live a more efficient life demands control; (4) detailed studies on households' energy consumption are not so common.

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Hydro One, an energy supplier active in Canada conducted a test in order to create a measurable world. They gave real-time electricity monitors to 17'000 customers and results showed that it helped homeowners reduce their consumption of electricity by up to 15%, with an average reduction of 6.5% (Chartwell's best practices, 2007). In Geneva area, the energy supplier launched a vast campaign named Eco21 with different promotion tools focusing on the four points cited above[7].

Previous studies have discussed some specific action that affects energy consumption. Gyberg and Palm (2009) highlighted that people provide two motivations for changing their behavior: lower energy costs and a reduced impact on environment. But Wallenborn et al. (2006) research found that even if behavior is influenced by many criteria and constraints, financial issues are often less important than other personal criteria. Ouyang and Hokao (2009) shown that improving consumption behavior can save up to 10% of energy use by studying the relationship between electricity consumption and household lifestyle. Moreover, Diamond (1984, cited in Wilhite et al. 2000) showed that there could be a variation of 10-to-1 in total energy use among identical apartments.

This literature review showed that energy-use behavior depends on our culture and on socio-economic aspects. In that sense, understanding behavior is primordial. Information and how it is communicate also influence citizens' behavior. This paper aims to analyze different aspects and themes on energy consumption, focusing on behavioral aspects. It will cover day to day activity but also knowledge and point of view of interviewees on energy in general.

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[7] Eco21 website : http://www.eco21.ch/eco21/qui-sommes-nous/le-bilan.html (accessed August 20, 2012)

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3. Methodology

This section will present methodology used to complete this study. It relies on quantitative and qualitative methods, but as qualitative methods are not very developed in TIMES/MARKAL family of models, author will present them more thoroughly. For practical reason, this part will be written in French.

3.1. Etude qualitative

Lorsque l'on parle d'études de marché dans notre quotidien, le premier exemple qui nous vient en tête est celui du sondage téléphonique ou encore mené dans la rue. Celui-ci permet de collecter des données précises permettant de généraliser les observations à l'ensemble d'une population à partir d'un échantillon. Les résultats de ce type d'enquête sont souvent repris dans la presse car ils font ressortir des chiffres clés qui permettent une bonne compréhension des phénomènes. Ce type de recherche fait appel à des méthodes quantitatives.

Cependant, les études de marché ne se limitent pas à ce type de méthode. Ainsi, comme le relève Miles & Hubermann (1994), *«Toute recherche possède une base qualitative».* Alors que les études quantitatives répondent majoritairement à des questions fermées et aboutissent à des résultats chiffrés généralisables, les études qualitatives cherchent à analyser en profondeur des phénomènes sociaux et offrent souvent comme résultats des mots.

La méthodologie présentée ici place la recherche qualitative en amont d'une deuxième phase quantitative. Elle doit nous permettre de découvrir des éléments menant à la construction de l'étude quantitative. Notons ici qu'une étude qualitative peut se suffire à elle-même et que la méthode de recherche utilisée doit avant tout être choisie en fonction de l'objet étudié.

Recherche documentaire

Pour commencer, il s'agit de se documenter un maximum sur la thématique abordée. En effet, il est sans doute possible de trouver des articles de journaux ou même des articles scientifiques traitant d'un sujet proche du votre. Cette première prise de contact permet d'élargir le champ ; nous partons parfois avec des idées préconçues sur notre objet de recherche. De plus, on peut alors connaître les moyens utilisés par d'autres personnes ayant travaillé sur le même thème et cela peut nous orienter dans notre travail.

Afin d'effectuer ces recherches, il s'agit de choisir différents moyens adaptés à ses propres besoins. En plus d'Internet, il existe des bases de données, payantes ou gratuites, qui compilent les références autour de thématiques précises. Il est aussi intéressant d'utiliser les modes de recherche avancée des différents moteurs de recherches. Ceux-ci permettent de spécifier une période, un nom de domaine ou encore un format de document spécifique de recherche pour ne citer que quelques possibilités. Les bibliothèques, souvent abonnées à des journaux ou magazines, regorgent elles aussi d'informations pouvant vous être utiles.

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Cette première prise de contact avec votre objet de recherche vous donne des pistes de réflexion et vous permettra de préciser les questions auxquelles vous souhaiter obtenir des réponses. On peut alors passer à la partie de terrain avec les entretiens.

Recherche terrain

Après cette première phase de recherche documentaire, il est temps de se lancer sur le terrain. Il existe plusieurs méthodes de recherche qualitative présentées au début de ce chapitre. Cependant, nous avons choisi de privilégier celle de l'entretien semi-directif sur laquelle nous reviendrons donc plus en détails.

1. Méthodes de recherche qualitative

Il existe quatre grandes familles de recherche :

a. Entretien non-directif

Mené comme une discussion libre, il s'agit d'un échange entre l'interviewé et l'intervieweur autour d'un thème générique. Ce type de discussion va donc suivre librement le raisonnement de l'interviewé.

b. Entretien de groupe

Aussi connu sous le nom de « focus group », ce procédé consiste à rassembler plusieurs personnes autour d'une thématique et de lancer une discussion. Un modérateur est présent afin d'organiser le débat.

c. Observation

Cette méthode se veut très révélatrice des phénomènes qui nous entourent dans notre vie de tous les jours. Elle permet de décortiquer ce que l'on voit à travers une grille d'analyse. L'observation peut être participante ou non. Dans le cadre d'une observation participante, le chercheur interagit avec l'environnement étudié et devient donc partie intégrante de l'observation puisqu'il en modifie la nature. Au contraire, si la méthode retenue est celle de l'observation non participante, l'enquêteur se fait le plus discret possible et se tient en dehors du champ observé.

d. Entretien semi-directif

Fondée sur le même type d'interaction que l'entretien non-directif, celui de l'interview en face à face, cette méthode se veut tout de même plus construite. A travers l'élaboration d'une grille d'entretien préconstruite selon les axes de recherche retenus, l'intervieweur va diriger en partie l'entretien et s'appliquer à ce que chaque thème soit abordé.

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Il est cependant important de ne pas être trop directif et de laisser le temps à l'interviewé de s'exprimer. Comme indiqué en début de chapitre, c'est ce type de méthode qui est privilégiée dans notre approche. Dans les parties suivantes, nous allons revenir sur l'élaboration de cette grille puis, sur la manière de conduire un entretien.

2. Construction de la grille d'entretien

A l'issue de la recherche documentaire, nous aurons dégagé différents axes de recherche. Il va maintenant s'agir de les exprimer sous forme de questions ouvertes. Contrairement aux questions fermées rencontrées en majorité dans les sondages quantitatifs, les questions ouvertes doivent permettre de lancer la discussion sur une thématique. On cherchera à savoir le « pourquoi » ou le « comment » d'un phénomène.

Il ne faut pas que la grille d'entretien soit trop longue, au risque de décourager l'interviewé… et l'intervieweur ! Une moyenne idéale se situe entre cinq et sept questions. Un moyen relativement facile est de procéder par axe. On cherche alors une ou deux questions par thématiques retenues puis, au besoin, on effectue un tri.

Avant de débuter la collecte effective des entretiens, il est important de tester sa grille. En effet, étant plongé dans le sujet de recherche, il peut arriver que l'on manque de distance et que certaines choses nous échappent. On peut par exemple avoir recours à un vocabulaire très spécifique ne correspondant pas à tous les publics. Ces tests doivent donc nous permettre de confronter notre grille à une situation réelle d'entretien et de détecter d'éventuel(s) problème(s) dans sa conception. A partir du moment où on estime que tout est au point, on peut débuter la récolte des données !

3. Echantillon et conduite d'entretien

Dans un premier temps, il est nécessaire de réfléchir aux personnes que l'on cherche à atteindre pour notre recherche. Par exemple, si l'on fait une étude sur les goûts musicaux chez les adolescents, on veillera à retenir des personnes issues d'horizons musicaux différents et à garder un certain équilibre entre les groupes. Pour une étude de ce type, on peut considérer avoir des résultats consistants en réalisant vingt à trente entretiens.

Lors de l'entretien, il faut toujours bien garder en tête les différentes questions composant notre grille. En effet, même s'il s'agit de questions ouvertes et que le but est d'amorcer le dialogue avec l'interviewé, il ne faut jamais perdre ses objectifs de vue. De plus, plus on connaît sa grille d'entretien, plus on peut prêter une réelle attention aux propos de la personne en face de nous. Il est très important de valoriser la personne interviewée ; c'est elle le centre de notre étude et ce sont ses opinions, motivations, comportements qui nous intéressent.

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Une fois les entretiens réalisés et retranscrits, il s'agit d'analyser leur contenu. Ici, nous utiliserons les méthodes d'analyse de discours en recherchant les mots ou thèmes les plus récurrents. Il existe différents types d'outils pouvant aider à l'analyse de texte, plus ou moins ludiques, tels que le logiciel Sphinx ou encore Tagxedo qui permet de créer des nuages de mots. Néanmoins, ce type d'analyse ne nécessite pas l'utilisation de telles applications et peut aussi être mené manuellement ou à l'aide d'un tableur Excel comme présenté à la section 4.1.2 de ce travail.

3.2. Paper Methodology

In order to focus on individual behaviors, the author chose to use both qualitative and quantitative methodology in a complementary way. In fact, they don't aim to achieve the same goal. Whereas quantitative authorizes to describe trends and generalize results from a sample to a population, qualitative tools aim to gain diversity and give the broadest view of a phenomenon.

Research started with a literature review on energy and behaviors topics in order to build a semi-directive interview schedule. Twenty-four semi-directive interviews of seven questions each have been submitted to people living in the Geneva area during months of October and November 2011. Questionnaire addressed perceptions, attitudes, information and behavior of the consumers. Objective of semi-directive interview technique consists of open-ended questions that give the interviewee the opportunity to talk and give his/her point of view, submit his/her habits, reflect on his/her behaviors, etc. The author aimed to obtain in-depth findings about consumer behavior from their perspective. A special attention has been put on interviewing men and female, house owners and tenants but also diverse ages in order to reach every part of the population. Author then analyzed all data to outline main topics and hypotheses were built from a synthesis.

After constructing these hypotheses, they were then tested in the quantitative part of our survey. It resulted in a 21-question questionnaire, including seven ethnology questions for statistical purposes such as age, sex, occupation, and house tenants or owners. The size of the sample was 495 questionnaires collected during the month of December 2011. We questioned people on their consumption habits of water, heating, and lighting, impact of an increase in prices for their consumption, elements that influence their attitude toward energy, use of electrical appliances and, finally, their knowledge of energy production sources.

Next sections will now present research's results.

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4. Qualitative Research

To start the research and get in depth finding about people's behavior, author started by using qualitative method. More specifically, it consisted in semi-directive interviews. This section will present data analysis and then propose hypotheses to be tested in the quantitative part of this paper.

4.1. Data analysis

This section will start by presenting our sample characteristics and will address thematic issues, question by question after presenting how the author analyzed and classified qualitative data.

4.1.1. Ethnology questions

The interview schedule (Appendix I) consisted in 6 open-ended questions, plus a secondary one. It has been submitted to 24 people living in the Geneva area paying attention to their gender, age and whether they were owners or tenants. Table below sums up interviewees' characteristics. As all interviews were anonymous, author used a code formed by interviewers' initials and numbers.

Table 4.1. Interviewees' characteristics

Interviews' codes	Male/Female	Class of age	Owner/Tenant
AO1	Male	19-24 years old	Tenant
AO2	Female	25-34 years old	Tenant
AO3	Female	35-44 years old	Owner
AO4	Male	45-54 years old	Owner
CF1	Female	25-34 years old	Tenant
CF2	Female	19-24 years old	Tenant
CF3	Male	+55 years old	Owner
CF4	Female	45-54 years old	Owner
CFS1	Male	35-44 years old	Owner
CFS2	Male	35-44 years old	Tenant
CFS3	Female	45-54 years old	Owner
CFS4	Female	35-44 years old	Tenant
HD1	Male	25-34 years old	Tenant
HD2	Male	45-54 years old	Owner
HD3	Female	19-24 years old	Tenant
HD4	Male	+55 years old	Owner
JMG1	Male	25-34 years old	Owner
JMG2	Female	25-34 years old	Tenant
JMG3	Female	25-34 years old	Tenant
JMG4	Female	35-44 years old	Owner
MC1	Female	25-34 years old	Tenant
MC2	Female	25-34 years old	Owner
MC3	Female	45-54 years old	Tenant
MC4	Female	19-24 years old	Tenant

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4.1.2. Thematic issues

To carry out analysis of semi-directive interviews, the author used an Excel chart referencing interviews extract. Work consisted in a lexical analysis. As shown in Table 4.2 below, the author assigned a theme to each of them and also pointed out which interview and question it referred to.

Table 4.2. Sample of qualitative analysis file

Extraits d'interviews	Thèmes	Q 1	Q 1b	Q 2	Q 3	Q 4	Q 5	Q 6	H	F	P R	LO C	0/18	19/24	25/34	35/44	45/5 4	55	AO 1
Serait plus attentif à sa consommation d'électricité	CHANGE			X					X			X		X					X
Beaucoup de gens se définissent aussi comme tels mais n'ont pas conscience des sacrifices à faire	CHANGE						X		X			X		X					X
Pas assez ciblée	CIBLE				X				X			X		X					X

Once all data compiled, the author summarized the whole collection on an analysis spreadsheet to facilitate an overall view as shown as in Table 4.3. He chose to highlight three different things:

- Questions in which a theme was mentioned more than ten times (in orange)
- Themes that were mentioned more than twenty times (in green)
- Themes mentioned by more than half of the interviewees (in red)

This ranking method enabled the author first to analyze data question per question and then, find out which of the themes were recurrent and more cited.

List of themes with labels' definition is presented on Appendix II. As interviews have been conducted in French, analysis file and labels are also in French.

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Table 4.3. Analysis spreadsheet

Thèmes	NB de citations	NB Q1	NB Q1b	NB Q2	NB Q3	NB Q4	NB Q5	NB Q6	NB ITW cité
ARGENT	9		3	4				2	8
ATT	17			1	12		4		11
CHANGE	20		1	13	1		3	2	15
CHAUFF	20	16	2	1				1	13
CHAUFF_OFF	2	1	1						2
CIBLE	7				7				4
CONFORT	12	1		9				2	10
CONTRA	7	2					5		4
EAU	25	16	4	2				3	15
EAU_OFF	22	13	8					1	14
ELEC	3	1						2	3
EN	4	1	1					2	4
ENSEMBLE	10			4				6	7
ENTREPR	5			1	1		2	1	4
EQUIP	46	21	1	4	3	1	5	11	19
EQUIP_OFF	12	10					1	1	9
FUT	1							1	1
GREEN WASHING	2				2				2
IMPACT	10	1				1		8	7
LUMIERE	2	2							2
LUMIERE_OFF	38	21	12	1				4	21
MANQUE INFO	20	2			8		10		13
MENTALITE	26		12	6	1	1	4	2	12
MOBI	15	1					1	13	12
NO CHANGE	5			4			1		4
PC_OFF	7	2				4		1	6
QUALI	12				12				9
RECY	17	1	1					15	12
SIMU	28					28			20
SMARTPHONE	4					4			3
STANDBY	6	2				1		3	6
SUGG	19			1	18				10
TV_OFF	6	1	2			3			5
UTI_PC	16	1				15			9
UTI_TV	36	1				34		1	22
VALEURS	5	1				2	1	1	4
VIDES	110	7	7	27	15	1	22	31	23

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Now, the author will carry out data analysis question per question and will discuss after recurring themes.

Question 1
What are the reflexes you have in saving energy (water/electricity/heating)?

Two topics are mainly mentioned by interviewees with both 21 quotes: turning lights off and types of electrical appliances they decide to buy.

Turning lights off is often the first element given by interviewees and it seems like a large part of the population has really integrated this gesture in their behavior. Here are some relevant quotes to illustrate this observation:

"Without hesitation: turn off the light" (Interview CF3)

(He snaps his fingers) It is to ensure turning off lights when leaving a room (Interview CFS2)

Regarding electrical appliances, people mentioned different topics. Firstly, they talk about the fact they have installed low consumption bulbs. Pay attention here that, as in many countries, you cannot find incandescent bulbs anymore on the market. Secondly, they refer to the use of power strip in order to completely switch off equipment when not used. The use of such equipment has also been classified in the "turning off electrical appliances". Interviewees also referred to diverse appliances such as refrigerators, washing machines or dishwasher. They told that they prefer to buy more efficient appliances, talking about European Union Energy Label[8]. Even if prices can be higher, they believe that they would make sustainable savings. Owners also talked about the installation of photovoltaic panel.

Third and fourth topics have been raised sixteen times and concern water and heating savings. Regarding water, it is important to note that this theme refers to water consumption but does not include the gesture of turning off water which is another theme in itself that will be discussed later. The habit people talk about the most is the fact that they prefer to take shower instead of bath saying it saves a lot. It is also important to note that a few people do not make any effort towards water saving as interviewee CFS 2 who says "We have a lake full of water, why deprive?".

Owners are more concerned with heating savings as they represent ¾ of quotes referring to that theme. They talk about using the sun when possible to warm their houses or cutting off heating in rooms where it is not necessary. A few tenants also talk about heating but it is obvious that they have less control on it except in buildings equipped with individual radiators "I rule on 3/5 thermostatic valves of my radiators" (Interview CFS2).

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[8] Neue EU Energielabel website: http://www.newenergylabel.com/index.php/ch/home/ (accessed May 10, 2012)

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At the end, we find the two habits of turning water and electrical appliances off. Interviewees think of turning off water when brushing their teeth or washing dishes and speak about standby mode when mentioning electrical appliances but also "ghost energy" loss (Interview JMG4). Some of them especially mentioned energy consumed by cellular phones remained plugged in when not used.

It is interesting to point out that no one talked about money saving while evoking energy saving.

Question 1b
Which of them have you received during your childhood?

That question reveals two main themes: "turning off the light" and "mentality". In fact, both have been quoted 12 times.

As observed in question 1, turning off the light seems to be perfectly integrated since childhood. But the interesting finding of that question relies on the fact that people saying they haven't received any reflex during their childhood mentioning "mentality" as a factor of education, are aged of 35 years old or more and/or referred to the specific area they grew up in. The author would like to highlight that there may be a link with the fact that first big concerns on energy savings started after the 1973 gas crisis. We can consider that it took a few years for people to integrate new behaviors.

Question 2
How would you handle the introduction of a quota of electricity? You would be entitled to a certain amount of electricity at a fixed price and then, beyond this threshold, you would be charged more for each unit consumed. (Would you be more careful? Would you change your behavior?)

A majority of people say they would make a change if needed. In the meantime they often consider that their actual behavior is already appropriate and they would only have to make small changes "Interviewee would make 2-3 efforts without radically change his lifestyle" (Interview CF1).

A few interviewees mentioned the importance of comfort and the fact that it could lead to a change in mentality. For some person, it is also really important to set on something that is fair and take into consideration specificity from each home (m2, number of adults and children, sick people, etc.).

Question 3
What do you think of the communication made today about energy consumption? (Technology, behavior ...) (Economy and reduction) (Are you sensitive? Is there enough? Is it attractive? Do you have a specific example?)

Almost half of interviewees declare that they do not really pay attention to the communication made about energy consumption. Interviewee CFS4 for instance "doesn't find the subject very attractive". Regarding quality, people say that it has improved past years but it can still be more. It is important to point out that there are 8 quotes talking about a lack of information towards energy sources, tips to save energy or risks related to energy consumption.

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In that question people evoked a few ideas to improve communication about energy. Firstly, three quotes suggest that communication should be more fun and involve people "It's good to educate people in a fun way with images and brochures" (Interview JMG2).

Secondly, some interviewees highlight the need to see what could result from a better use of energy "SIG (Geneva area energy provider) should educate us and show one how much waste of energy cost him" (Interview CFS1). Thirdly people mention the fact that there should be more advertisement or educational program on television, considering that nowadays, most of the people watch it daily especially at news time.

Question 4
Why do you turn on your TV / PC? (When?) (Some people leave the TV to simulate the presence or boost the mood, what do you think of this behavior?)

Most of the interviewee says they turn on TV when they want to watch something. Often, it is at night, back from work, to watch news and/or entertainment programs. 8 people say they really don't understand people who leave their television on when not watching it while 7 say that if even if they don't do it, they can imagine why a person would act that way. 5 interviewees say they keep television turning when they are alone at home.

People say they use more and more their PC's, mainly to work, study, check their emails or go on social networks. The interesting thing to note here is that a few interviewees say they now use a lot their smartphones and this tend to substitute their PC's for different type of tasks.

Question 5
We use more and more electrical appliances while at the same time, we speak of a nuclear phase-out. What do you think?

It is interesting to highlight the fact that many interviewees say they miss information to answer that question. Interviewee MC3 says that "he only heard about Fukushima" while interviewee HD1 just says "I have no idea". It is hard for them to figure out the link between nuclear production and energy consumption. They don't know that around 40% of Swiss energy consumption results from nuclear activity.

Some express the desire of a better communication on how politics think that nuclear can be replaced arguing that we should find a solution before planning to get rid of nuclear.

Question 6
How would you define an eco-friendly behavior?

There are three behaviors that seem to define eco-friendly behavior. Firstly, interviewees mention recycling, then mobility and finally electrical appliances. Mobility refers to the fact that eco-friendly person use bikes or public transportation instead of personal cars and electrical appliances refers to the number of devices owned by a person and its efficiency.

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It is relevant to highlight here that this question is, with question 1, the one that had the most various answers with 22 of main themes quoted and 31 non-classified answers. This highlight the fact that eco-responsibility is the fact of paying attention to one's whole behavior, energy consumption, water, mobility, recycling, equipment, etc.

4.1.3. Analysis of recurrent themes

In this section, the author will shortly presents themes that have been mentioned 20 times or more and/or by more than half of interviewees.

Themes mentioned more than 20 times (second column number highlighted in green in Table 4.3) :

CHANGE	EQUIP	INFO
CHAUFF	LUMIERE_OFF	MENTALITE
EAU	MANQUE	SIMU
EAU_OFF		UTI_TV

Among those themes, it is important to distinguish those that came spontaneously in interviewees' mind and those that were suggest by the question. SIMU and UTI_TV are part of that second category, thus author will not take them into consideration as important themes revealed by interviews.

First theme that has been the most cited is EQUIP, highlighting the fact that people are aware that there are different technologies to satisfy their need. Most of the time they also mention the fact that buying more efficient appliances leads to spending more money.

CHAUFF, EAU, EAU_OFF and LUMIERE OFF can be grouped in one category that is types of household energy consumption. CHAUFF_OFF and LUMIERE can be added to those categories. The interesting thing to note is that behaviors related to heating are the less mentioned during interviews. In fact, 22 quotes talk about this theme, while 47 talk about water and 40 about lightning.

Related to state of mind, MENTALITE has been quoted 26 times and CHANGE 20 times. This shows that consumption behaviors are linked with time period in which people have been raised up or in which they live. CHANGE seems to suggest that nowadays people are aware that there is a need for change and they seem to be ready for it.

Lastly, with 20 quotes, MANQUE_INFO is a crucial theme which reveals that interviewees often consider they do not have access to information about energy consumption but also about energy in general. There are two main reasons for that lack of knowledge: they do not know where to find the information or they do not have interest for information they receive.

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To conclude this section, author will now list themes cited by half or more of the interviewees, trying to show trends in discussion about energy consumption. Those data are in red in Table 4.3's last column.

CHANGE	EQUIP	MOBI
CHAUFF	LUMIERE_OFF	RECY
EAU	MANQUE INFO	SIMU
EAU_OFF	MENTALITE	UTI_TV

Again, author chooses to exclude SIMU and UTI_TV themes that are suggested by the question. One can see that other themes are the same as most quoted except MOBI and RECY. This shows that people consider energy consumption in a large way and are aware that the way they travel or how they recycle has an influence on total energy consumption.

4.2. Main findings

In this section, author sums up findings of question analysis. Lexical analysis enabled us to highlight seven main ideas regarding interviewees' behavior. Here are the seven findings:

a) People tend to pay more attention to their energy consumption when it's visible
b) Behaviors learned during childhood are the one people retain through their adult life
c) People are ready to make little changes to avoid paying more
d) Television is the best media to inform people about energy saving
e) People make rational use of television and computer
f) People lack information about their energy production sources
g) Being eco-friendly means thinking about every types of consumption

In the next chapter, author will use a quantitative questionnaire in order to test those findings and see if they can be generalized.

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5. Quantitative Research

After analyzing qualitative data and proposed different hypotheses to be tested, author developed a quantitative survey. Questionnaire consisted on 12 close-ended question, 1 open-ended question and 7 ethnology questions for statistical purposes such as age, sex, occupation, and house tenants or owners. It has been submitted to 495 people living in the Geneva area.

5.1. Data analysis

First of all, author will take on question per question and give descriptive statistic results. When relevant, there will be crossed analysis but first, we will start by presenting our sample with ethnology questions' results.

5.1.1. Ethnology questions

This section presents results of questions 14 to 21. Ethnology questions enabled the author to check if there were any personal factors that affect energy consumptions behaviors, such as age or earning for instance. Those data will be used lately when relevant.

Graph 5.1. Question 14 – Gender
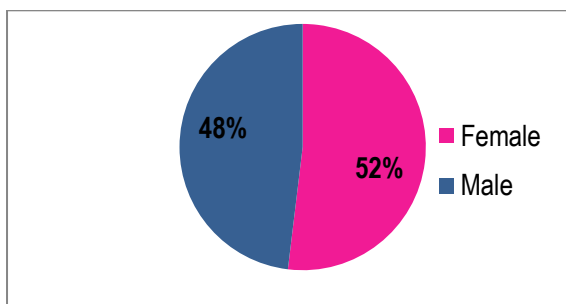
Graph 5.2. Question 17 – Owner or Tenant
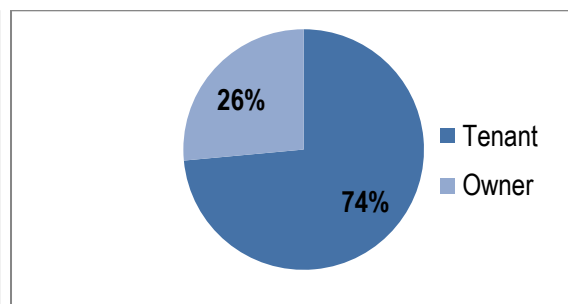
We questioned people if they were fully, partly or not responsible for costs associated with energy consumption. The aim was to find if there is a link between the way people behave and what they pay for.

Graph 5.3. Question 18 – Are you responsible for costs associated with energy consumption of your home?

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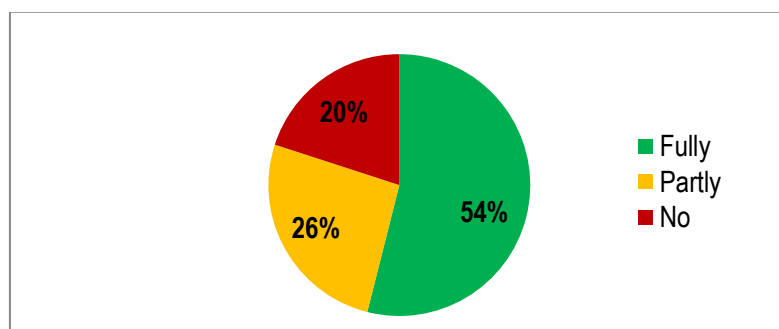
Graph 5.4. Question 20 – What is your current job profile?
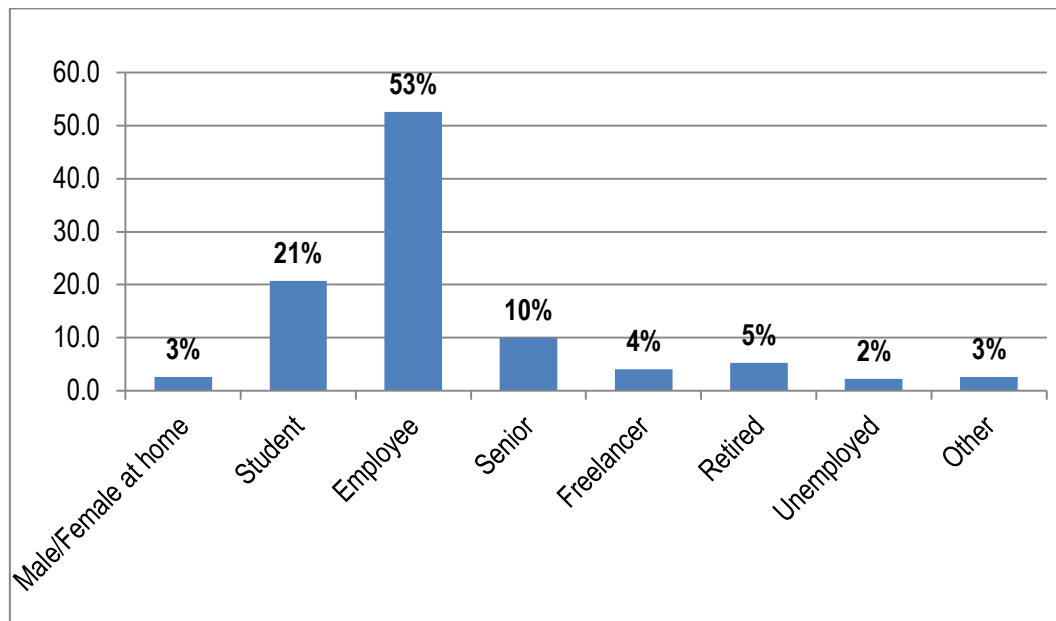
In the above graph people who checked "Other" are all part-time students.

Next question ask for interviewees' revenue. It will help the author to see if there is a link between financial factors and energy consumption behavior. As this question was facultative, sampling is downsized to 291 valid questions.

Graph 5.5. Question 21 – What is the annual gross income of your household?

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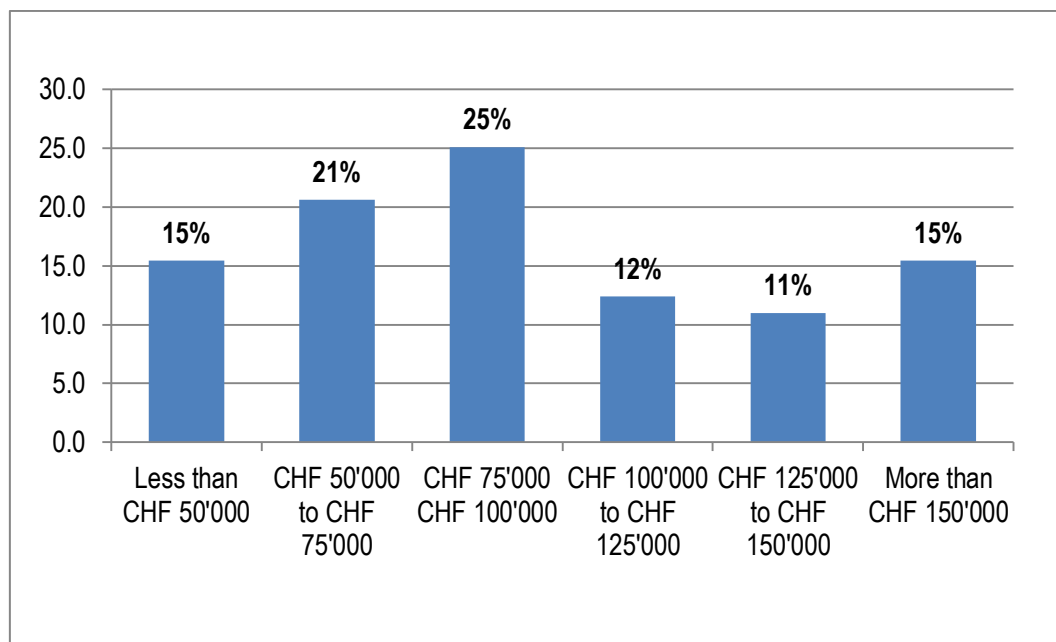
Last ethnographic question asked people their age. When comparing results with those from Geneva Statistic Office, author noted sampling gaps. In order to have results one can really rely on, this sampling gap should be corrected by statistic methods. Gross results will be used for this analysis.

Graph 5.6. Question 15 – In what year were you born?

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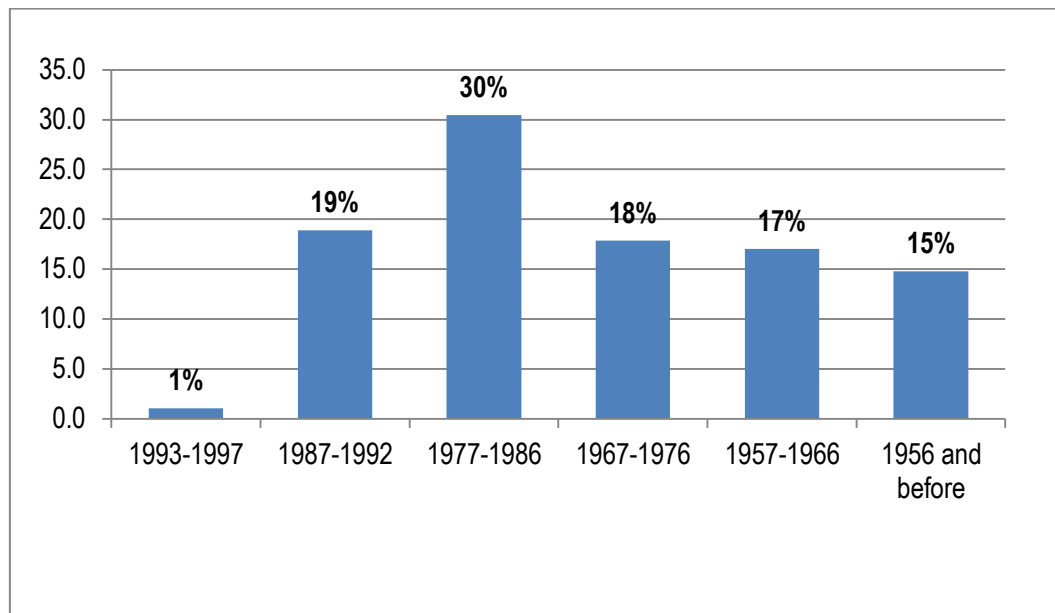
5.1.2. Thematic issues

This section presents results, question per question, grouping them in themes as done during questionnaire's construction.

Questions 1, 2 and 3
1) On what behaviors do you pay the most attention to in order to save water?
2) On what behaviors do you pay the most attention to in order to save heating?
3) On what behaviors do you pay the most attention to in order to save electricity?

Author chose to group the first three questions as they all refer to the a) hypothesis saying that:

People tend to pay more attention to their energy consumption when it's visible.

Before explaining how they are related to that hypothesis, we will have a look separately on each question with descriptive statistics, starting with question 1 focusing on water saving.

Table 5.1. Question 1 – On what behaviors do you pay the most attention to in order to save water?

	N	%
Closing the tap during brushing teeth	335	67.7
Taking a shower rather than a bath	302	61.0
Using the washing machine only when it is full	171	34.5
Using the dishwasher only when it is full	170	34.3
Using the least water when washing dishes manually	115	23.2
Taking short showers	71	14.3
I have no particular behavior or reflex	27	5.5
Other	14	2.8

Around two thirds of respondents say they close the tap during washing their teeth and around the same percentage say the prefer taking a shower rather than a bath. Approximately one third of the sample then mention the way they use washing appliances, both for dishes and clothes. Only 5.5% declare they have no particular reflex regarding that topic.

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Question 2 was formulated the same way but was addressing heating savings behaviors.

Table 5.2. Question 2 – On what behaviors do you pay the most attention to in order to save heating?

	N	%
Taking profit of the direct sunlight to heat interior space	186	37.6
Keeping a constant temperature thanks to a thermostat	168	33.9
Turning heating off when keeping the window open	143	28.9
When it is cold outside, keeping the shutters closed to save energy	125	25.3
I have no particular behavior or reflex	114	23.0
Using wood for heating because I have an open oven chimney	63	12.7
Other	38	7.7

One can note that there are less differences between respondents' answers, which means that there is not one specific behavior that really takes advantage on other. It is important to observe that 23% of sample declare they have no particular reflex in order to save heating.

Finally, question 3 also addressed savings behaviors but regarding electricity. Here, as in question 1, there are again big differences in answers. Turning off light when leaving a room comes first with around 80% and using low-consumption is second with around 40%. The four next answers come with 30% to 20% and then one find use of washing appliances with around 15%. Only 4.8% declare they have no particular behavior regarding electricity savings.

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Table 5.3. Question 3 – On what behaviors do you pay the most attention to in order to save electricity?

	N	%
Turning lights off when leaving a room	390	78.8
Using low-consumption bulbs	212	42.8
Turning on light only when it is necessary	138	27.9
Connect appliances to a power strip and a switch to be able to turn them off all at once easily	124	25.1
Pulling off plugs of appliances that I am not using	116	23.4
Purchasing appliances of class A or better	108	21.8
Using the washing machine only when it is full	81	16.4
Using the dishwasher only when it is full	78	15.8
I have no particular behavior or reflex	24	4.8
Other	2	.4

Regarding hypothesis a) in section 4.2, advancing that *people tend to pay more attention to their energy consumption when it's visible*, it is interesting to look at people answering they have no particular behavior to those three questions.

For water and electricity, that are the two visible energy consumptions, we had respectively 5.5% and 4.8% of people ticking that answer. When it comes to heating, which is the invisible energy consumption, there are 23% of answerers saying they have no particular reflex. It seems we can conclude visibility of energy is an important factor to facilitate savings.

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Question 4
Did your parents teach you to turn off lights when leaving a room?

That question had the purpose to find out whether turning off lights when leaving a room is an educational gesture or not. As one can see in Table 5.6 below, 78% of respondents said their parents taught them this habit during their childhood while only 7% said they didn't.

Table 5.6. Questions 4 and 15 –
Did your parents teach you to turn off lights when leaving a room? and In what year were you born?

		Age by category						
		1993-1997	1987-1992	1977-1986	1967-1976	1957-1966	1956 and before	Total
Did your parents teach you to turn off lights when leaving a room? (%)	No	20	9	11	11	20	27	15
	Yes	80	88	86	80	69	56	78
	I don't know	0	3	3	9	11	16	7
Total		100	100	100	100	100	100	100

After crossing question 4 with ages of respondents, it seems like there has been a growing attention through years regarding energy consumption for lightning. In fact, only 56% of people born in 1956 or before said they learned that habit when they were children. For people born from 1967, this percentage rises up to 80% or more.

Author then crossed question 4 with question 3 answer "Turning off lights when leaving a room" to verify the hypothesis b) advancing that *behaviors learned during childhood are the one people retain through their adult life*.

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Table 5.7. Questions 3 and 4 – Did your parents teach you to turn off lights when leaving a room? and Turning lights off when leaving a room

		Did your parents teach you to turn off lights when leaving a room? (%)		
		No	Yes	I don't know
Turning lights off when leaving a room (%)	No	27	19	28
	Yes	73	81	72
Total		100	100	100

There is a bigger percentage of respondents turning lights off also answering their parents taught them that habit when they were children. Nevertheless, the difference with people declaring they didn't get that habit during their childhood is too little to confirm the above hypothesis b) formulated in section 4.2.

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Question 5

Should electricity price be doubled, would this influence your behavior?

As there is a broad range of literature arguing price is not anymore a good incentive to change people's behavior, we wanted to discuss that question.

Graph 5.7. Question 5 – Should electricity price be doubled, would this influence your behavior?
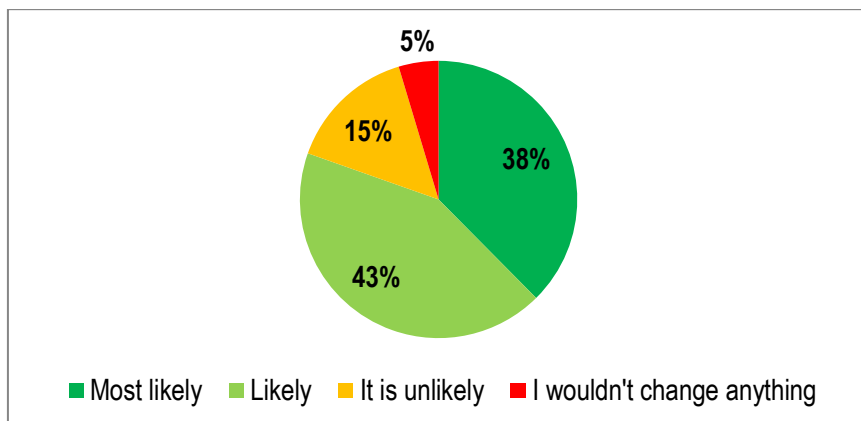
Results seem to show that people are still sensitive to prices. Around 80% say they would likely or most likely change their behavior for a doubling of prices. Such results show that people are ready to make little changes to avoid paying more. Nevertheless, when crossing this question with question 18 asking if people are fully, partly or not in charge of costs associated, one can note that the more people pay for energy, the more they are ready to change.

Table 5.8. Question 5 and 18 – Should electricity price be doubled, would this influence your behavior? and Are you responsible for costs associated with the energy consumption of your home?

		Q. 18 - Are you responsible for costs associated with the energy consumption of your home? (%)		
		Fully	*Partly*	*No*
Q.5 - Should electricity price be doubled, would this influence your behavior?	*Most likely*	40	36	33
	Likely	36	45	59
	It is unlikely	19	14	5
	I wouldn't change anything	5	5	3
	Total	100	100	100

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Question 6 and 7

6) Among the following elements, which ones would mostly influence your behavior?

7) In your opinion, which advertisement media is the most efficient to sensitize people to their electricity consumption?

Author choses to group results of those two questions as both tend to address hypothesis d) arguing that television is the best media to inform people about energy saving.

First, question 6 tried to understand which vector was the most influential for one's behavior.

Table 5.9. Question 6 – Among the following elements, which ones would mostly influence your behavior?

		Effectives	*Percentage*	*Valid percentage*	*Cumulative percentage*
Valid	*Friends / Family advices*	67	13.5	13.6	13.6
	Education	120	24.2	24.3	37.9
	Advertisement	9	1.8	1.8	39.7
	Information's (TV, radio, newspapers)	88	17.8	17.8	57.5
	My personal values	198	40.0	40.1	97.6
	Other	12	2.4	2.4	100.0
	Total	494	99.8	100.0	
Missing	*Missing system*	1	.2		
Total		495	100.0		

People say that their personal values (40.1%) and their education (24.3%) are the two elements influencing the most their behavior towards energy consumption. It is interesting to note that 17.8% declare that information is the third vector that influences them.

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Question 7 focused more on the information category mentioned above. It aimed to find out which media was the best to communicate and sensitize people to energy consumption in order to know if television was the most recurrent answer.

Table 5.10. Question 7 – In your opinion, which advertisement media is the most efficient to sensitize people to their electricity consumption?

		Effectives	*Percentage*	*Valid percentage*	*Cumulated percentage*
Valid	*Television*	335	67.7	67.8	67.8
	Internet	27	5.5	5.5	73.3
	Radio	18	3.6	3.6	76.9
	Providers' advertisement	82	16.6	16.6	93.5
	Advertisement in public transportation	11	2.2	2.2	95.7
	Other	21	4.2	4.3	100.0
	Total	494	99.8	100.0	
Missing	*Missing system*	1	.2		
Total		495	100.0		

Clearly, television is said to be the best way to communicate with people. In Switzerland, there is a very little communication through that media.

Author crossed this question with age's categories as we might expect difference of favorite media for different generation. This didn't lead to relevant results.

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Question 8
Let's suppose government has no choice but to ration quantity of distributed electricity. Would you pay more in order to consume more?

This question, as question 5, also addressed prices. It wanted to find out whether people would prefer to pay more and keep the same comfort or change their behavior. Author crossed those two questions in order to check if people who would agree to pay more are the same who won't change their behavior if electricity price should be doubled, and vice-versa. This crossing didn't give any consistent results but this might be related to question's formulation.

Graph 5.8. Question 8 – Let's suppose government has no choice but to ration quantity of distributed electricity. Would you pay more in order to consume more?
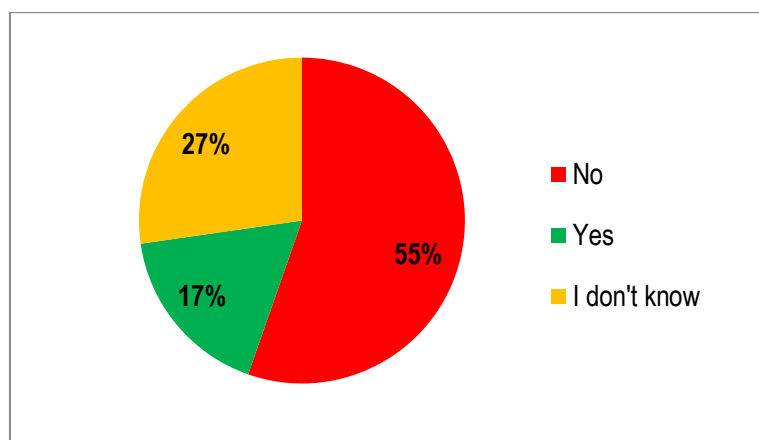
A majority (55%) of respondents say they are not ready to pay more. This may suggest that they are ready to adjust their behavior in order to consume only the amount they would receive.

As there is around 30% saying they don't know, we can consider that this question may be a little too vague for people to take position.

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In your opinion, what actions best characterize eco-friendly behavior?

There is a big trend about eco-friendly behavior. But what does this term evokes for people? That is the purpose of that question. In the qualitative part, we have seen that people think there are a lot of things to care about to act in a eco-friendly way. This leaded to hypothesis g) arguing that *being eco-friendly means thinking about every types of consumption*.

Table 5.11. Question 9 – In your opinion, what actions best characterize eco-friendly behavior?

	N	%
Sorting waste	400	80.8
Educate future generations	265	53.5
Using public transportation	176	35.6
Using car as little as possible	176	35.6
Taking shower rather than bath	109	22.0
Using a bicycle	76	15.4
Consuming organic products	53	10.7
Buying second-hand products	22	4.4
Other	14	2.8

First answer comes far before others and is related to waste management. In fact, Switzerland is known to pay a lot of attention to that point and people are used to sort waste.

Around 50% think that being eco-friendly also means educating future generation. We can relate this answer to the theme of MENTALITE mentioned in the qualitative part.

As in the qualitative interviews, mobility concerns come right after with around 30% of answers for "Using public transportation" and "Using car as little as possible". Water savings concern 22%.

With 5 answers around 25% or more, those result may confirm the above hypothesis.

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Question 10

What makes you turn your television on?

People often make irrational use of devices. Author wanted to question the "relation" people have with their television, namely if they turn it on to watch it or if they just let it on to simulate a presence. Qualitative survey enabled author to draw the hypothesis e): *people make rational use of television and computer*.

Table 5.12. Question 10 – What makes you turn your television on?

	N	%
Entertainment (movies, series, variety show, etc.)	356	71.9
Need for information	275	55.6
Need for company	48	9.7
I turn it on without thinking, as a daily activity	44	8.9
Other	36	7.3
To keep children busy	20	4.0

Results clearly show that "Entertainment" and "Need for information" are the two main reasons for which people turn on their television (respectively 71.9% and 55.6%). Only 9.7% ticked "Need for company".

In that way, one can consider that as proposed by the above hypothesis, people tend to make a rational use of their television.

It is also interesting to note that television is firstly associated to entertainment. This remark has to be associated with previous results suggesting television is the best media to communicate on energy consumption and that this communication has to be entertaining and funny (qualitative survey, question 3).

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Question 11 and 12
11) What does a car represent for you? (Give maximum 3 elements)
12) Do you own a car?

We know that mobility plays a huge role in energy consumption. But with hundreds of existing model, car cannot anymore be considered just as a mean of transport. In order to understand how people consider cars we asked them to give 3 elements to express what a car means to them in question 11. Then, in question 12, we asked them whether they own a car or not.

Graph 5.9. Question 12 – Do you own a car?
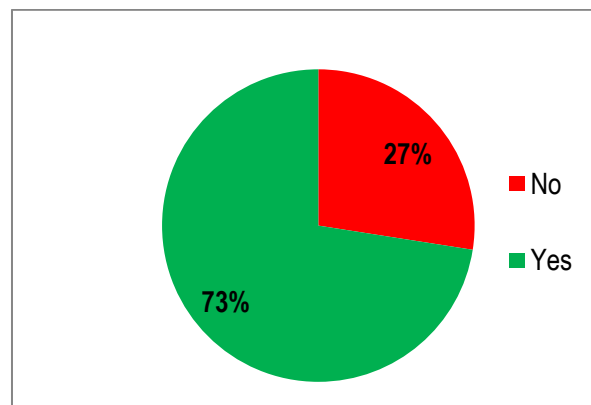
The percentage we got is close to official statistics for Geneva area. In fact, in 2005, 24% of households owned at least one car[9].

In order to address open-ended question 11, author used the online word cloud tool Tagxedo[10]. This tool aggregates the list of all words and gives them a weight according to their number of occurrences. After copying all the words on the window, you can select the ones you want to take off (determinant for instance) and it gives you all the words from the most used to the least one. Then it results in a word cloud.

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[9] STATISTIQUES CANTONALES. REPUBLIC ET CANTON DE GENEVE. *Coup d'œil, Juin 2009*. (accessed May 10, 2012)
[10] TAGXEDO. http://www.tagxedo.com/ (accessed August 20, 2012)

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Here is the word cloud including everyone's answers:

Figure 5.1. Question 11 – What does a car represent for you? Word cloud
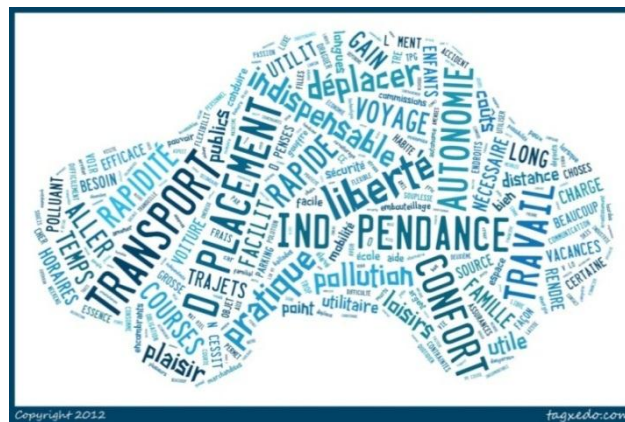
The first ten words that people use (whether they have a car or not) are:

1. Transport
2. Freedom
3. Travel
4. Independence
5. Comfort

6. Work
7. Autonomy
8. Practice
9. To travel
10. Fast

In a previous research, Rocci (2007) determined five words representing car: freedom, sensation, pleasure, flexibility and control. Our results go in the same direction. When it comes to differentiate answers from people who own a car or not, one can note a difference of perception when people do not have a car. Words like "pollution", "city" or "nothing" appears on top of the list.

Figure 5.2. Question 11 and 12 – What does a car represent for you? and
Do you own a car? Word cloud

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Question 13

13) Do you know the production source of your electricity?

13a) If not, would you like to know the production source of your electricity?

13b) If yes, what is in your opinion the ratio of each source? Total = 100 %

Last question addressed the hypothesis that people lack information about their energy production sources. This question seems important while Switzerland, as many other countries, is facing debates about nuclear energy production and eventual substitute.

First, we asked respondents if they know the production source of their electricity. Around 75% of them say they don't. Those 75% where then asked if they would like to get that kind of information and 66% say they would. It is clearly a will of getting more information about that topic.

Graph 5.10. Question 13 – Do you know the production source of your electricity?
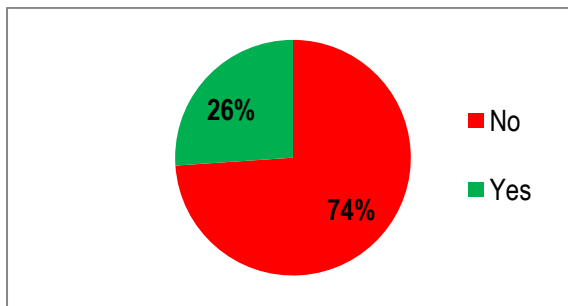
Graph 5.11. Question 13a – Would you like to know the production source of your electricity?
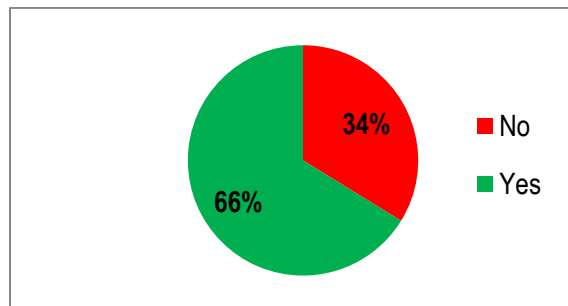
The 25% of respondents who answered they knew the production sources of their electricity were asked to number the three production sources represented by:

- fossil energy (coal, oil, gas),
- nuclear energy,
- renewable energy (hydro, solar, wind, biomass)

Author calculated the mean of every answer. Results are presented on Graph 5.12.

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Graph 5.12. Question 13b – What is in your opinion the ratio of each energy sources in your electricity?

**Answers for each production source
(average percentages)**

28%

42%

31%

■ Fossil ■ Renewable ■ Nuclear
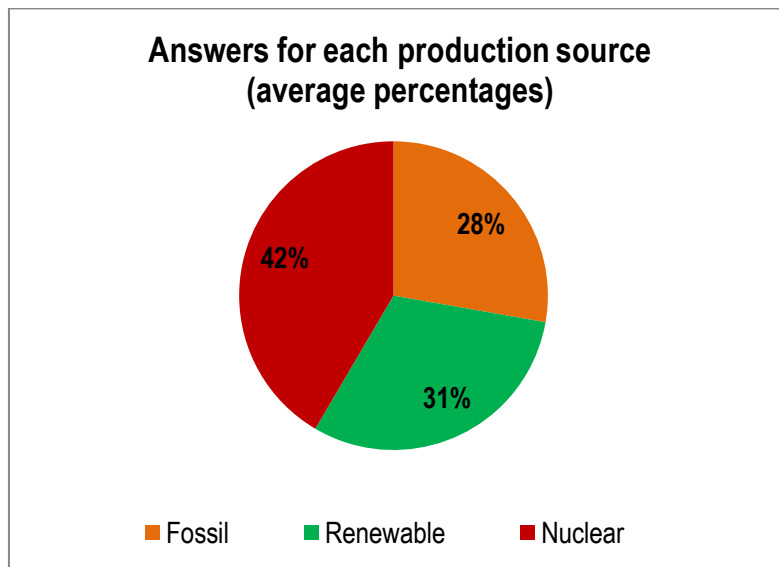
As categories in official statistics are stated differently, it is hard to make precise comparison. Nevertheless, renewables are underestimated as hydroelectricity accounts for 53.7% of energy consumption in Switzerland in 2011[11].

5.2. Main findings

In this section, author sums up findings of quantitative questionnaire data analysis. We will also draw links with hypothesis obtained from qualitative data, presented in section 4.2.

Quantitative questionnaire examined different aspects of energy consumption behavior. With the first three questions, we found that people pay more attention to energy savings when their consumption is visible. This seems to confirm hypothesis a), which stated: *People tend to pay more attention to their energy consumption when it's visible*.

We also questioned people about their lighting behavior. Crossing education with ages seems to show a growing tendency through the years to sensitize children about turning off the light when leaving a room. When crossing adult behavior with education of turning light off, there is a bigger percentage of people who learned that gesture during their childhood that do it as an adult. However, this difference is not big enough to go in direction of hypothesis b): *Behaviors learned during childhood are the one people retain through their adult life*.

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[11] http://www.rts.ch/video/info/journal-19h30/4010289-les-projets-de-barrages-soumis-a-examen-sont-nombreux-en-suisse.html

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Two questions approached theme of energy costs. It clearly seems that people are still sensitive to price changes as most of them declare they would change their behavior if prices should be doubled. We also noted that the more people are in charge of costs, the more sensitive they would be to a doubling of prices. This goes on same direction as hypothesis c) that said: *People are ready to make little changes to avoid paying more*. However question's formulation should have been different to test it; for instance "To what extent a double in price would make you change your behavior?" and answers "A lot", "A little" and "Not at all".

We also wanted to know what mostly influence one's behavior. After "personal value" and "education" (which partly goes together), "information's" is the third given answer. Television is definitely the media people declare to be the best way to communicate about energy consumption which confirms hypothesis d): *Television is the best media to inform people about energy saving*.

Hypothesis e) stated that: *People make rational use of television and computer*. One question of the quantitative part tried to find out if people use television in order to simulate company. Only approximately 10% of people admit behave that way which seems to confirm results from the qualitative part.

As many energy companies in Switzerland offer their customers to choose between different packages of energy, we wanted to know if people really know what sources of production comprise the electricity they get. Qualitative part led us to formulate hypothesis f) saying: *People lack information about their energy production sources*. Quantitative results seem to show the same as only one quarter of people say they know the sources of their electricity. However, author would like to draw attention on two points: firstly, people who say they don't know the energy production source are mostly interested to learn; secondly, results of people saying they know are actually not close to reality. It suggests more that they think they know.

Then, as eco-friendly behavior is a big tendency nowadays, we wanted to know how people understand that concept and what it includes for them. If qualitative results led us to state hypothesis g) : *Being eco-friendly means thinking about every types of consumption*, quantitative results shown that sorting waste is ahead, education is cited by half of respondents, transport by approximately a third. Use of water, riding a bike, food consumption or buying second-hand products are not cited that often.

Finally, we asked people what a car represent for them. Even if "Transport" is the main topic, "Freedom", "Independence", "Comfort", "Autonomy" and "Speed" have also been raised. This shows there are many other incentives than moving from point A to point B when buying a car.

Initial objective was to use quantitative data to feed MARKAL model. However, author and her supervisor at the GERAD concluded that it couldn't be done directly with collected data. Next section will give a line of thought for a method to integrate behavioral aspects in MARKAL/TIMES framework, using real case of TIMES-Canada.

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6. Data Introduction in TIMES-Canada

In that research, author wanted to understand end-user energy consumption behavior in order to integrate results to TIMES/MARKAL family of models.

After analyzing data and comparing them with TIMES/MARKAL family of models' structure, author found that they couldn't be directly integrated. This encourages author to think of another method to integrate end-user energy consumption behavior, namely starting from the model. Doing so will immediately integrate model structure in question formulation and will also point model area where potential changes can have an impact on the whole model.

A first attempt has been done with member of the GERAD team. This section will give a line of thought for further researches. Author will first briefly present TIMES-Canada model and then preliminary research in order to integrate behavioral data in the model.

6.1. TIMES-Canada

In this section, author presents briefly TIMES-Canada. The model has been constructed by the GERAD E2G team, coordinated by Kathleen Vaillancourt, Ph.D. It is a national model covering the 13 Canadian provinces and territories, divided in 4 regions (West, Center, East and North).

Figure 6.1. 13 Canadian provinces and territories

Source : VAILLANCOURT, Kathleen et al. Recent Developments in the Energy Model TIMES-Canada : Focus on the Unconventional Gas Production Until 2050 [on line]. ETSAP WORKSHOP, Athens, 2011.

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Base year is 2007 and model can produce data for energy policy to a 2050 horizon and climate policy to a 2100 horizon. Such data are not previsions but should be considered as decision aid tool. In order to be able to consider consumption variation through seasons but also days, model has been divided in four seasons (Summer, Autumn, Winter and Spring) and three diurnal division (Day, Night and Peak).

Figure 6.2. TIMES-Canada model global structure

Primary energy → Production / Conversion Technologies → End-Use Technologies → Demand for Energy Service

Constructing such a model represents years of researches as it contains around one and a half million variables. It includes extraction, transformation, distribution, end-uses, and trade of all energy forms in all sectors[12]. End-use demand data are based on Canadian National Office of Energy (GDP, energy costs, population as drivers) and Canada Statistics. Other data are collected through different official sources depending on the sector of research.

In next section, author will present preliminary research ran at the GERAD.

6.2. Preliminary research

After noting qualitative and quantitative results collected couldn't be used directly in the model, author considered starting from the model in order to point model area where potential changes can have an impact on the whole model and structure the ethnographic research.

During an internship at the GERAD, author ran trial with TIMES-Canada model. Together with Denis Lavigne, Assistant Professor at the Royal Military College Saint-Jean and author's supervisor for her internship, author decided to only take into consideration data for the province of Quebec in order to minimize time for a model run. As this study focused on end-users' behavior, we will also only study the part of the model that analyzes the residential sector.

In the following tables are presented different run of the model. Residential sector is divided by different type of electricity consumption, namely: cooling, cloth dryer, cooking, cloth washer, dish washer, freezer, heat, lighting, refrigeration, water and other electric. Acronym enables to know what specific commodity it refers to, for instance RCAH refers to Residential Cooling Apartment House and RHDH to Residential Heat Domestic House. As one can note, the model integrates every kind of housing from Apartments to Individuals.

Author choose to run three different scenarios in order to compare results and see if there is any interesting results that gives a starting point. First of all, author and her supervisor ran the model without any constraints, which means results will represent the least expensive option to satisfy useful demand; it resulted in Scenario_0. As Quebec as an objective to reduce greenhouse gas emission of 20% between 1990 and 2020, we used a scenario that limits emission, Scenario_GHG. Third scenario, Scenario_Elas, is based on Scenario_0 but introduces elasticity in demand which allows system to reduce demand where it enables to diminish total costs; it also takes in consideration the 20% reduction constraint on greenhouse gas emission. We did our analysis on three levels. First, we considered demand for residential sector. Scenario_0's results are presented in Table 6.1, and Table 6.2 presents differences that have been noted in demand between Scenario_0 and Scenario_Elas. After, in Table 6.3 we represent marginal costs of each scenario for the year 2020 and compare them, and finally on Table 6.4 we analyzed total costs for every scenario.

Concerning demand, we only run Scenario_0 and Scenario_Elas as in Scenario_GHG demand doesn't vary. Table 6.1 presents full results for Scenario_0.

Table 6.1. Quebec demand for residential sector – Scenario_0

Commodity		Scenario_0					
		2007	2008	2010	2012	2015	2020
RCAH	cooling	0.828170	0.847722	0.854790	0.872035	0.908763	0.966558
RCAP	cooling	0.732543	0.749838	0.756090	0.771343	0.803831	0.854952
RCDH	cooling	1.859247	1.903143	1.919010	1.957724	2.040181	2.169930
RCDR	cloth dryer	11.465709	11.736407	11.834256	12.073003	12.581499	13.381643
RCMH	cooling	0.046059	0.047146	0.047539	0.048499	0.050541	0.053756
RCOK	cooking	10.359045	10.442021	10.600940	10.759668	10.993494	11.442353
RCWA	cloth washer	0.734864	0.752214	0.758485	0.773787	0.806378	0.857661
RDWA	dish washer	0.681354	0.697441	0.703255	0.717443	0.747660	0.795209
RFRE	freezer	3.303370	3.381361	3.409552	5.146017	8.371361	12.788554
RHAH	heat	13.684006	13.765042	13.949200	14.147919	14.426925	14.885947
RHAP	heat	47.303991	47.584125	48.220736	48.907683	49.872176	51.458960
RHDH	heat	119.875772	120.585675	122.198948	123.939780	126.383958	130.405119
RHMH	heat	3.562422	3.583518	3.631461	3.683194	3.755830	3.875329
RLIG	lighting	38.703438	39.617201	39.947497	40.753407	42.469878	45.170831
ROEL	other electric	19.411538	19.869832	20.035490	20.439691	21.300579	22.655230
RREF	refrigeration	10.957536	11.216236	11.309748	11.537913	12.023873	12.788554
RWAH	water	3.062293	3.086822	3.133801	3.180723	3.249846	3.382536
RWAP	water	15.014622	16.920629	19.409403	21.839028	25.246883	30.473765
RWDH	water	19.459394	19.615264	19.913792	20.211961	20.651202	21.494381
RWMH	water	0.458616	0.462290	0.469325	0.476352	0.486704	0.506576
TOTAL		321.5040	326.8639	333.1033	342.2372	357.1716	380.4078

One can note the increasing demand through the years. This reinforces the fact that one should pay attention to behavior as resources are limited.

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Author also ran the Scenario_Elas and noted little differences for the year 2020 regarding heating electricity consumption as shown in Table 6.2. Only lined containing relevant observation are presented.

Table 6.2. Comparison heating Scenario_0 and Scenario_Elas

Commodity		Scenario_0 2020	Scenario_Elas 2020	Differences
RHAH	heat	14.885947	14.737088	0.148859
RHDH	heat	130.405119	129.101068	1.304051
RHMH	heat	3.875329	3.836576	0.038753

When we allow the model to, reducing residential sector heat will produce a less expensive result. This could represent an area for future research and it would be interesting to focus on that heating topic in order to assess if people are ready to make a change.

We also extracted the three scenarios marginal costs. Full results are presented on Appendix IV. In Table 6.3 we solely present results of each scenario for the year 2020 and calculated differences. Marginal costs are lower in Scenario_Elas than in Scenario_GHG. They are also lower when comparing with Scenario_0, except for heating and water in one type of household. Those are the area future study should focus on.

Table 6.3. – Marginal costs for 2020 and calculated differences

Marginal costs	Scenario_0	Scenario_GHG	Scenario_Elas	Differences	
				Scen_0 –	Scen_GHG –
Commodity	2020	2020	2020	Scen_Elas	Scen Elas
RCAH	8.48	11.82	8.40	0.08	3.43
RCAP	8.48	11.82	8.40	0.08	3.43
RCDH	4.99	6.79	4.95	0.04	1.84
RCDR	18.33	19.89	18.29	0.04	1.60
RCMH	8.48	11.82	8.40	0.08	3.43
RCOK	31.59	33.15	31.55	0.04	1.60
RCWA	174.99	176.67	174.96	0.04	1.71
RDWA	78.22	79.90	78.18	0.04	1.71
RFRE	0.00	0.00	0.00	0.00	0.00
RHAH	8.37	11.97	10.78	-2.41	1.19
RHAP	15.77	20.62	18.57	-2.80	2.05
RHDH	8.88	12.61	11.42	-2.54	1.19
RHMH	8.60	12.16	10.99	-2.38	1.17
RLIG	2.29	2.40	2.29	0.00	0.11
ROEL	375.15	376.82	375.11	0.04	1.71
RREF	26.99	28.75	26.95	0.04	1.80
RWAH	6.86	8.38	7.28	-0.41	1.11
RWAP	0.00	0.00	0.00	0.00	0.00
RWDH	5.84	6.95	5.83	0.01	1.11
RWMH	5.84	6.95	5.83	0.01	1.11

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Looking at Table 6.4 which represents total costs, we can note that costs increase when we put the constraint of 20% reduction. This seems logical because the model has less freedom may be force to invest on expensive technologies that emit less greenhouse gas, etc. The interesting fact is that again, when we allow model to play with elasticity of demand, costs are lower than in Scenario_GHG even if it takes the gas reduction in consideration.

Table 6.4. Total costs

Total costs	2007	2008	2010	2012	2015	2020
Scenario_0	10613.7	26005.6	31149.0	43174.7	55225.5	69681.0
Scenario_GHG	10613.7	26019.0	31128.4	42826.8	55373.5	71103.9
Scenario_Elas	10613.7	26019.2	31155.8	42809.3	55360.8	70514.6

Such results allow the author to think that it could be interesting to study elasticity of demand by using ethnology methods. We also think that running a vast literature review on energy behavior topic can provide us with useful data to implement directly in the system.

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7. Synthesis & Conclusions

The aim of this paper was to keep on with previous studies realized in order to include social behavior in TIMES/MARKAL family of models. Author tried to understand some part of end-users energy consumption by using both qualitative and quantitative in a complementary way. As qualitative research was made through 24 semi-directives interviews and has been used in order to get large and in depth comprehension in order to draw hypothesis, quantitative had the role to confirm or invalidate them through a 20 questions questionnaire. Since author had been unable to use collected data directly in the model, we tried to present possible way of including behavioral facts using TIMES-Canada model. This section will briefly sum up main results of the survey and make recommendations that result from those conclusions. To conclude, we will then formalize results of preliminary research in order to give a canvas for further studies.

Analysis of the 24 semi-qualitative interviews enabled the author to state 7 hypotheses:

  a) People tend to pay more attention to their energy consumption when it's visible
  b) Behaviors learned during childhood are the one people retain through their adult life
  c) People are ready to make little changes to avoid paying more
  d) Television is the best media to inform people about energy saving
  e) People make rational use of television and computer
  f) People lack information about their energy production sources
  g) Being eco-friendly means thinking about every types of consumption

Those hypotheses helped us to build the quantitative questionnaire and analysis gave us lines of thought for a few of them. We are now going to come back on each one that has been confirmed through quantitative data and formulate recommendations in order to consider results. But first of all, we would like to remind that author noted sampling gaps that should be corrected, therefore results are more indicative than representative of the Geneva area's population. Author will conduct more thorough analysis on data in order to align sample characteristics with Geneva official statistics.

Quantitative results seemed to go in the same direction as hypothesis a) stated that *people pay more attention to their energy consumption when it's visible*. Author recommends thinking of action or tools that can help end-users to see more easily what they consume. That way, they will also have more control on their consumption. Electricity monitors could be a way to get control over household consumption but it can be complex to use and requires installation. Personal and specific energy auditing can also be a good way to help people understand energy issues but it's costly. A simple way to make it easier and visible for end-user would be to change contents and layout of energy invoices.

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Second findings is that even if previous studies seemed to show that price is not a priority factor to determine energy consumption behavior (Wallenborn et al. 2006), our sample clearly declare that changing in prices would influence them. Here, this could lead to reconsider energy policy and taxes but such tools are very complex to evaluate. It also draws attention on the fact that studying price elasticity could be interesting in order to complete the model.

Results showed that people consider "information's" as one of the most influencing elements about their behavior and "television" seems to be the best information media to communicate about energy issues. Whereas in France short television programs about energy are played, there is no equivalent in Switzerland. As the biggest television channels in Switzerland are public, author thinks that politics and programmers together could think of a fun and short way to give people "tips & tricks" to save energy. Playing such a program before daily news for instance would reach a large part of the population.

Despite author found interesting facts about energy consumption that give lines of thought, data collected couldn't be utilized to supply TIMES-Canada model. In order to collect usable data, author did preliminary researches to propose a method to implement behavioral results in TIMES/MARKAL family of models. First of all, it seems to be essential to start from the model, so first step is to run the model with different scenario and note differences. When finding gaps, this gives indications of area to focus on. Researchers have then to find real data (from previous studies or their own survey) that analyze every aspect of one variable in order to produce results with the model. When running own survey, one can be inspired by previous studies' methodology like Residential Energy Consumption Survey[13] ran by the American Energy Information Administration (EIA) for instance.

There is no doubt that household's behaviors have a huge role to play in energy consumption and therefore should be integrated in energy models. However, researches on that topic are not common and specifically in the TIMES/MARKAL framework which is based on mathematics and linear optimization. Nevertheless, author truly think that it is possible to detail more deeply data about demand and that starting from the model in order to study behavior is a good way to collect strong results.

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[13] U.S. ENERGY INFORMATION ADMINISTRATION website: http://www.eia.gov/survey/#eia-457 (accessed August 27, 2012)

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9. Appendices

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Enquête qualitative

« Compréhension des modes de consommation d'énergie des usagers »

Dans ce qui suit, toute désignation vise indifféremment l'homme ou la femme, par la suite nous utiliserons « le répondant » pour qualifier la personne sondée.

Sondeur :
Informations confidentielles :
- Numéro de sondage : Initiales+N°
- Catégorie d'âge :

0 – 18 ans	19 – 24 ans	25 – 34 ans	35 – 44 ans	45 – 54 ans	+ 55 ans

- Locataire / Propriétaire
- Sexe :
- Profession

1. Quels sont les réflexes que vous avez en matière d'économie d'énergie ? (eau/électricité/chauffage)

   o Lesquels vous ont été transmis durant votre enfance ?

2. Comment réagiriez-vous face à l'introduction d'un quota d'électricité ? Vous auriez le droit à une certaine quantité d'électricité à un prix fixe puis, au-delà de ce seuil, vous seriez facturé plus cher pour chaque unité consommée. (Seriez-vous plus attentif ? Modifieriez-vous votre comportement ?)

3. Que pensez-vous de la communication faite aujourd'hui autour de la consommation d'énergie ? (d'un point de vue : technologie, comportement…) (Economie et réduction) (Y êtes-vous sensibles ? Y en a-t-il assez ? Est-elle attractive ? Avez-vous un exemple précis ?)

4. Pourquoi allumez-vous votre TV/PC ? (Quand ?) (Certaines personnes laissent la TV pour simuler une présence ou dynamiser l'ambiance ; que pensez-vous de ce comportement ?)

5. On utilise de plus en plus d'appareils électriques et, en même temps, nous parlons d'une sortie du nucléaire. Qu'en pensez-vous ?

6. Comment définiriez-vous un comportement éco-responsable ?

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ARGENT	Sensible au prix
ATT	Manque d'attention/intérêt
CHANGE	Prêt à changer
CHAUFF	Chauffage
CHAUFF_OFF	Etindre le chauffage
CIBLE	A qui s'adresse la communication
CONFORT	Confort
CONTRA	Contradiction
EAU	Utilisation de l'eau
EAU_OFF	Eteint l'eau
ELEC	Electricité
EN	Energie
ENSEMBLE	Impact global sur l'environnement
ENTREPR	Entreprise
EQUIP	Equipement
EQUIP_OFF	Eteint les équipements
FUT	Penser au futur
GREEN WASHING	Green Washing
IMPACT	Impact individuel sur l'environnement
LUMIERE	Utilisation de la lumière
LUMIERE_OFF	Eteint la lumière
MANQUE INFO	N'a pas assez d'informations
MENTALITE	Mentalité générale
MOBI	Mobilité
NO CHANGE	Pas de changement
PC_OFF	Eteint le PC
QUALI	Qualité de la communication
RECY	Recyclage
SIMU	Simulateur de présence
SMARTPHONE	Utilisation de smartphone et/ou tablettes
STANDBY	Stand-by
SUGG	Suggestions et/idées
TV_OFF	Eteint la TV
UTI_PC	Utilisation du PC
UTI_TV	Utilisation de la TV
VALEURS	Valeurs personnelles

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Sondage sur les comportements en matière de consommation d'énergie

Cette enquête est réalisée par la Haute École de Gestion de Genève

La confidentialité et l'anonymat des données sont garantis

<u>**Dans ce qui suit, toute désignation de personne vise indifféremment l'homme ou la femme**</u>

> Merci de répondre aux questions dans l'ordre

1. Quels sont les comportements auxquels vous faites le plus attention afin d'économiser de <u>l'eau</u> ? **(Maximum 3 réponses)**

☐ Couper l'eau durant brossage de dents

☐ Prendre une douche plutôt qu'un bain

☐ Faire tourner la machine à laver le linge lorsqu'elle est pleine

☐ Prendre des douches courtes

☐ Utiliser un minimum d'eau lorsque je fais la vaisselle à la main

☐ Faire tourner la machine à laver la vaisselle lorsqu'elle est pleine

☐ Je n'ai pas de réflexe particulier

☐ Autre : _____

2. Quels sont les comportements auxquels vous faites le plus attention afin d'économiser <u>le chauffage</u> ? **(Maximum 3 réponses)**

☐ Profiter du soleil pour chauffer mon intérieur

☐ Garder les volets fermés pour contenir la chaleur lorsqu'il fait froid

☐ Eteindre le radiateur lorsque j'ouvre une fenêtre

☐ Chauffer au bois car je dispose d'une cheminée

☐ Maintenir une chaleur constante grâce à un thermostat

☐ Je n'ai pas de réflexe particulier

☐ Autre : _____

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3. Quels sont les comportements auxquels vous faites le plus attention afin d'économiser de l'électricité ? **(Maximum 3 réponses)**

☐ Eteindre la lumière en sortant d'une pièce

☐ Acheter des équipements catégorie A ou supérieure

☐ Utiliser des ampoules à basse consommation

☐ Allumer la lumière que lorsque c'est vraiment nécessaire

☐ Débrancher les appareils que je n'utilise pas

☐ Relier les appareils à des multiprises dotées d'interrupteur afin de les éteindre totalement

☐ Faire tourner la machine à laver le linge lorsqu'elle est pleine

☐ Faire tourner la machine à laver la vaisselle lorsqu'elle est pleine

☐ Je n'ai pas de réflexe particulier

☐ Autre :_____

4. Vos parents vous ont-ils inculqué le geste d'éteindre la lumière lorsque vous quittez une pièce ? **(1 seule réponse possible)**

☐ Oui　　　　　　　　☐ Non　　　　　　　　☐ Je ne sais pas

5. Si le prix de l'électricité doublait, cette hausse aurait-elle un impact sur votre comportement ? **(1 seule réponse possible)**

Très probablement	Probablement	C'est peu probable	Je ne changerai rien
☐	☐	☐	☐

6. Parmi les éléments suivants, quel est celui qui influence le plus votre comportement en matière d'économie d'énergie ? **(1 seule réponse possible)**

☐ Conseils d'amis / famille

☐ Education

☐ Publicités

☐ Informations (TV, radio, presse)

☐ Mes valeurs

☐ Autre :_____

7. Quel est selon vous le canal publicitaire le plus efficace pour sensibiliser les gens à leur consommation d'électricité ? **(1 seule réponse possible)**

☐ Télévision

☐ Internet

☐ Radio

☐ Publicité des fournisseurs (p. ex. SIG ou Romande Energie)

☐ Publicité dans les transports publics

☐ Autre :_____

8. Admettons que l'Etat soit obligé de rationner la quantité d'électricité distribuée. Seriez-vous prêt à payer davantage pour pouvoir en consommer plus ? **(1 seule réponse possible)**

☐ Oui　　　　　　　　☐ Non　　　　　　　　☐ Je ne sais pas

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9. Selon vous, quels gestes caractérisent le mieux un comportement eco-responsable ? **(Maximum 3 réponses)**

☐ Trier les déchets

☐ Utiliser les transports publics

☐ Eduquer les générations futures

☐ Utiliser le vélo

☐ Consommer bio

☐ Acheter des biens de seconde main

☐ Prendre des douches plutôt que des bains

☐ Utiliser le moins possible la voiture

☐ Autre : _____

10. Qu'est-ce qui vous pousse à allumer votre télévision ? **(Maximum 2 réponses)**

☐ Besoin d'informations

☐ Divertissement (Film, série, variété, etc.)

☐ Besoin de compagnie, simulateur de présence

☐ Je l'allume sans réfléchir comme un geste quotidien

☐ Pour occuper les enfants

☐ Autre : _____

11. Pour vous, que représente la voiture ? **(Donnez 3 éléments au maximum)**

a _____

b _____

c _____

12. Possédez-vous une voiture ?

☐ Oui

☐ Non

13) Connaissez-vous la source de production de votre électricité ?

☐ Oui (Passé à la question 13b)

☐ Non

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13a) **Si non**, aimeriez-vous connaitre la source de production de votre électricité ?

☐ Oui   ☐ Non

13b) **Si oui,** selon vous, quelle est la part de chacune de ces sources ? **Total =100 %**

Fossile (charbon, mazout, gaz)	……..%
Renouvelable (hydraulique, solaire, éolien, biomasse)	+……..%
Nucléaire	+……..%
	100 %

Questions générales :

14. Vous êtes :   ☐ Une femme   ☐ Un homme

15. Année de naissance : 19___

16. Code postal de votre domicile :

17. Vous êtes :   ☐ Locataire   ☐ Propriétaire

18. Etes-vous en charge des frais liés à la consommation d'énergie de votre foyer ?   (eau, chauffage, électricité)

☐ Oui, ces frais sont <u>entièrement </u>à ma charge
☐ Oui, ces frais sont <u>en partie</u> à ma charge
☐ Non, je n'ai aucun frais à ma charge

19. Combien de personne(s) vivent dans votre ménage ?
(Toute personne de plus de 18 ans doit être considérée comme un adulte)

Nombre d'adulte(s) : ___

Nombre d'enfant(s) : ___

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20. Quel est votre profil professionnel actuel ?

☐ Femme/Homme au foyer   ☐ Indépendant

☐ Étudiant   ☐ Retraité

☐ Employé   ☐ Sans emploi

☐ Cadre   ☐ Autre : _____

21. Quel est le revenu brut annuel de votre ménage ? (réponse facultative)

☐ Moins de CHF 50'000.- (env. € 30'000)

☐ Entre CHF 50'000.- et CHF 75'000.- (entre env. € 30'000 et € 45'000)

☐ Entre CHF 75'000.- et CHF 100'000.- (entre env. € 45'000 et € 60'000)

☐ Entre CHF 100'000.- et 125'000.- (entre env. € 60'000 et € 75'000)

☐ Entre CHF 125'000.- et 150'000.- (entre env. € 75'000 et € 90'000)

☐ Plus de 150'000.- (plus de € 90'000)

La Haute École de Gestion de Genève vous remercie pour votre participation.

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Appendix IV – Marginal costs for residential sector in TIMES-Canada

Coûts marginaux																				
	Scenario_0						Scenario_GHG						Scenario_Elas							
Commodity	2007	2008	2010	2012	2015	2020	2007	2008	2010	2012	2015	2020	2007	2008	2010	2012	2015	2020		
RCAH	5.00	8.59	5.76	14.09	9.55	8.48	5.00	8.51	5.86	12.47	9.98	11.82	5.00	8.51	5.86	12.41	9.98	8.40	0.08	3.43
RCAP	5.00	8.59	5.76	14.09	9.55	8.48	5.00	8.51	5.86	12.47	9.98	11.82	5.00	8.51	5.86	12.41	9.98	8.40	0.08	3.43
RCDH	5.00	8.15	5.76	8.22	5.76	4.99	5.00	8.11	5.86	7.34	5.99	6.79	5.00	8.11	5.86	7.31	5.99	4.95	0.04	1.84
RCDR	8888.00	22.75	22.96	23.86	22.49	18.33	8888.00	22.85	23.04	23.05	22.70	19.89	8888.00	22.85	23.04	23.02	22.70	18.29	0.04	1.60
RCMH	8888.00	21.05	9.63	14.09	9.55	8.48	8888.00	20.87	9.81	12.47	9.98	11.82	8888.00	20.88	9.81	12.41	9.98	8.40	0.08	3.43
RCOK	8888.00	37.21	38.89	38.85	38.48	31.59	8888.00	37.29	38.95	38.05	38.80	33.15	8888.00	37.28	38.95	38.02	38.80	31.55	0.04	1.60
RCWA	8888.00	294.91	252.95	210.01	218.85	174.99	8888.00	295.03	253.04	209.20	219.07	176.67	8888.00	295.03	253.04	209.17	219.07	174.96	0.04	1.71
RDWA	8888.00	94.11	82.96	91.40	95.04	78.22	8888.00	94.24	83.05	90.59	95.26	79.90	8888.00	94.24	83.05	90.56	95.26	78.18	0.04	1.71
RFRE	8888.00	4.01	2.72	0.00	0.00	0.00	8888.00	4.13	2.80	0.00	0.00	0.00	8888.00	4.12	2.80	0.00	0.00	0.00	0.00	0.00
RHAH	5.00	7.26	9.22	10.54	9.15	8.37	5.00	7.37	9.27	9.98	9.30	11.97	5.00	7.37	9.27	9.96	9.30	10.78	-2.41	1.19
RHAP	5.00	15.43	17.87	21.10	17.96	15.77	5.00	15.60	17.95	19.91	18.35	20.62	5.00	15.60	17.95	19.88	18.36	18.57	-2.80	2.05
RHDH	5.00	7.30	9.42	10.75	9.42	8.88	5.00	7.41	9.47	10.20	9.57	12.61	5.00	7.41	9.47	10.19	9.57	11.42	-2.54	1.19
RHMH	8888.00	6.97	9.08	10.53	9.03	8.60	8888.00	7.08	9.12	9.89	9.22	12.16	8888.00	7.08	9.12	9.88	9.22	10.99	-2.38	1.17
RLIG	8888.00	3.55	3.26	2.78	2.83	2.29	8888.00	3.56	3.27	2.72	2.84	2.40	8888.00	3.56	3.27	2.72	2.84	2.29	0.00	0.11
ROEL	8888.00	479.49	449.48	412.06	432.37	375.15	8888.00	479.61	449.56	411.25	432.59	376.82	8888.00	479.61	449.56	411.22	432.59	375.11	0.04	1.71
RREF	8888.00	94.87	53.76	34.66	33.59	26.99	8888.00	94.88	53.78	33.80	33.81	28.75	8888.00	94.88	53.78	33.77	33.81	26.95	0.04	1.80
RWAH	8888.00	6.90	6.60	9.48	7.39	6.86	8888.00	6.98	6.63	8.67	7.59	8.38	8888.00	6.98	6.63	8.65	7.59	7.28	-0.41	1.11
RWAP	8888.00	0.00	0.00	0.00	0.00	0.00	8888.00	0.00	0.00	0.00	0.00	0.00	8888.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RWDH	8888.00	6.90	6.60	9.48	7.39	5.84	8888.00	6.98	6.63	8.67	7.59	6.95	8888.00	6.98	6.63	8.65	7.59	5.83	0.01	1.11
RWMH	8888.00	6.90	6.60	9.48	7.39	5.84	8888.00	6.98	6.63	8.67	7.59	6.95	8888.00	6.98	6.63	8.65	7.59	5.83	0.01	1.11

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