Relevance of Swiss buildings sector to total energy consumption/

How the buildings sector can reduce Switzerland's total energy consumption

Lucas Neff, dipl. Arch. ETH/SIA

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Preface

We use energy every day, when preparing food, at work and in our leisure activities. In physics energy cannot be destroyed or lost. But what we as humans are interested in is the kind of energy that can be put to our own use, such as electricity in the home or gasoline in the car›s tank. It is this kind of energy that I refer to in the statistics in this discussion of energy consumption or use in Switzerland. Between the years 2002 and 2006 the figures are quite constant at 244,040 kWh representing a value of Fr. 28,260,000,000, or Fr. 3,763 per inhabitant in Switzerland.

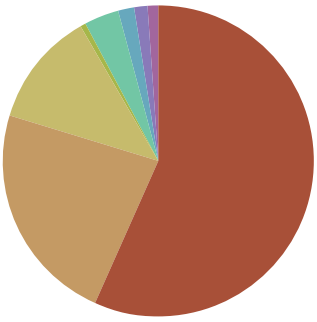
While statistics are available for recent years, the dataset is incomplete; therefore these earlier dates were selected for this report. According to the Swiss Department of Energy, end use consumption can be divided into three categories, usage by sector, energy source, and application or end use.

Just 20 percent of energy production in Switzerland comes from sustainable sources, the most important being hydro-power and renewable wood. Other renewable sources such as solar photovoltaic and wind, as well as others, are only marginally available in Switzerland. There is potential to increase the usage of sustainable energy sources in Switzerland. For example, the use of renewable wood could be increased by a factor of three, while solar thermal for warm water has an even greater potential for increased usage. Increases in sustainable energy use for warm water can be implemented in a cost-effective way, even when measured by cost per person per square meter. However, even if all feasible increases were executed in the medium term, representing a doubling of the current sustainable energy sources – it would still only cover about 40 percent of today›s energy consumption.

Swiss domestic energy usage and production in million kWh
Yearly averages 2002 to 2006

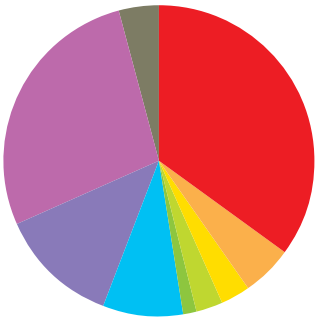
Usage by sector

Residential	71'748	31.7%
Industrial	47'657	21.0%
Services	40'535	17.9%
Transport	62'576	27.6%
Farming and differences	3'939	1.7%
Total Domestic	226'454	100.0%
Other fuels	17'585	7.8%
Total	**244'040**	**107.8%**



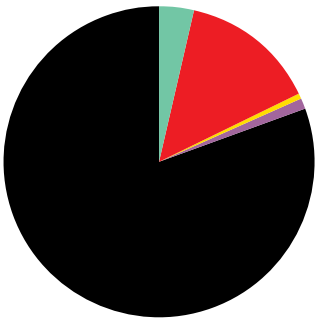
Energy source

Fossil fuels	139'057	61.4%
Electricity	56'089	24.8%
Gas	28'965	12.8%
Coal	1'667	0.7%
Wood	8'507	3.8%
District heating	4'248	1.9%
Industrial waste	3'303	1.5%
Other renewables	2'204	1.0%
Total	**244'040**	**107.8%**



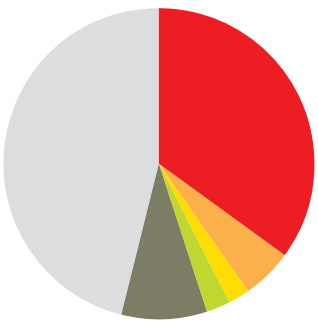
Energy consumption by end use

Space Heating	79'219	35.0%
Warm water	12'275	5.4%
Lighting	7'301	3.2%
Temperature, ventillation & building	5'854	2.6%
Computing & telecommunications	2'917	1.3%
Process use	19'328	8.5%
Process heat	28'312	12.5%
Transport domestic	62'507	27.6%
Others	8'741	3.9%
Total Domestic	226'454	100.0%
Other fuels	17'585	7.8%
Total	**244'040**	**107.8%**



Sustainable energy production

Wood	8'510	3.8%
Other renewables	2'204	1.0%
Sustainable Electricity Production		
Hydro - Fluvial power plants	15'976	7.0%
Hydro - storage pump	18'702	8.3%
Deduction for hydro storage pump	-2'619	-1.2%
Share - Geothermal	812	0.4%
Share - Wood	31	0.0%
Share - Biomass	150	0.1%
Share - Solar Photovoltaic	17	0.0%
Share - Wind	8	0.0%



Building sector

Space Heating	79'219	35.0%
Warm water	12'275	5.4%
Lighting	4'867	2.1%
Temperature, ventilation & building	5'854	2.6%
Estimated energy use for constructic	19'805	8.8%

Energy consumption of Swiss buildings sector

Every building uses energy throughout its lifecycle, during the construction phase, maintenance and operational phases, and the phases of renovation, remodeling, and demolition. Heating to warm homes and buildings is the greatest consumer of energy representing 35 percent of total consumption. When the consumption of energy for water, lighting, and appliances is added, the building sector uses nearly 50 percent. And if the massive energy consumption involved in maintenance and demolition phases of the building is added, then it is well over 50 percent. – Clearly, the buildings infrastructure is relevant to any discussion of Swiss energy consumption.

Is there a potential to save energy in this sector? And is it possible to do it in a cost-effective, culturally preserving, and comfortable way? – My answer is a clear «yes» and it can be demonstrated with some examples from my work as an architect.

Comparison of the energy usage in 8-family condominium Bremgartnerstrasse 124 in Dietikon to Swiss average, all figures measured in kWh - averaged over the years 2002 to 2006

Bremgartnerstrasse 124											**Differece compared**		**Switzerland**	
Apartments		**Whg1**	**Whg 2&4**	**Whg3**	**Whg5**	**Whg6**	**Whg7**	**Whg8**	**Total**	**Average**	**to Swiss**	**Average**	**Total**	
Share of Building Basis		0.084	0.218	0.134	0.156	0.156	0.126	0.126	1	0.143				
Living space in m²		76	196	121	141	141	115	115	905	129	127%	102	326'136'536	**
Persons		2	5	3.5	5	4.5	1	4	25	3.6	155%	2.3	7'412'194	
Living space in m² per person		38	39	35	28	31	115	29		36	82%	44		
Household		1	1	1	1	1	1	1	7				3'210'000	**
Total	Various consumption*	3'162	5'390	3'518	4'605	4'030	2'323	6'927	29'955	4'279	130%	3'297	10'583'062'000	
	Heating	1'177	1'859	999	1'778	1'707	2'305	1'780	11'607	1'658	10%	16'033	51'465'492'000	
	Water heating	291	529	379	273	493	97	397	2'458	351	13%	2'762	8'865'662'000	
	Household Total	**4'630**	**7'778**	**4'896**	**6'657**	**6'231**	**4'725**	**9'103**	**44'020**	**6'289**	**28%**	**22'092**	**70'914'216'000**	***
per Person	Various consumption*	1'581	1'078	1'173	921	1'008	2'323	1'732		1'198	84%	1'428		
	Heating	589	372	333	356	427	2'305	445		464	7%	6'943		
	Water heating	145	106	126	55	123	97	99		98	8%	1'196		
	Total	**2'315**	**1'556**	**1'632**	**1'331**	**1'558**	**4'725**	**2'276**		**1'761**	**18%**	**9'567**		
per m²	Various consumption*	41.6	27.5	29.1	32.7	28.6	20.2	60.2		33.1	102%	32.4		
	Heating	15.5	9.5	8.3	12.6	12.1	20.0	15.5		12.8	8%	157.8		
	Water heating	3.8	2.7	3.1	1.9	3.5	0.8	3.4		2.7	10%	27.2		
	Total	**60.9**	**39.7**	**40.5**	**47.2**	**44.2**	**41.1**	**79.2**		**48.6**	**22%**	**217.4**		

* Various consumption = Cooking, Dishwashing, Cooling, Refrigerator, Washing machine and Dryer, Lighting, Telcoms and computing, Consumer electronics, I&K Unterhaltungselektronik, Elevator - composed of values divided into General and Personal electricity usage

	Electricity - Personal	2'489	3'643	2'444	3'355	2'780	1'313	5'917	21'941	3'134
	Electricity - General	673	1'747	1'074	1'250	1'250	1'010	1'010	8'014	1'145

** = Estimated

*** = Immaterial difference in the Department of Energy statistics

Item 1:
New construction project Dietikon 8-unit condominium, 2002

A more or less random group of 24 people are living in 7 households in 8 condominium apartments. They enjoy a comfortable standard of living in several respects. The apartments are large, light, and conveniently comfortable. Attention was paid to using sustainable materials in construction not only for the apartments but for other parts of the building too, such as the recreational rooms and exterior garden area with a swimming pond. Thanks to consistent, goal-oriented planning from day one, when the land was purchased, the cost of the individual apartments was not higher than the cost of a standard new apartment. As for climate within the apartments, fresh air, humidity, and temperature are perfectly regulated throughout the year. It is when it comes to energy use that the figures are compelling, especially considering that the majority of homeowners are not putting a great deal of effort into conservative use of energy.

Very precise figures are available thanks to widespread use of meters. Each household has an individual electricity meter, as does the geothermal heat-pump, and the common rooms of the apartment building. Meter readings are also available for individual heating and warm water usage. The readings enable a detailed measurement per square meter and a one-to-one translation of the measurements of the living space. In order to interpret the numbers, some background details are required. The south-facing apartment Number 7 uses 2,049 kilowatt hours (kWh) per year while the north-facing identical apartment number 8 uses only 1,531 kWh hours per year.

Compared to Apartment 7, Apartment 8 has more people living in it. The family does a lot of baking, and it has solarium and aquarium, which contribute to heat required to keep the apartment warm. Apartment 8 uses more electricity, 5,629 kWh, compared to apartment 7, which uses only 1,349 kWh. For statisticians, this makes it difficult due to multiple purposes of energy usage – and using a baking oven to heat is of course not very efficient. Nevertheless, the overall figures in terms of energy consumption still make a clear statement. Typically, heating represents 40 percent of the energy used for homes in Switzerland, when measured based on per person and per square meter – the homes described here reduce the

amount of heating energy required by 90 per cent! If the numbers are extrapolated onto the total energy consumption for all buildings (residential and non-residential sectors), it would mean a potential reduction of more than a third! And a little more daring, if a similar reduction is possible for all energy consumption in Switzerland, it would mean that the country would have a significant surplus of sustainable energy today - it would not have to import oil, gas or uranium or other fuels. And this can be achieved as explained above without reducing consumer comfort. That's progress!

8 Unit Condonomium Bremgartnerstrasse 124 in Dietikon
Basic "Minergie" house with additional energy-saving concepts

- double insulated glass u-value 1.0 W/m^2
- The narrowest possible window frame and only a few areas of large glazing. Window cannot be tipped open.
- A geothermal heat pump with 285 m depth, small scale solar thermal collectors.
- Individual ventilation settings with heat recovery for each apartment.
- Ventilation concept in cellar is designed for optimal warmth and humidity
- Underground ventilation concept is designed for optimal warm and humidity.
- No permanent ventilation staircase and lift shaft.
- Elimination of thermal bridges.
- Thermal insulation between individual apartments and unheated common rooms (3 recreational rooms, laundry room, staircase, etc.). Apartment doors are climatic doors
- Thermal barrier on building exterior or hull is enabled by consistent

usage of simple rectangles.
- In-depth monitoring of building systems and installations, ensuring that appropriate settings and partial adjustments are made during operation;
- 100% individual hot water and heating bills – an additional artificial cost is added to each energy to benefit the building's renovation fund bank account;
- Public transportation in front of building with frequent connection to trains to Zurich HB in 25 minutes.

Account
- Price of 4.5 room apartment with 121 m2 net living space is Fr 602,000 .-; including land costs, construction loan interest, change of ownership fees, parking space in garage underground
- Swimming pool, 3 common rooms of 40 m2 (office, games room, fitness center), with 110 m2 swimming pool
- 8 person lift
- generously equipped laundry room

Miscellaneous
- Clean, urban design and architectural concept.
- Very good noise protection - interior and exterior noise. With measurement protocols.
- Use of natural materials
- Star-shaped electrical cable guides that reduce electromagnetic emissions
- All Swiss-natural landscaping, including flat roof
- Consistent surface seepage of rain water, although the area is rated as a non-permeable.
- Apartment temperature throughout the year ranges between 20 and 26 degrees Celsius
- Relative humidity in the heating season in the homes without special measures is between 40 to 55%.
- Well-setup for wheelchair and disabled person accessibility, enabling Intergenerational living.

Unfortunately, Switzerland's building infrastructure is already in place

The potential to optimize energy consumption of Switzerland's building sector cannot be realized overnight. There is an existing infrastructure in Switzerland and the trend to invest to increase energy efficiency in buildings is only fledging. The actual opportunity lies in upcoming re-redevelopment and refurbishing and renovation projects. It is possible to make positive changes in an economical way, as long as the project is structured with a clear overall energy-reduction concept based on appropriate specialized knowledge. It can be executed step-wise in a typical multi-phase approach, while still preserving the country›s architectural heritage.

Item 2:
Restoration and conversion of old city hall into new public library, Dietikon.

The success of the overall renovation concept of this historical building were undertaken in 1996 is notable in viewing the Dietikon City annual report›s rankings of energy consumption in public buildings. The Dietikon public library with its theater in the cellar uses an average of 50 kilowatt hours per square meter and this over the six days a week operation. It is a figure that is comparable with energy usage in brand new buildings. The renovation's only change to the exterior of the historical building was a new coat of paint. It maintains the original beaver-tail interlocking tile roof and a stately large carved wooden entrance door. In addition, the delicate, double glazed windows installed in 1950›s were not changed. The good energy values are achieved due mainly to a complete overhaul of the insulation systems, including an airtight layer and matching internal insulation. Insulation in the ceiling support beams was deliberately avoided due to high condensation levels, while radiators were equipped with insulation that is over 20 cm deep. Vapor barriers were largely avoided because of a virtually unsolvable humidity problem. Today there is a discussion about replacing several windows and it is affordable now to install new, slender, climatic windows. Further, air ventilation sealing to reduce vapor pressure would have to be done.

Old City Hall Dietikon. Built originally in the 19th century as a school-house, the building houses today the public library and a theatre. Since the partial renovation in 1996, the building holds the number one spot for energy efficiency among the City of Dietikon properties.

Item 3:
Minergie upgrade apartment buildings Kirchweg 58 & 60 in Oberengstringen.

The ten apartments, renovated in 2008, perform better than most of today›s standard new buildings when it comes to energy use, and all that was changed were exterior aspects of the building. The previous refurbishment carried out about 15 years ago was still intact. The project required installation of 20 cm external insulation, triple glazed IV window installations, and enlargement of the balconies. In addition, in response to my pressing recommendation ventilation was also addressed. Along with the previously installed large solar thermal collectors for hot water, the certification for a Minergie label was fairly straightforward.
A challenge continuing to use the recently installed traditional-style window shutters, which were valued highly by the residents. The problem was solved, despite adding a six-inch window opening insulation layer, which also did not obstruct the views from each apartment, nor the proportion of light entering the interior of the apartments. Another note on the building envelope: a purely mineral treatment of the multi-layer structure enables the avoidance of the use of biocides, without a danger of esthetically unsightly algae on the facade.

Renovations to upgrade occupied apartment building to the Minergie standard. Mostly exterior work was done. Improved ventilation, exterior insulation, and larger balconies deliver increased comfort and less energy consumption.
Left: before renovations
Right: after renovations

Item 4:
Fischer House in Niederlenz

My personal opinion is that the single family home is not at all an energy efficient form of housing. It uses too much land and increases the use of automobiles and traffic. As an architect, single family homes are not my preferred project type for these reasons, nevertheless there are some positive things to learn from the example of the Fischer house in Niederlenz. Purchased in 2006, it has 260 m2 of net living space for a six-person household. During the week, the company hosts a motherless-child and often his father too. It was planned from the beginning to a design a home that could later be easily converted into two independent apartments, including the appropriate sound insulation and landscaping. In addition, the ground floor is wheelchair accessible, although there is no immediate need for it. The family does not own a car. The garage is used to store toys and gear from the whole neighborhood. The Lenzburg train station with a direct train to Zurich can be reached in about ten minutes. Large-area solar thermal collectors provide hot water and heating for eight months of the year. And the operation of a wood-fired heating system offers the homeowner manual labor that contrasts with his sedentary day job in an office.

The Fischer family's new home exhibits sustainable energy usage, enabled by solar thermal and a wood-burning heating system. It is Minergie certified.

Conclusion

The building infrastructure in Switzerland has a large part to play in today's unsustainable energy consumption in Switzerland. There is a room for improvement, a huge amount of room, and it can be achieved without sacrificing consumer comfort. What is required is customized planning by a team of dedicated and engaged designers, with the skills, interest, and with knowledge outside of their fields. It is critical that architects take responsibility for the physical form and shape of urban infrastructure. By using good, sustainable design, we can build the foundation for our future. It is important begin now, as quickly as possible, to do what is feasible and have the greatest possible positive impact.

Sources

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