

ENVR E-103: ENERGY AND CLIMATE: VISION FOR THE FUTURE

Climate Issues in Switzerland

A safe haven in the heart of Europe?



Picture: <https://www.revolvesolar.com/december-was-one-of-the-worst-months-ever-for-the-ski-industry/>

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Abstract

In 2015, the Atlantic newspaper asked James Hansen of the Columbia University Earth Institute: "If climate change continues at this pace, is anywhere going to be safe?". "Switzerland would be a good guess" was his answer. (News 2015) As a Swiss national and resident, the answer from one of the experts on global warming might sound comforting. Is Switzerland's landlocked position in the heart of Europe really the safest place on the planet if global warming continues to change our climate?

2015 was the hottest year in terms of average temperature in Switzerland since measurements began in 1864. Every one of the last five decades was warmer than the preceding one. (Hosi & Mittler 2016) Switzerland, especially in its Alpine region, has seen temperatures rise at double the average global rate since the mid 19th century, with an aggregate increase of 1.8 degrees compared to 0.85 degrees globally since 1850. (Anon 2016)

The 5th Intergovernmental Panel on Climate Change (IPCC) Report, published in 2014, has confirmed that human activity has been at the core of these transformations. Man's impact on Earth's climate is mainly due to the increased amounts of carbon dioxide released into the atmosphere by burning fossil fuels. The warming of Earth's climate system is unequivocal, and since the 1950s, many of the observed changes have been unprecedented over decades to millennia. The atmosphere and the ocean have warmed, the amounts of snow and ice have diminished and sea levels have risen. (Report 2014, p.2)

The consequences of global warming have been visible in Switzerland for a long time. Glaciers have been receding for years, winters have become milder and weather extremes have become more prevalent with storms and floods becoming more frequent.

It is the aim of this paper to show that even with Switzerland's landlocked and sheltered location in the middle of Europe, the impact of global warming will still be direct and disruptive. The analysis will include three sectors of the Swiss economy likely to be the most affected, tourism,

energy and agriculture. The consequences will not just be economic though, political and even societal change often come in the wake of economic disruption and they will be described as well.

I will attempt to show how disruptive climate change will be even in what is considered a relatively safe haven like Switzerland. I will not explore the best policies to adapt to these changes, for that would have gone beyond the scope of this assignment. I will make the case though that climate change should be taken very seriously, not only because we can imagine what might result in some parts of the world if the consequences described here are considered benign by experts, but also because this being a man-made problem, we can actually do something to mitigate it.

Climate Change - the local view

As mentioned in the introduction, the average temperature in Switzerland has been rising at a rapid rate. There are various reasons why the rise in Switzerland has been faster than the global average, the most important ones being:

- Temperature in general rises more quickly over landmass than over the oceans
- The melting of glaciers and the overall reduction of snow coverage in the Alps have changed the Albedo effect
- Internal fluctuation in the climate system (e.g. North Atlantic Oscillation) can overlay and strengthen warming
- Higher locations usually warm up more quickly (SECO 2011, p.20)

This development has not been linear though. Temperature rises have picked up speed in recent decades. Overall, the rise in temperature since 1864 has been 1.8 degrees. This corresponds to 0.12 degrees per decade. The average increase per decade since 1961 has been about 0.37

degrees, three times the average. Also, seventeen of the twenty warmest years since 1864 have been measured in the last 27 years. (Hosi & Mittler 2016, p.42)

Various climate models have been used to predict that in the future, average temperatures will continue to rise, mainly by increasing the number of hot days (defined as days where the maximum temperature rises above 25 degrees Celsius) during the summer and a reduction of frosty days in winter (where the temperature dips below freezing).

Mountains, Snow and Ice

It seems obvious that global warming would have an impact on snowfall and ice in the Swiss Alpine Region and it does. The Alps cover about 65% of the surface of Switzerland and are therefore an important feature of its topography. (Bätzing & Rougier 2005, p.21) Measurements during the last couple of decades have confirmed that the amount of snow and the number of days with snow cover have decreased significantly. (see image below)

Altitude in metres	Snow coverage in cm	Alps N/S	Nbr. snowdays 1948-1987	Nbr. snowdays 1988-2007	Difference (days)	Difference (percentage)
201-800	5	N	28	3	15	54
		S	15	6	9	60
801-1300	30	N	55	32	23	42
		S	60	40	20	34
1301-1800	50	N	93	74	19	20
		S	79	54	25	32

(Marty 2008)

These changes have been especially dramatic at lower altitudes and will have a great impact not only on tourism, but also on the energy sector and agriculture which I will look at in more detail in the second part of this paper. Another problem that is created by the rising of temperature at higher altitudes is the melting of glaciers and permafrost (soil, rock or sediment that remains frozen year round).

Glaciers used to cover about 1.735 km² or 4.2% of Switzerland's surface in 1850. By 2010, the coverage had decreased to 944 km² or 2.1%, almost halving the area covered by permanent ice. This changed the Albedo effect, lowering the amount of solar energy that used to be reflected by the icy surface.

The melting of the glaciers and permafrost also affect the structural stability of the Alps. An additional warming of 1-2 degrees over the next 50 years will move up the altitude at which soil remains frozen all year by 250 to 750 metres. (CIPRA International 2002, p.3) This will make rock falls more likely on steep hills until then covered by permafrost. It will also put at risk man-made infrastructure (e.g. houses, ski lift masts, constructions for avalanche protection) that relies on permafrost for its stability. Great investments will be required to adapt this infrastructure to the new conditions.

Water Cycle

It has been an accepted fact that the warming of the atmosphere has a significant impact on the water cycle. Warmer temperatures increase the amount of water in the atmosphere and increase the speed of the water cycle. More water evaporating into the atmosphere increase precipitation levels. (McElroy 2016, p.IX)

Switzerland's unique location makes it especially vulnerable to changes in the water cycle. The natural barrier of the Alps is the reason why yearly rainfall in Switzerland is about double the average amount in Europe. This is why Switzerland has been dubbed the European water castle. (Bartu 2012) It is home to about 6% of Europe's freshwater resources even though its landmass covers only 0.4% of the continent's territory. Major European rivers like the Rhine and Rhone have their sources in Switzerland.

The global projections described in the IPCC Report show that we can expect more rainfall in the tropics as well as in the middle and higher latitudes and a reduction of rainfall in the subtropics. Switzerland finds itself at the transition of the middle latitudes to the subtropics. (Hosi & Mittler

2016, p.47) The models for Switzerland predict drier summer months and slightly increased rainfall during the rest of the year. (SECO 2011, p.21) Due to the milder winters, fewer precipitations will be in the form of snow, thereby depleting the amount of water that is stored naturally in the Alps over the winter months. This will decrease the snowmelt during the spring and summer and make these seasons even drier.

Extreme Weather

Weather extremes such as storms, floods and droughts have always been part of life on planet Earth. It is very difficult to prove a direct causal relation between any specific weather event and global warming, because of the multitude of factors that influence weather patterns.

Switzerland is a rather small country, which makes it even more difficult to prove a causal relationship between climate change and weather extremes, because the weather patterns are overlaid with strong local and natural variability. (Hosi & Mittler 2016, p.55) Still, for the last two decades, Switzerland has seen a number of records and weather extremes that seem to indicate a trend. The summers of 2014 and 2015 were the hottest and driest on record. (Sütterlin n.d.) There were major floods in 2005 and storm Lothar in 1999 created damages of \$ 6 bio. in little over 2 hours. (SwissRe 2002, p.23)

Impact

The changes described in the last chapter should, in my view, be enough to convince anybody to take climate change seriously. In the second part of this paper, I will describe the impact these changes will have on Switzerland's economy, politics and society, which should compel even the hardest critics of the merit of the topic.

I have chosen the three areas, where I believe the impact will be the biggest, namely tourism energy and agriculture. Many others such as impact on human health, urban areas and migration patterns I have left out, not for lack of interest but of space.

Tourism

Tourism is a very important part of the Swiss economy, not only in terms of volume but also in terms of its contribution to its Balance of Trade (BOT). In 2015, its total contribution to Gross Domestic Product (GDP) was CHF 48 bio (7.4% of GDP). The projections of the World Travel & Tourism Council (WTTC) estimate that the industry will grow at 1.9% per annum to CHF 59 bio by 2025. It provides more than 206.000 jobs or 3.9% of total employment. More than CHF 18.8 bio were in the form of direct exports. (Turner 2015)

On June 8, 2010, the Swiss government published a report analyzing the future of the industry. In it, the National Executive Council mentioned the impact of global warming as one of the five biggest threats to the growth of tourism in Switzerland. (SECO 2011, p.5)

As might be expected, the biggest threat will be to winter tourism in the Alpine region. The reduction of snowfall at lower altitudes has already been mentioned. This will mainly impact ski resorts below 2.000 m above sea level. As a result, their existence will be in jeopardy. Due to increased precipitations during the winter season, resorts at higher altitudes might actually benefit from the changes, but they will not be able to compensate for revenues lost by resorts at lower altitudes.

The melting of permafrost will impact all resorts and their infrastructure. Costly investments will be needed to secure buildings and other infrastructure.

Competition for water resources will become fiercer. Today's infrastructure of artificial lakes and dams is set up for a climate which builds up water reserves during winter in the form of snow and ice. These reserves melt in stages when the weather warms up in spring and fill up artificial lakes. The fact that more precipitations in winter will be in the form of rain means that the capacity of the dams might not suffice and that less water will be available during the summer months.

The production of artificial snow, which for many resorts is a life line, needs huge amounts of water. This water cannot be used with the current infrastructure without being missed in the spring and summer for electricity production. (SECO 2011, p.33)

The outlook for summer tourism is somewhat brighter. Higher temperatures during the summer months will most likely make mountain holidays more attractive. Many resorts have already started to pivot to the summer months as a source of revenue. This is an opportunity, but not one that will come cheap. Many investments will have to be made to make the offering more attractive. Other than in winter tourism, the competition during the summer months is fierce and there are many destinations that vvy for potential customers.

Another risk for the tourism industry in general is extreme weather. Of all the impacts of climate change, extreme weather in general and floods in particular currently create the most economic damage in the Alps. (Agrawala 2007, p.63) These storms and floodings, especially if they happen more frequently, may constitute a barrier for many foreign tourists to travel to the Alps as an alternative to beach holidays.

Energy sector

The Energy sector in Switzerland has some peculiarities due to the size and location of the country. Although its dependence on fossil fuels remains great, especially in the area of transportation, the production of electricity relies heavily on renewable energies. As a matter of fact, 57% of Electricity in 2010 was produced from renewable sources. (BFE 2010, p.6)

Comparable to other industrialized countries, the production of electricity from newer renewables (e.g. sun, wind, biomass etc.) remains quite small, about 2.19%, even though it is rising quickly. What sets Swiss electricity production apart is that more than half is based on hydropower. This includes power plants on rivers as well as dams, which are located mostly in the Alps. (BFE 2010, p.6) Any changes in the water cycle will therefore have major impacts on this sector.

River plants will probably be less affected, even though longer dry periods during the summer months will lower the amount of water in the rivers, particularly at a time when consumption of electricity rises. (ElCom 2016, p.35)

The major impact will be on dams. First, the reduced snow cover, which works as a natural water reservoir during winter months will be less plentiful. Second, as discussed in the previous chapter, increased production of artificial snow for tourism will use extensive amounts of water during the winter months. The current infrastructure of dams will be insufficient to capture enough water in winter satisfy the demand for the entire year without significant amounts of snow melting in the spring.

Therefore, it will become necessary either to invest into new dams, or to rely more heavily on nuclear power, for which there is little political enthusiasm in Switzerland. In any event, global warming will have a definite impact on the Swiss energy sector.

Agriculture

Due to its size and great population density, agriculture in Switzerland is a very small part of the economy. In 2015, the Federal Office for Statistics (BFS) released numbers that put agriculture's contribution to GDP at about CHF 4.256 bio or 0.65% of total GDP. (Statistik n.d.) Even if the contribution is negligible in economic terms, agriculture remains very important, because it provides Switzerland a reliable source of food.

More importantly, farmers are very adept at organizing politically, giving them influence quite out of proportion to their economic importance.

Global warming will have an impact on Swiss agriculture, but it will not be all negative as it will be in other parts in the world. The increased likelihood of crop failures in summer will be balanced out by longer growing seasons as well as warmer and drier falls. (Hosi & Mittler 2016, p.113)

What it will mean though is that farmers will have to adapt their crops. Where wheat and millet were the staple crops especially on the Swiss plateau, corn is expected to become more

important. This change in crops will mean additional investments that will need to be made in the medium to long term.

If the warming continues unchecked over longer periods of time, droughts will increase the risk for crop failures. Also, some scientists have warned that the warming will reduce the Alpine region's effectiveness as a cold barrier for invasive vermin. (Hosi & Mittler 2016, p.113) New illnesses will increase the risk of crop failures even more.

By far the biggest threat in terms of security of supply is the fact, that Switzerland is a small and densely populated country. It is heavily dependent on imports for its food and other raw materials and therefore needs the global commodity markets to work. These markets will be impacted far more heavily by climate change and a reduction in production as well as more fluctuations will increase the price of many commodities that need to be imported.

Conclusion

Global climatic trends as described in the IPCC report of 2014 seem to be born out by meteorological measurements in Switzerland. Global warming trends are actually accentuated in the Swiss context because of its unique location where more than half of the country's surface is covered by the Alps. Temperatures in Switzerland have risen more than twice the global average in the last 150 years. The consequences of this warming have been visible in Switzerland for quite some time. Glaciers have been retreating, permafrost has been melting and the amount of snow that falls during the winter months has been declining. These trends also show no signs of being reversed anytime soon. If anything, they are getting stronger as time goes by.

My parents live in small village in the French speaking part of Switzerland. It is a small ski resort at about 1.700 metres above sea level. I went skiing there this year with my family as I have done since I was a kid. We used to be able to ski there every year from December until late March. This year, the number of days the resort was opened for skiing dropped down to 21 days in January and February. The rest of the time it was closed for lack of snow. It is only one example of the impact of global warming that is having a very real effect on people's livelihoods. Many small

shop owners are struggling because the tourists are staying away. The authorities are trying to adapt and find new offerings that will secure tourism revenue, but it is difficult to compete and find the capital to invest in what many see as a dying region.

That is why, while agreeing with James Hansen's premise that there are regions in the world that will be worse off in terms of climate change impacts, I have seen that the impacts in Switzerland are far from negligible and can be very disruptive.

Other areas that have been analyzed in this paper are the energy sector and agriculture. There, the consequences might be less direct, but they still will be tangible. For instance, the more food Switzerland will need to import to feed its people, the more it will be dependent on global commodity markets, which will bear the full brunt of climate change.

In the end, the effects of climate change do not recognize borders, this should be an incentive to do more, rather than less about global warming.

Definition of Terms

BOT	Balance of Trade
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
WTTC	World Travel & Tourism Council

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