Cleantech ALPS | Western Switzerland Cleantech Cluster

Waste recovery in Switzerland

a model to be emulated









CleantechAlps is an initiative of the Cantons of Bern, Fribourg, Vaud, Valais, Neuchâtel, Geneva and Jura. Supported by the SECO under the New Regional Policy (NRP).

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Summary

« Clean technologies (cleantech) developed over several years throughout the world, and particularly in Switzerland, are showing us the way to go in moving towards truly sustainable development. »

Editorial

The recycling, our new source of raw materials

There is no getting away from it – the world's population is continually increasing. The number of people living on our planet is set to grow from 7.2 billion in 2014 to 9 billion by 2050.

This drastic population increase will be reflected in, amongst other things, greater consumption of water, energy and food. In its wake, this demographic growth will also bring pronounced economic development in urban areas, which will have major impacts on the environment (air quality, greenhouse gases, waste water, etc.).

We are heading inexorably towards an increase in the pressure on our planet's natural and energy resources. The most obvious solution on the horizon seems to be what is known as « Footprint one ». This concept of « a single ecological footprint », developed by the English-speaking world, is nothing more than common sense. It means not consuming more resources each year than the planet can regenerate during that same period.

It therefore means finding a balance between a society's economic needs whilst protecting its total ecosystem. And so we are finally entering the era of true sustainable development, characterised by its three fundamental components : ecology, the economy, and society.

Waste management is undoubtedly the sector that best highlights the paradigm shift that has to take place, with an improvement in both the exploitation and reuse of resources. If energy efficiency is the fuel of the future, recycling is the new source of raw materials !

Switzerland has a well-developed industrial base in the waste processing and recovery channels, with efficient, innovative technologies. The aim of this study is to present an overview of this sector and the issues within it. The study spotlights the players who have enabled our society to reach its present standard, which sets an example for other nations to follow, and whose skills continue to shape Switzerland's future.

Eric Plan
Chef Operating Officer of CleantechAlps

An expert talks about...

« The installation of waste treatment centres in the heart of the urban habitat is the proof that these technologies have been mastered »

Marc Andlauer, head of the geology, soils and waste division (GEODE) General Directorate for the Environment,Department of Land and Environment of the canton of Vaud

1. Mr Andlauer, Switzerland is a world leader in waste treatment, what are the reasons for this ?

Sitting as it does on the crossroads between the « southern » and the « northern » European cultures, Switzerland has had the benefit of a favourable cultural and sociological context for more than a century. We inherited the awareness of an agricultural society at one with nature, which immediately found expression in the importance of conserving our natural environments.

The shock wave created by the ecological disasters of the 1970s in the industrial landfill sites on the other side of the Atlantic really acted as an accelerator in the field of waste management in Switzerland. The political authorities and the will of the people were united about the need for drastic legislation in this field. The waste management guidelines published in 1986 by the Swiss Federal Council laid the foundation for a strategy whose effects are still being felt today. It strongly emphasises the idea of prevention at source. The slogan of the time was : « Le bon déchet est celui qui n'existe pas » (good waste is non-existent waste). It's strongly reminiscent of the highly topical idea of « negawatts » in energy use (in terms of energy efficiency, the cheapest kilowatt is the one that isn't consumed). It is a concrete expression of the authorities' vision in those times and of the setting up of strong, adaptable legislation mirroring the waste management programmes, which are reviewed every ten years.

> *“ Good waste is non-existent waste. ”*

With this in mind, our country opted very early on for the path of recovery through incineration. Since the 1980s, incinerators have given us the opportunity to make significant progress in flue gas treatment (trapping pollutants before they are released into the atmosphere).

Today they contribute 3% of Switzerland's energy production (heat and electricity) and share in the economic optimum estimated for western society, with a recovery/incineration ratio of around 60/40. By way of comparison, the canton of Vaud as a whole is currently operating at 55/45.

Another factor that explains this success is the choice of involving the general public and the local politicians in the deployment of the measures to be taken on the ground. This decentralisation of decision-making at a regional level has ensured speed and flexibility of execution. This sector's strength undoubtedly lies in the decision to introduce waste reception centres alongside the household waste incinerators, as well as a policy of education and awareness-raising, particularly in schools. While three pilot waste reception centres, including ones at Peney-le-Jorat and Echandens, started things off in the canton of Vaud, the approach developed in the canton for awareness-raising in schools has spread like wildfire ... if you'll pardon the expression.

The legislative and political framework is undoubtedly an important driving force. Allow me to illustrate this point by finishing with the example of Tridel in Lausanne. That was a deliberate political decision to construct a high-technology incinerator on an urban site in order to reduce the transport impact and optimise thermal energy recovery. Its success is due to a strong political will !

2. More than a third of the key figures in energy recovery in western Switzerland are located in the canton of Vaud. How do you explain that ?

Our canton is lucky enough to have a large number of the sector's key players, who have already accumulated a long tradition. Among them, a few pioneers in recycling – such as Gravière de la Claie-aux-Moines – were keen, from very early on, to establish and disseminate a mind-set of reusing waste. The authorities' strong focus on doing something about the building industry, with its high levels of embodied energy, is also part of the explanation. Huge efforts were made in terms of both recovery and standardisation of the recovered products. We simply transferred the concept of waste reception centres ... to the building sites. Today 85% of construction waste is recovered. The key to success lies in a positive overall economic record, in which habits have changed thanks to the incentive scheme.

“Today 85% of construction waste is recovered.”

Added to this is the fact that, very early on, we also set up some public limited companies, referred to as « perimeter » companies, with an aim to managing waste. They were spread over eight regions and had the task of facilitating the relationship between the municipal authorities and the waste treatment businesses (transport, sorting, etc.). They acted as intermediaries in the implementation of the waste management programme on the ground. This is a federating initiative launched by the politicians to ensure competitiveness and a uniformity of practices, and is another highly successful operation.

Another important aspect is the impetus provided, in the 90s, by the out-and-out visionaries employed by large groups and institutes such as CHUV, UNIL, IMD, Nestlé’s research centre and others. These simply put in place co-operations for purchasing consumables but also for a collective waste-disposal scheme. These people were the pioneers of industrial ecology in Switzerland. While the jobs of energy or facility manager have already gained recognition, the role of waste manager of an industrial zone is still in its infancy. This role will cover a whole range of services that I like to describe as « from the laundry to the dustbin ».

Tridel, Lausanne

3. As head of GEODE, the division responsible for waste, what, in your opinion, is the next contribution that Switzerland will make to this sector ?

The installation of facilities in the heart of the urban habitat is the proof that we have mastered chemical engineering technologies that are suited to the objective of environmental conservation and of fully taking into account the social and economic aspects. It is living proof of the reality of our society’s sustainable development. It would be pretentious of me to try to predict the future. However, I can well imagine that the effects of the prevention-at-source strategy will continue to bear fruit. As for waste recovery, whether in the form of materials or energy, the skills network of institutes such as the Paul Scherrer Institute, Eawag, UNIL, the Swiss Federal Institutes of Technology and the Universities of Applied Sciences will undoubtedly lead to innovative solutions. For the recovery of phosphorus from sewage sludge, for example. We are already extracting zinc from flue ash, together with most of the metals contained in the combustion products.

Our next contribution will very probably be sharing the expertise that we have developed over the past century, in particular in the last thirty years. This will probably be in the form of solutions that provide the full package, covering all the technological, legislative, methodological (results), analytical and social aspects. The ambassador for this service could be the aforementioned waste manager. To sum up, Switzerland’s next contribution will be an integrated solution, with a common vision, shared by the stakeholders, that is technically and economically sustainable !

An expert talks about...

The evolution of incinerators in Switzerland

By Edi Blatter, ETH Zurich engineer, and managing director of SATOM SA in Monthey

In their current configuration, Swiss incinerators contribute to our country's energy supply under conditions that are favourable both to the economy and to the environment. Effective sorting and better handling of incinerable municipal waste will make it possible to further improve their social utility.

Yesterday's facility versus today's

Most of Switzerland's incinerators were constructed in the 1970s. At the time, the goal was to eliminate landfill sites, as these seriously affected both the landscape and the environment, in particular the water. The facilities had no other function than to eliminate waste by incinerating it.

The Swiss Federal Office for the Environment soon recognised the shortcomings of this practice and its drawbacks in terms of air pollution, made all the worse by the rapidly growing use of plastics. It laid down flue gas treatment standards that were technically demanding and as yet unheard of in other countries. The realisation of this ambitious objective altered people's perception of incinerators and their acceptability close to urban centres.

During the same period, waste composition changed: on one hand, the volume of mineral and metal materials dropped and that of plastics increased; on the other, the development of sorting at source meant that glass and other low-energy materials could be removed from the rubbish bins.

From destruction to recovery

To start with, incinerators used gas or heating oil to burn waste. The evolution in waste composition, coupled with technical advances, soon meant that these fossil fuels could be abandoned in favour of the plants' own electricity generation.

Better still, these facilities quickly found themselves in a position to be able to inject electricity into the grid and produce energy to power district heating networks at very favourable prices.

And this changed the status of incinerators. From simple household waste incinerators at their conception, they have now become energy-from-waste plants (EfW plants).

In Switzerland, in 2012, these facilities produced:

- 1.6 TWh of electricity, equal to 2.3% of Swiss household consumption
- 3.1 TWh of thermal energy, equal to 62% of the thermal energy distributed in Switzerland's networks.

We should also point out that the potential has not yet been fully exploited in all the facilities.

EfW plants and other energy-generation centres

Let's make one thing clear from the start: nowadays the energy efficiency of Switzerland's best EfW plants equals that of heating plants or power stations run on heating fuel, gas, coal or wood. This is a proven fact that anyone can check.

EfW plants located close to towns co-generate heat and electricity. They have an optimum energy exploitation, something that cannot be said of wood- or pellet-fired heating plants, although no one questions the latter's social utility.

As for coal- or gas-powered power stations – or nuclear power stations, for that matter – they are too large to find buyers for the residual heat from their electricity production. What is more, because of their environmental impact and the risks they present, they cannot be constructed close to towns or cities, something that is essential to finding a market for the waste heat. This wastage of residual energy accounts for their poorer performance compared with EfW plants.

> *"From simple household waste incinerators at their conception, they have now become energy-from-waste plants (EfW plants)."*

EfW plant production adjustment

Nowadays, EfW plants play a relatively important role in ensuring a steady power supply in Switzerland. That doesn't come from their production in terms of quantity, but from their ability to adjust it based on requirements. In practice, a large proportion of the waste material can be stockpiled and used for on-demand energy production. The most advanced facilities already operate in this way. They incinerate more waste in winter, when there is a particularly high energy demand. They are able to adjust their electricity production hourly, based on demand, and even play their part in regulating the electrical grid at a tertiary level.

This function is set to become increasingly important with the development of photovoltaic installations, whose production is by its very nature irregular. Because of their decentralisation and their capacity for adjustment, EfW plants are able to take the strain off the networks and to stabilise them at moments of peak demand.

EfW plants will be even better able to assume this role if the biodegradable waste is separated out to be used in other energy recovery methods (in particular biogas generation).

We have not yet mentioned steam generation for industrial use, a third function of EfW plants. SATOM, for example, which is located in a highly industrialised region, handles all three types of energy generation – electricity, industrial steam and hot water – and develops synergies between the three. The practices described above make up what is referred to as industrial ecology, and are a part of circular production. In this, waste is not destroyed but fully recovered, in the form of energy – an energy that is very good value compared to that produced from conventional energy sources. This is important for the Swiss economy.

The importance of sorting

EfW plants would be even more efficient if communities developed their policy on sorting without prejudice. We have already mentioned the need to direct biodegradable waste, with its high water content, towards a dedicated channel. It would also be better to separate out from incinerable waste the pieces of glass, and the ceramics and minerals that contain no energy but exit the combustion chambers in the form of ash that has to be dumped in landfill sites. This would ensure that only incinerable waste was left in the rubbish bags, which would be completely recoverable.

At the same time, and contrary to popular belief, quite a substantial fraction of household plastics cannot be recycled; this represents a highly valuable energy source for EfW plants, similar to that of used wood.

By better explaining to the public what is incinerable and what is not, we can further improve the already considerable yield of EfW plants.

If waste separation is approached in the way we have described, it radically changes the current paradigm of rubbish disposal. It will no longer be a case of « disposing » of anything, but of directing each type of waste towards the appropriate channel. Energy-from-waste facilities will only receive incinerable material.

In this context, the current collection of household refuse in rubbish bags that, in Switzerland, are often taxed is no longer relevant. It needs to be replaced by the collection of incinerable material in the same lorries with their integrated compactor. This is the most ecological and effective tool in the collection of bulky materials.

In a circular economy, the term ‘waste’ no longer applies: there are only materials whose use changes in permanent recycling processes. EfW plants already realise this objective in their sphere of activity.

Interview

« In Switzerland, waste recovery is taught in schools »

Jean-Marc Hensch, Managing Director of Swico SA

1. Mr Hensch, Switzerland has a long tradition of waste management: what, in your opinion, are its strengths in this sector ?

In the 1990s, Switzerland was one of the pioneers in recycling electrical and electronic waste. Manufacturers in the ICT sector did not wait for legislation before they acted. On their own initiative, they set up a collective take-back system that has been emulated by many other countries. Today we all benefit from the fact that this system was put in place so long ago. Firstly because it has undergone constant improvement, and secondly because returning used equipment is firmly anchored in consumers' minds, to the point where it is now taught in schools.

2. According to some studies, ten years from now a quarter of the 88 elements that make up Mendeleev's periodic table (copper, zinc, platinum, etc.) will have been exhausted. Does your industry offer an answer to this problem ?

The recovery of rare earth elements presents a challenge to the recycling sector precisely because they are present in such minute quantities. Given their low concentration and their dispersal through the products, it is extremely difficult to collect them, and the energy required to do so is far greater than the potential yield. In the context of a study ordered by the Swiss Federal Office for the Environment, and carried out in partnership with the Swiss Federal Laboratories for Materials Science and Technology (Empa), Swico has been attempting to establish which are the elements for which a special recovery treatment could be worthwhile. The problem before us is well known. But, in the long term, I think it is better to replace these elements at the manufacturing stage (in other words, to avoid using them), rather than attempt to recover them retrospectively at the recycling stage.

3. The impact of waste sorting and recycling depends a great deal on the legal framework: how do you see the contribution of Switzerland, and in particular of Swico, on the foreign markets ?

You are absolutely right: the legislative setting is crucial. In Switzerland, we have had the advantage of very « light » legislation, leaving the market to regulate itself in the right direction. It is almost more important to note that both the population and economic world as a whole are convinced of the quality and efficiency of our system. Return rates of more than 90% are ample evidence that this collection is worthwhile. For many years, Swico and Empa, acting on behalf of Swico, have been actively engaged not only in optimising the Swiss system, but also in making our know-how and experience available worldwide. Our publications are read with interest throughout the world, and journalists and television crews often come to Switzerland to inform their audiences about the latest developments at Swico. And, on top of this, we are also involved in international development projects.

An expert talks about...

The environmental footprint of waste recovery

By D. Bochatay, G. Schneider, and S. Humbert, Quantis

Is it always preferable to recycle waste rather than incinerate it ? Although such a solution is banned in Switzerland, wouldn't it be simplest to store CO_2 and combat climate change by putting non-putrescible carbon-containing waste on a tip ? Should we aim for a quantitative or a qualitative increase in the sorting of waste ?

It is important to answer this type of question, so that the appropriate public policies can be put in place. Life Cycle Assessment (LCA) provides complete, scientific answers by modelling the impact on different environmental indicators, for example air pollution that affects human health, or CO_2 emissions that are responsible for climate change.

LCA or ecological balance sheet

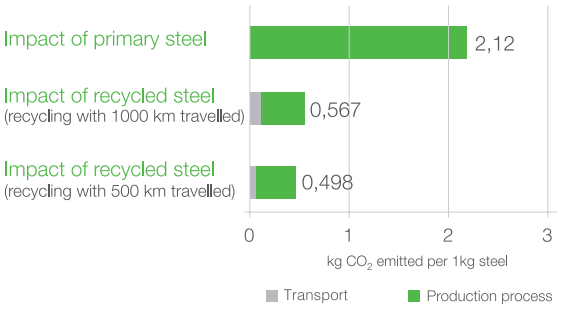
LCA, shown diagrammatically below, is a scientific method that assesses the environmental impact of a system (product, etc.). The natural resources consumed and the emissions produced at each phase in the life cycle of a product, such as its manufacture, transport or use, are modelled and their effects are grouped together into a limited number of impact indicators so that an interpretation can be produced.

The advantage of LCA over simpler, single-indicator methods, such as the carbon footprint or embodied energy, is that it gives a broader view of the effects on the environment. For instance, the carbon footprint of hydroelectricity is unbeatable in comparison with other sources of electricity, but this indicator gives no information about the effect on the biodiversity of run-of-river dams or of rivers upstream from storage dams.

Let's see how LCA can guide public policy in optimising waste awareness, sorting and recovery, using two simple examples.

Example 1 : metal waste

Industry and the construction sector recycle large amounts of waste metal, particularly steel. Recycled steel can take the place of primary steel, which is steel produced after ore has been mined. The diagram below (indicator : carbon footprint) shows that despite the energy and transport required by recycling, it is definitely better to use recycled steel rather than primary steel, for all the environmental indicators illustrated above. The same applies to other metals.



Source : ecoinvent 2.2

Example 2 : paper

Swiss households sort greater quantities of paper than any other form of waste, with over 160 kg per inhabitant per year. Despite this effort, between 10% and 15% of household waste consists of paper. Can we be content with this situation or should we promote improved sorting of paper?

The ecological balance sheet shows that using recycled paper, as compared with white, FSC-label paper, does not offer a major environmental benefit. Secondly, comparing the recycling of old paper with its incineration depends on several key parameters, such as the incinerators' thermal efficiency (CH : from 5% to 65%) and electrical efficiency (CH : from 5% to 25%). This means that if an incinerator enables a district to be supplied with electricity or heated efficiently, it is just as worthwhile, from an environmental standpoint, to incinerate paper as to recycle it.

"LCA validates the environmental benefit of sorting and recycling waste, but in a very contrasting manner, depending on the waste concerned."

Conclusion

In short, LCA validates the environmental benefit of sorting and recycling waste, but in a very contrasting manner, depending on the waste concerned.

For a country such as Switzerland, where the levels of waste recycling are high, improving the system should focus, as a priority, on forms of waste such as metal, for which recycling produces a significant environmental gain. Conversely, establishing an expensive or coercive system to optimise the recycling of waste such as paper is not necessarily essential.

Other approaches could also be developed : reducing the production of waste at source ; developing a system that reduces the transport of waste ; facilitating product recyclability ; increasing the energy efficiency of incinerators, etc.

About Quantis

Quantis is a leading consultancy in the area of Life Cycle Assessment (LCA), and was formed as a spin-off from EPFL. It specialises in supporting organisations so that they can measure, understand and manage the environmental impact of their products, services and activities. Quantis is an international company with offices in Switzerland, France, the USA and Canada, and employs 70 staff, several of whom are internationally recognised experts in LCA. Further information about the company's services is available on its website. (www.quantis-intl.com)

Interview

« A straight export of what we are doing here is rarely successful »

Patrick Hofer-Noser, President of Cleantech Switzerland

1. Mr Hofer-Noser, Switzerland is at the cutting edge of waste management: what future do you see for its key players on the international markets ?

The improving living standards in many countries around the world are resulting in additional waste. Swiss companies have gained a great deal of experience in waste recovery in Switzerland. This valuable expertise can be used to export know-how, products and services to the countries that need these technologies to convert waste to energy or to use waste as a source for materials. Nevertheless, it is crucially important to understand the local legislative and social requirements in order to develop successful solutions with the local partners.

“ The best way is to avoid the waste in the first place by designing products appropriately. ”

2. One of the main challenges in developing countries is the problem of landfill sites. Switzerland has already got over this hurdle and incinerates or recycles most of its waste. Is this the way forward ?

The best way is to avoid the waste in the first place by designing products appropriately and by introducing appropriate legislation. Some developing countries have banned plastic bags as a result, for instance.

Before a company plans its entry on the market in one of these emerging countries, it’s important to understand the local requirements; it’s important to understand the local economy. A straight export of what we are doing here is rarely successful. Swiss companies have a deep understanding of waste-treatment processes and technologies. If we combine these technologies with local knowledge, the potential of these countries can be leveraged, as the study shows.

3. We often hear that the internal market is THE major export market. Given this, access to this market and the confidence of its players are essential. Is this one of the reasons behind your partnership with CleantechAlps ?

Cleantech Switzerland is the official Swiss platform for export activities in the field of clean technologies. Our partnership with CleantechAlps, which represents us in Western Switzerland, works very well. Our common aim is to communicate a co-ordinated image of the cleantech scene to people abroad, in order to maximise the impact for Swiss enterprises. As regards the first part of your question, for many SMEs the Swiss market is an essential point of reference. However, export activities require an understanding of new cultures and different challenges – we can offer substantial support to SMEs, with our partners and with the external Swiss network that has strong local footholds in the countries in question.

Cleantech Switzerland - Your partner for Cleantech business abroad!

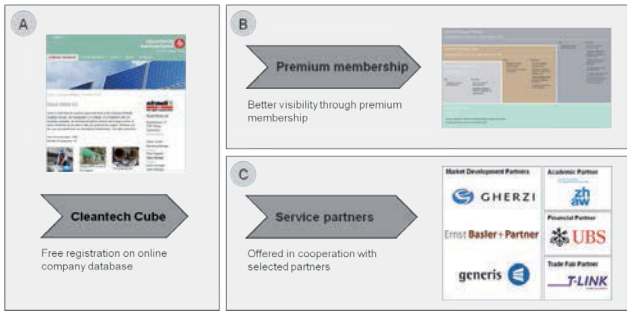
cleantech switzerland
Innovative. Reliable. Precise.

Transforming waste into value.

Switzerland: World Champions in waste management.
Switzerland is world-class when it comes to recycling. Glass, aluminum cans, PET beverage containers, paper, organic waste and even electrical and electronic appliances record very high collection rates. Today more than 2.7m. tons of waste are discarded in Switzerland. Importantly, between 77% and close to 100% is recycled depending on the materials used. Switzerland's excellent know-how in recycling and waste management is in demand abroad, especially in countries where waste is still dumped in landfills (and not burned in waste incineration plants) and recycling technologies are not yet established. Here, Swiss expertise is highly sought after and offers interesting business opportunities for Swiss Cleantech companies.

Cleantech Switzerland is the official Swiss export platform and a powerful interface between Swiss companies and foreign project and business partners. Cleantech Switzerland increases your visibility in foreign Cleantech markets and ensures access to potential business partners.

What do we offer? Cleantech Cube, Marketing Services and Service Partners.
The services we offer are divided into three categories:



Cleantech Cube: All Cleantech companies with a registered office are welcome to enter their details on the company database. This is free of charge.
Marketing Services: Premium members of Cleantech Switzerland benefit from additional marketing support and better visibility in export markets as well as in the Swiss marketplace.
Market development services: Cleantech Switzerland offers market development and consultancy services in cooperation with selected service partners.

We are ready to support you!
We would be delighted to help you to identify project opportunities abroad to increase your export sales.

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Waste recovery in Switzerland: a model to be emulated

1. General context and definitions

1.1 Introduction

Recent press articles throughout the world have drawn attention to the existence of a sixth continent, consisting of plastic waste created by human activities. Dumped in the sea and carried along by the currents, this plastic has accumulated in the Pacific, between California and Hawaii, and covers almost 3.5 million square kilometres, which makes it 85 times larger than Switzerland or one-third the size of the European continent! And this is only the tip of the iceberg, because, every day, 66 tonnes of the plastics dumped by human beings are ingested by marine creatures.

In December 2013, shortly before Christmas, the French newspaper Le Monde published an eloquent article on an open waste dump in Ghana that is one of the largest of its kind in the world, and the source of some major public health problems. According to this article, the majority of electrical and electronic waste that reaches Ghana arrives from Europe in containers exported from the Netherlands. A study commissioned by the UN and mentioned in the article, predicts that the world's electronic waste is set to increase by a third by 2017, representing an annual mountain of waste weighing 65.4 million tonnes. This is almost 200 times the weight of the Empire State Building !

There are dozens of other similar examples that could be cited to illustrate this problem and the current issues posed by waste, its processing, and the need for it to be managed on a global scale.

But what actually is waste ? Before analysing what is a very broad sector, it is worth defining a few terms and establishing a frame of reference.

1.2 Definitions

Although the general definition is known, it is important to go a little further in explaining the term « waste ». Switzerland's Federal Act on the Protection of the Environment[1] states that an item of waste is « any moveable material disposed of by its holder or the disposal of which is required in the public interest. » Waste can also be defined as «any substance or object which the holder discards or intends or is required to discard[2]. It therefore represents a potentially enormous loss of resources, whether in the form of raw materials or energy. In addition, the management and disposal of waste can have serious effects on the environment. Waste dumps, for example, take up space and can pollute the air, water or soil, while incineration, if inadequately regulated, can produce emissions of dangerous atmospheric pollutants.

An extremely comprehensive description is given on the website www.dechets.ch which lists over 100 different categories of waste[3].

The term « waste recovery » is frequently used. This can take three forms[4], and our study will focus on these :

- **recovery of energy** : this consists of exploiting the potential energy contained in waste. This energy produces electricity, heat or steam, and is used to heat buildings, for instance, particularly in district heating networks ;
- **recovery of material** : this involves using all or part of an item of waste to replace an element or a material ;
- **recovery of organic matter** : this refers to the production and use of compost, digestate or any other organic waste as a soil improver.

There are four basic steps in waste management. These are described below, so that the functioning of this sector and the issues within it can be better understood. :

Dumping : this term covers both unregulated and controlled depositing of waste, with consequent potential for pollution of water, soil or air.

Processing by an incineration plant : part of the waste is incinerated (burned). The residual heat can be recovered by the plant (electricity generation, heating network, etc.) and some residues, such as metals, can be recovered. This practice is widespread mainly in industrialised countries.

Recycling : this consists of collecting and reusing waste to make new materials or for new uses.

The circular economy and eco-design : these refer to work that takes place before what will eventually be a waste item is created. It involves producing things in a more carefully thought-out manner, and bearing their eventual disposal in mind even before they are made.

Dumped in the sea and carried along by the currents, this plastic has accumulated in the Pacific, and covers almost

3,5 million square kilometres.

66 tonnes of the plastics dumped by human beings are ingested by marine creatures everyday

Waste recovery in Switzerland: a model to be emulated

1. General context and definitions

From the dump to the circular economy

Although disposal in waste dumps is the starting point for organised waste management throughout the world, this fundamental step has been followed by the appearance of incineration plants to deal with the various forms of pollution produced by these more or less controlled dumps. Large-scale recycling, as we know it today, emerged later. This latest step in what is regarded as the conventional approach to waste management is giving way to a new step – the circular economy. We will refer to it as «(re)injection of materials» in the value chain presented in page 47.

The circular economy is a response to the concept of a single ecological footprint (or footprint one) mentioned in the introduction. Experts in the supply of raw materials estimate that within fifty years, steel resources will be exhausted or too scarce to be exploited profitably. For the rare earths used in applications such as telecommunications and particularly mobile telephony, the timescale is around 10 years …

Towards recirculation of materials

The current economic model, based on excess consumption of resources, has to change. The transition from a way of thinking and a linear economy based on continually extracting new raw materials to one in which materials are recirculated is inevitable. This new approach that is beginning to emerge is known as the circular economy. It is based on reuse, maintenance, recycling and the reinjection of recycled materials into the manufacturing process as a new raw material.

This is nothing new. It has been happening for decades, for example at the quarry at La Claie-aux-Moines in the Vaud canton, where concrete and other products are recycled. However, this "cradle to cradle" approach is still far from being mainstream.

The circular economy is based largely on two key activities: life cycle analysis (LCA) (see page 12) and eco-design. The latter makes use of LCA and other types of analysis (behavioural, etc.).

Eco-design

Eco-design means deliberately designing goods and services to comply with the principles of sustainable development so that their environmental impact is reduced.

It involves an overall approach with multiple criteria and multiple steps. Multiple criteria, because it takes into account the impact on water, air and soil quality, on noise, and on the consumption of raw materials, energy, etc. Multiple steps, because it takes into account every stage in the life cycle of the products concerned. This approach, when used from the start, is a virtuous circle, because it enables the whole system for processing and recovering waste to be improved.

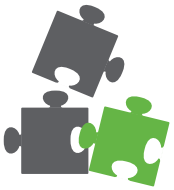
One of the most compelling examples of this is the Softcar. Designed at La Neuveville, in the Bernese Jura, by Jean-Luc Thuliez and his team of engineers, the Softcar is a proper electric city car with a biopolymer body.

Softcar

THE CIRCULAR ECONOMY IS BASED ON SIX PRINCIPAL ELEMENTS

THE MODERATE AND MOST EFFICIENT USE POSSIBLE OF NON-RENEWABLE RESOURCES

USING RENEWABLE RESOURCES WITH AN AWARENESS OF THE CONDITIONS UNDER WHICH THEY ARE RENEWED



ECO-DESIGN AND CLEAN PRODUCTION

ENVIRONMENTALLY-AWARE CONSUMPTION

RECOVERY OF WASTE MATERIALS AS RESOURCES

PROCESSING WASTE WITHOUT ADVERSE EFFECTS

Source: J.-C. LEVY, The circular economy: an environmental emergency? Presse de l'école nationale des ponts et chaussées, 2009.

The urban mine

The concept of the urban mine is derived from the same line of thinking. Nowadays, towns have actually become mines because of the waste that they produce each day. The resources contained in goods to be disposed of mean that countries without natural resources of their own are becoming potential producers.

The adaptation made by Umicore, a Belgian metal-production company formerly known as Union Minière, provides a revealing example. In tandem with its metal extraction business, it now recycles 1,000 tonnes of electronic waste per day, which makes it Europe's leading metal recycling company. From every 50,000 mobile phones that Umicore processes, it extracts a kilo of gold, 10 kilos of silver and 400 kilos of copper.

In Switzerland, incineration plants are already set up to exploit incineration residues that contain aluminium and noble metals such as palladium, gold and silver. Developments in this sector are coordinated from the Centre for sustainable management of recyclable waste and resources (ZAR) at Hinwil, in the Zurich canton.

One of the companies associated with ZAR's work, SATOM (see portrait p. 69) is continually experimenting with new processes in this field at its base in Monthey. Eldorado could soon be right on our doorstep…

1. General context and definitions

1.3 The global context

As has already been said in the introduction, huge growth in the world's population and the resultant economic activity will inevitably lead to an increase in the volume of waste.

Calculating the volume of waste worldwide is a complex exercise. This is because definitions are not necessarily the same in each country, particularly where toxic waste is concerned.

According to the 2009 World Waste Survey[1], estimates suggest (though these are difficult to produce) that the world generates between 3.4 and 4 billion tonnes of waste per year, which means that between 80 and 126 tonnes of waste are generated every second ! However, there is still considerable uncertainty concerning the figures for toxic or dangerous waste (solvents, etc.). Various studies show that the quantity of waste in the world is due to increase by 40% between 2008 and 2020, so we are already almost at the half-way point.

With this context, there is a risk of being overwhelmed by statistics that, in the end, say nothing. What does producing 100 tonnes of waste per second mean, what can we learn from that, what opportunities are hidden behind it ? This is the challenge that we intend to take up throughout this study, precisely by making these statistics say something…

The correlation between GDP and waste

There is a general assumption that the per capita quantity of waste generated may depend on the standard of living as measured by per capita gross domestic product (GDP). Again according to the World Waste Survey 2009, the causal link between GDP and the amount of waste generated is debatable. In practice, the two variables are related, because the statistics on waste generation are based on the collection of waste, and the higher the GDP, the more comprehensive the waste collection. In other words, the figures for volume track the change in GDP, but illegal dumping does not necessarily do likewise ...

Similarly, the generation of municipal waste is related to per capita GDP in two ways: firstly via the residents' standard of living and secondly by the efficiency of collection, which is itself dependent on GDP. A change in household consumption is thus an indirect measure of an increase in GDP.

The USA heads the list

The fact remains that the richer you are, the more waste you produce! Countries where incomes are high produce on average 500 kg or more of urban waste per capita per year. Unsurprisingly, the United States heads the list, with 730 kg. The most advanced emerging countries produce between 300 kg and 400 kg per capita.

The figure for China is between 200 kg and 350 kg, and for developing countries, where any data is available, and particularly in urban areas, it is around 150 kg.

Rich and poor produce different types of waste

The nature of the waste generated varies according to the level of development that a country has reached: the waste produced by rich countries cannot be compared with that produced by poor countries ! The richer a country, the more packaging and sophisticated products its waste contains. The proportion of food waste (and therefore of compostable material) therefore reduces. The paper and cardboard content can be as high as 50%, with plastic, metal and glass also making up a significant proportion. In these countries, it therefore makes sense to sort and recycle waste. In countries described as poor, compostable material still constitutes between 50% and 80% of waste[2].

34% of Europe's waste is dumped

In the European Union (EU 28) in 2012, 492 kg of urban waste was generated per capita, of which 480 kg was processed, using various methods:

- 34% was dumped,
- 24% was incinerated,
- 27% was recycled,
- 15% was composted[3].

In the EU, the proportion of municipal waste that is recycled or composted has increased significantly, from 18% in 1995 to 42% in 2012. This trend demonstrates a clear determination to reduce the environmental impact of waste, by reducing the use of landfill disposal and improving the quality of the waste processed in incinerators. It is a change that should become visible on a global scale in the next few years. The movement has begun, and its effects will be seen over several decades.

Hong-Kong's proactive policy

Hong Kong's proactive policy is a good example in this matter : in 2022, the volume of solid municipal waste is due to be reduced by 40% compared with 2013. In practice, this represents a reduction of 0.5 kg per person per day, to achieve a target of 800 grams.

The result can be seen in the drastic change in the profile of the waste management structure. At present, the city's waste is distributed approximately equally between dumps (52%) and recycling channels (48%). In 2022, dumps will represent only a quarter (22%) of waste processing, the remainder being sent to incineration plants (23%) or recycled (55%)[1].

Solutions that are appropriate to the context

In short, the many different cultures and consumption habits throughout the world means that there is a tremendous diversity in the composition of waste. A change in these habits, associated with the economic development of the areas concerned, also leads to a change in the models for waste collection and recovery which, over time, alter drastically.

Given all the points mentioned so far, and in view of the observation above concerning the cultural diversity of societies throughout the world, it is obviously necessary that the solutions used are appropriate to their context. The effectiveness of any solution, however relevant it may be in a particular country, cannot be measured without taking into account the socio-economic environment of the country or region in which it will be used.

This particular aspect is one of the keys to efficient waste recovery, which must take place in harmony with the local ecosystem concerned. This is a subject to which we will return.

2. Waste recovery in Switzerland

The principle mentioned above, whereby the greater the level of a country's economic activity, the greater the amount of waste its inhabitants produce (figure 1) is certainly true of Switzerland. This situation is hardly surprising. Its advantage is that the full range of different channels for waste processing or recovery is available to it: dumping, sorting, selective recycling and incineration. This is one of the country's attractions for organisations or regions that are interested in establishing systems for total waste management or simply for managing one particular channel.

Let's talk figures …

In 2012, the Swiss generated 5.6 million tonnes of urban waste (household, industrial and trade waste), of which around 50% was collected separately and recovered, as against 29% in 1990. This progression is significant and at the same time, it highlights the inertia of a sector that affects citizens' habits. Stimulating activity in this field inevitably means developing a legislative framework appropriate to the objectives that have been set.

The remaining waste that could not be recovered, in terms of recycling, was incinerated in plants provided for that purpose, and was therefore recovered in the form of energy. The heat produced by combustion is often used by district heating networks, or even in combined heat and power installations.

Before 2005, almost all waste was either incinerated or dumped. This shows that, despite the potential inertia of the sector, drastic changes can be made in the space of a decade.

It is easy to envisage these changes occurring more quickly in emerging societies. In such a situation, the initial setting-up of the system benefits from a significant degree of unexploited potential, enabling relatively rapid progress to be made in absolute terms. The optimisation phase will probably take longer.

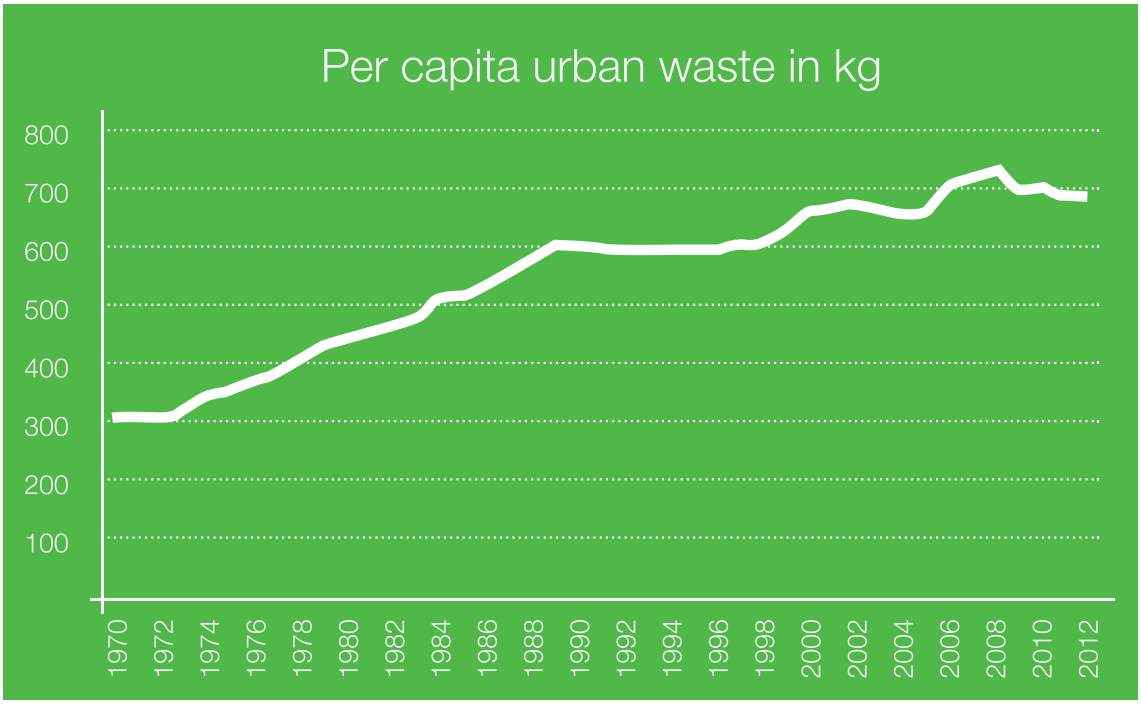


Figure 1: Per capita urban waste in kg - Source: FSO

2.1 Legislative framework

Switzerland has a comprehensive legislative framework, at federal, cantonal and municipal level.

It is based first of all on two laws: the Environmental Protection Act (EPA) and the Waters Protection Act (WPA). These are supplemented by a dozen or so ordinances, including those on waste processing (TVA), beverage containers (BCO), the prepaid charge for disposal of glass bottles for beverages, and on the return, take-back and disposal of electrical and electronic equipment (ORDEE). This legislation is complemented by some aids to compliance produced by the Federal Office for the Environment (directives, practical guides).

This study does not aim to produce an exhaustive list of the Swiss legislative framework for waste management, but a rapid overview is nevertheless useful to properly understand the legal environment required to promote waste management (see table 1).

Switzerland complies with two international conventions governing the international movement of waste considered to be hazardous. One of these is the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal (adopted in 1989), the other is the OECD decision on the control of transboundary movements of wastes destined for recovery operations (2001). These two conventions concern, in particular, chemical, medical, pharmaceutical and also nuclear waste.

Each canton also has its own legislation. Switzerland's federal system means that municipalities can legislate on particular arrangements. For instance, burning household or agricultural waste in the open air may or may not be permitted.

Abbreviation	Name
EPA (1983)	Environmental Protection Act
OAPC (1985)	Ordinance on Air Pollution Control
TVA (1990)	Technical Ordinance on Waste
WPA (1991)	Waters Protection Act
CSO (1998)	Contaminated Sites Ordinance
DüV (2001)	Ordinance on fertilisers
ORRChem (2005)	Chemical Risk Reduction Ordinance
VeVa (2005)	Ordinance on Movements of Waste
OCRCS (2008)	Ordinance on the Charge for the Remediation of Contaminated Sites
VTNP (2011)	Ordinance on the Disposal of Animal By-Products

Table 1 : The main Swiss legislations connected to waste

2. Waste recovery in Switzerland

The first stirrings of awareness in the 1970s

The Environmental Protection Act dates back to 1979, and came into force 6 years later, in 1983. The first stirrings of awareness began in the 1970s in Switzerland. The laws involved various measures, such as a reduction in the number of waste dumps and a ban on unofficial dumps.

This legislation was promulgated mainly to prevent water and air from being polluted by open-air dumps. The sorting of waste originated from the fact that it is more rational to use the minimum amount of oil (or gas) to burn waste. Nowadays, these three issues affect every country, particularly those experiencing rapid growth, such as China.

A pioneer for 40 years

It is almost 40 years since Switzerland began its pioneering activity in this field, whether in preparing the way or in developing legislation concerning a more specialised field, such as micropollutants or sewage sludge.

With the energy transition and the growing awareness that resources are finite, the time has come to capitalise on this know-how and enable the international community to benefit from it. Swiss expertise makes it possible to define a legal framework appropriate to the region concerned, then establish and implement the measures and infrastructures needed to achieve the objectives set as regards waste management.

2.2 Swiss organisation and infrastructures

The system for waste management in Switzerland is an integrated model that has changed over time. Its evolution has been governed by the successive laws and regulations produced at federal, cantonal and municipal level. In response to this comprehensive legal framework, there is an interlinked infrastructure at every level within the country, which includes:

- waste dumps (now mainly used for special or inert waste);
- incineration plants (household waste);
- plants for special processing (industrial waste);
- waste disposal or collection centres (supporting the different channels for sorting and transporting waste).

Collection centres are distributed throughout the country in accordance with population density or the degree of industrial activity. The regular distribution of these centres within the cantons tends to be the result of history (figure 2).

From the current perspective of a transition from domestic waste incineration plants (WIP) to energy-from-waste (EfW) plants (see page 8), this geographic distribution is a definite advantage when using residual heat in urban heating networks. And yet, a few years ago people were surprised at the overcapacity of these installations and at their distribution across the country. This once again highlights the fact that context is a key element in this sector – and one which applies in Switzerland as well as in foreign markets.

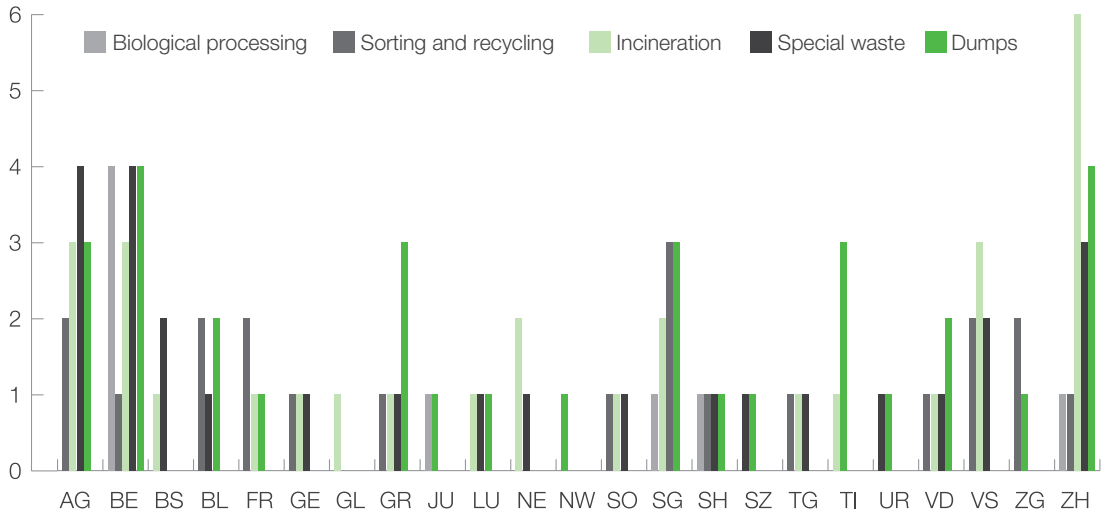


Figure 2: Distribution of plants by canton and by category

2.3 Switzerland, a nation of pioneers in environmental protection

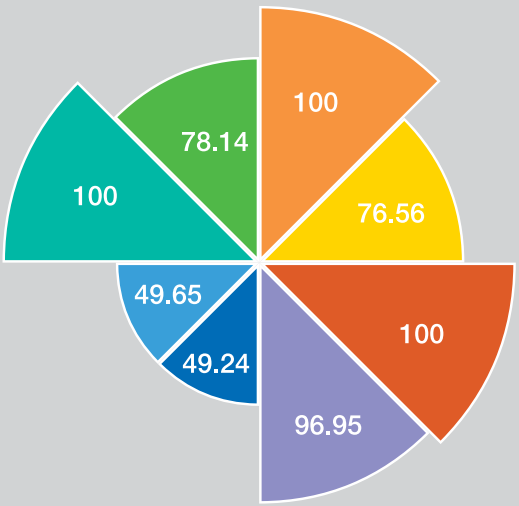
As has been said, the first law on environmental protection came into force in Switzerland, over thirty years ago now. It was the first law of its kind in Europe. Switzerland is also a pioneer in other key fields, such as green mobility, via the new railway link through the Alps (NEAT), which will enable heavy goods vehicles to cross the Alps on high-speed trains (piggybacking).

Switzerland is teeming with ideas and innovative concepts. It was the source of the 2000 watt society and car-sharing initiatives, and was among the first countries to have a fund for investment in sustainable development and clean technologies. The very concept of sustainable development was born at the Palais Wilson in Geneva, at a fringe meeting held during an international event.

In the last few years, Switzerland has occupied the leading position in the Global Competitiveness Report, which measures various factors, including the capacity to innovate. It was also ranked first in the 2014 Environmental Performance Index, ahead of Luxembourg, Australia and Singapore. This analysis is carried out jointly by the universities of Yale and Columbia, and covers 178 countries. In calculating the environmental performance index, the researchers use 20 criteria divided into 9 categories: health impacts, air quality, water and sanitation, biodiversity and habitat, water resources, agriculture, forests, fisheries, climate and energy.

Finally, there is Switzerland's performance in patents: for every million Swiss inhabitants, 330 Swiss enterprises were named in patents in 2009, as compared with 240 for Germany and 64 for the United States. Between 2010 and 2011[1], it recorded a 25% increase in patents filed in the clean technologies field, and particularly the environment.

Environmental Performance Index: the profile of Switzerland



Maximal mark by criterion: 100
Switzerland's average mark: 87.67
Rank number 1 of 178 countries

- Health impacts
- Air quality
- Water and sanitation
- Water resources
- Agriculture
- Forests
- Biodiversity and habitat
- Climate and energy

Source: Environmental Performance Index 2014

2. Waste recovery in Switzerland

2.4 Recycling in Switzerland – some figures

Switzerland currently generates over 1.6 million tonnes of household waste each year, which is 8% mor e than it produced just ten years ago[1]. It has been stated that a high level of economic activity is synonymous with the generation of large amounts of waste. However, this has to be seen in perspective. This increase is not all transferred to the ecosystem, given the high rate of recycling.

It has even been said that the Swiss are the world champions in the recycling of glass and PET bottles, and also aluminium cans. In 2012, the recovery rate reached 94% for glass, 92% for aluminium cans, and 81% for PET[2]. Switzerland also has high rates of recycling for other materials, particularly paper and cardboard (97%), tin plate (86%) and batteries (73%).

Nationally, the waste processing rate stands at 98%, and over 90% of solid municipal waste is incinerated.

Swiss waste bins still have some potential

It has been shown that Switzerland boasts some impressive recycling rates, in comparison with other nations. However, it could do even better. Since 1982[3], the authorities have been analysing the composition of waste, to improve the situation and make some relevant observations. The most recent study dates from 2012 and concerns the contents of 16.5 tonnes of domestic waste bags from 33 municipalities. The results show that 20% of Swiss household waste consists of recoverable materials. This corresponds to around 340,000 tonnes annually. Two-thirds of this unused material is organic waste, in other words, waste that could be composted or turned into methane (see figure 3).

2.5 Segmentation and channels

Waste is, of course, a huge subject and there are many analysis criteria. For the sake of consistency with earlier studies, we have chosen to map the Swiss ecosystem as regards waste in accordance with the segmentation proposed by the Federal Office for the Environment (FOEN) in its 2008 report on waste management.

The first step in the waste management value chain (after the generation of the waste itself, of course) is collection, followed by selective sorting and the different processing steps (figure 7, page 47).

Businesses have been analysed according to their activities along the length of this value chain, for each of the following channels:

- Wood (wood industry, old wood, construction site or household waste)
- Paper and cardboard
- Biomass (plant material produced by agriculture and gardening)
- Biodegradable household waste (products originating from the collection of sorted urban household waste, food waste)
- Organic matter requiring special processing (sludges, effluent or processing residues)
- Glass
- Waste from electronic products (PCs, mobile phones, etc.)
- Textiles
- PET (mainly bottles)
- Metal waste containing iron
- Aluminium
- Batteries
- Tyres
- Special waste, requiring specific processing (soil, polluted sludges, chemical residues etc.)
- Plastics
- Site waste (from construction and civil engineering).

High recycling rates can be achieved through the way in which the sector is structured and the dynamics between the different players involved. Analysis of the sector has highlighted the fact that Switzerland possesses organised channels for sorting and recovery in the following fields, listed below in size order, in terms of the number of players involved.

- **Biomass**: this channel includes businesses involved in waste recovery (anaerobic digestion, biofuels);

- **Wood**: this covers businesses that package and supply pellets for heating;

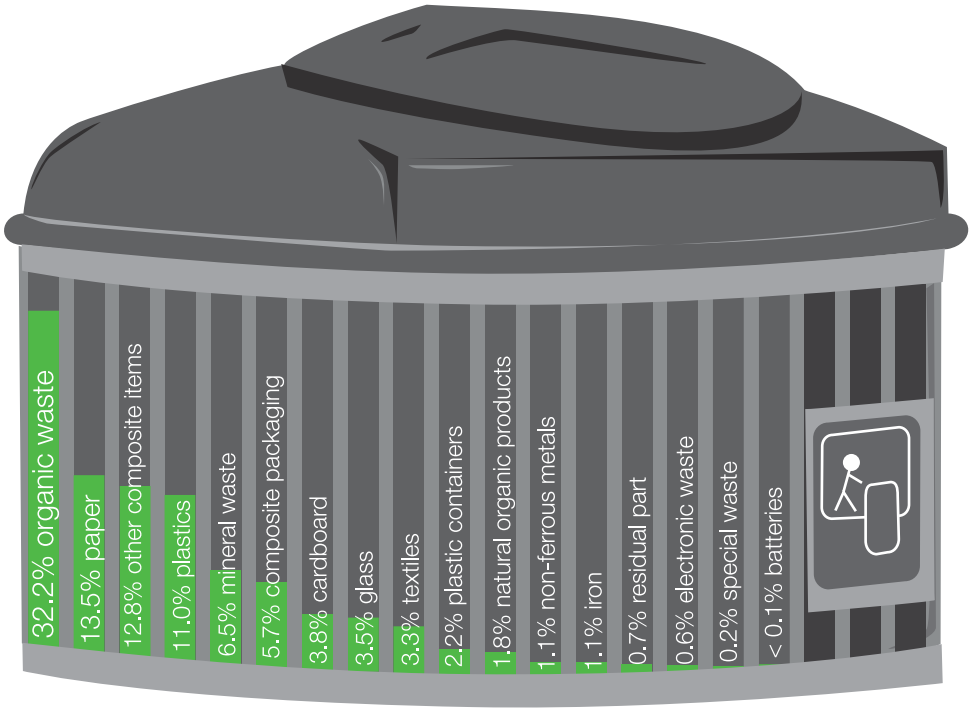


Figure 3: The content of a Swiss waste bin (source: FOEN)

2. Waste recovery in Switzerland

Distribution of « collection and sorting » businesses

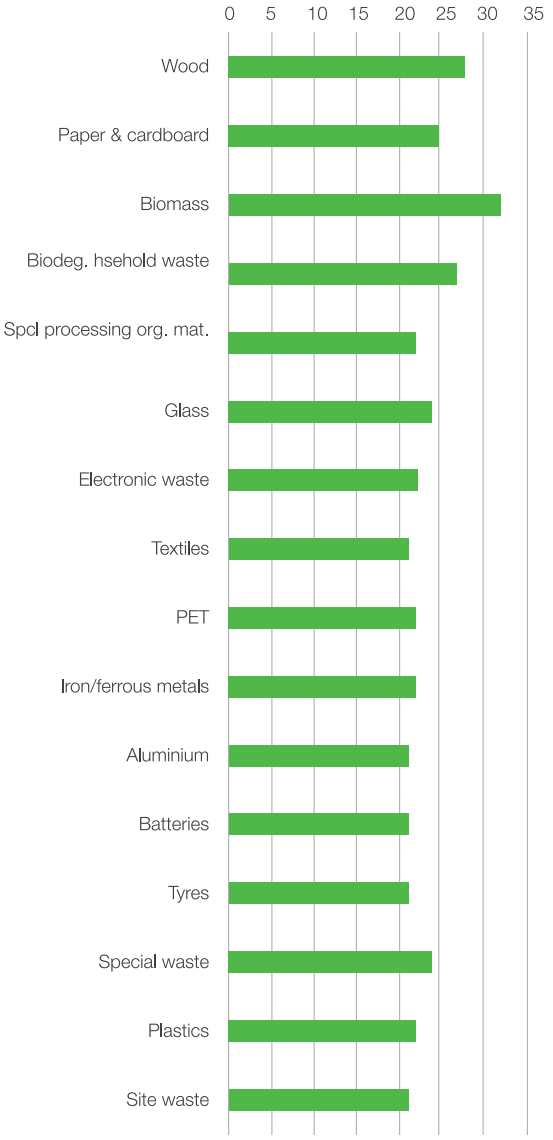


Figure 4 : Distribution of « colection and sorting » businesses (source : H3oC)

- **Special waste** : this channel brings together a large number of businesses, covering consultancy on the one hand and the development of storage and/or processing methods on the other ;

- **Biodegradable household waste** : this sector includes businesses specialising in consultancy and recovery technologies ;

- **Organic matter requiring special processing** (sludges, effluent or processing residues), **electronics, metal, aluminium and plastics** : these channels have a fairly similar profile, indicating that there are a few leading companies which specialise in processing in their particular segment ;

- **Other** (glass, textiles, PET, batteries, tyres, etc.) : the small number of businesses operating in this field tends to show that these are « mature » channels consisting mainly of big players.

The breakdown of the businesses involved in collection and sorting (see figure 4) shows, in particular, that these activities are mainly performed by large processing units.

It will be recalled that the 4 main categories alone (wood, paper and cardboard, biomass, biodegradable household waste) make up 93% of the waste processed in Switzerland (FOEN 2008).

Recycling channels : organisations and funding

The portrait would not be complete without a brief look at the organisational and financial aspect of the main recycling channels. These have a source of funding and a body that manages waste collection and the sources of income. The table 2 gives the main details.

We will now go on to provide a portrait of the main recycling channels and their features. These channels are very well documented by the bodies responsible for managing them. This study does not aim to be exhaustive, but rather to shed some light on their objectives and their potential impacts, and will conclude with some real-life examples.

Table 2: general organisation of the main sectors of recycling in Switzerland (source: FOEN)

Recyclable material	Name of reference organisation	Brief description	Financing of collection and processing
Batteries	INOBAT - Organisation d'intérêt pour l'élimination des piles, www.inobat.ch	Organises collection and recycling of batteries and accumulators for the Swiss Confederation, collects the PDF	PDF ranges from 5 centimes to CHF 2.30 for the most common batteries
Glass	VetroSwiss www.vetroswiss.ch	Collects the PDF on glass bottles on behalf of the Confederation and redistributes it to those receiving allowances	PDF is 2 centimes for bottles 0.09-0.33 litre, 4 centimes for bottles 0.33-0.6 litre, 6 centimes for bottles over 0.6 litre
Aluminium cans, trays and tubes	IGORA - Aluminium recycling cooperative www.igora.ch	Organises collection and processing of aluminium cans, trays and tubes for the trade (producers and retailers)	ARF of 1 centime per can, tube and tray
Domestic	SENS Foundation www.sens.ch	Organises collection and recycling of domestic electrical equipment and also the electronic components of DIY, gardening and leisure equipment, toys, light fittings and light bulbs for the trade	ARF of 50 centimes (items under 5 kg) to CHF 18 (up to 140 kg). Refrigerators: from CHF 9 (under 5 kg) to CHF 60 (over 250 kg)
Office equipment, leisure electronics	SWICO - Swiss Economic Association for the Suppliers of Information, Communication and Organisational Technology www.swico.ch	Organises collection and recycling within the fields of office equipment and leisure electronics, for the trade	Electronic toys: 50 centimes / ARF ranging from 7 centimes (small items such as iPods) to CHF 20 (large-screen TVs). Other rates for businesses.
Light fittings and light bulbs	SLRS - Swiss Lighting Recycling Foundation www.slrs.ch	Collects the ARF on light fittings and light bulbs (fluorescent tubes, energy-saving light bulbs) for the trade, organises collection and recycling	ARF ranging from CHF 1 to CHF 15 for light fittings and 50 centimes for each light bulb
Cans	Ferro Recycling - Association for promoting the recycling of tinplate cans www.ferro.ch	Organises collection of cans for the trade	ARF of 1 centime (up to 1.5 litre) or 2 centimes (large containers up to 5 litres)
PET	Association PET-Recycling Schweiz (PRS) www.prs.ch	Organises the collection of PET bottles for the beverages trade	ARF of 1.8 centimes for each PET bottle
Plastiques	Swiss Plastics www.swissplastics.ch	A federation of producers	No tax
Tyres	No federating body. Specialist enterprises		No tax
Metal, cardboard and paper	VSMR - Swiss association for iron, metal and paper recycling	Federation of 150 enterprises, organises collection and recycling	No tax

ARF = Advance recycling fee PDF = Prepaid disposal fee

2. Waste recovery in Switzerland

2.5.1 The batteries channel

Of the 3,700 tonnes of batteries and accumulators sold each year in Switzerland, almost two-thirds are returned and enter the recycling system. A third of them still disappear into household waste. INOBAT has been appointed by the FOEN to collect, manage and use the prepaid disposal fee (PDF), which Swiss consumers pay when they buy batteries and accumulators. Almost 130 manufacturing, import and retail organisations are affiliated to INOBAT.

A target collection rate of 80%

INOBAT's initial objective is to raise the present collection rate for used batteries from 72.9% (as at 31.12.2012) to 80%, the target set by the FOEN.

Used batteries and accumulators go to the Batrec AG recycling plant at Wimmis (see portrait p. 60), where they are taken apart and broken down chemically in a multi-stage process. The metals recovered in this way, particularly zinc and ferromanganese, are sold as raw materials for reuse in industry. The recovery of these materials does not just prevent pollution by heavy metals, but is also significant in view of the exhaustion of natural resources. It is said that in ten years' time, 26 of the 88 elements in the periodic table will be unavailable…

One interesting development is the Aquacell battery, launched in Geneva at the end of 2013 by the company Green Power System European Distribution SA and activated by soaking it in water. This eco-friendly battery does not contain any heavy metals and 85% of its materials can be recycled. When the battery leaves the factory, it is inactive, and the user has to activate it by plunging it in water for five minutes.

What is obtained from 1000 kilos of used batteries[1] ?

50-100 kg of organic materials (plastic, paper, wax)
50-100 kg of charcoal
→ Energy used in pyrolysis

50-100 kg water
50-100 kg salts
→ Taken to a water treatment installation

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230 kg of ferromanganese (iron, manganese)
230 kg of zinc (98.5% pure)
0.9 kg of mercury (99.995% pure)
→ Used in industry

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80 kg of slag
→ Used in road construction

Did you know ?

- Switzerland has no less than 12,000 battery collection points.
- Each year, 20 billion batteries are used worldwide.

2.5.2 The glass channel

Used glass is not waste, but a raw material! It is a natural, high-value packaging material made up of quarry sand, lime and soda. It can be melted down ad infinitum and the quality of the recycled glass is the same as that of new bottles made from primary raw materials. Recycled glass is used not only to produce new packaging for beverages or foodstuffs, but also as a raw material in the production of high-value construction materials.

In Switzerland, two-thirds of the waste glass that is collected is used and processed entirely as a raw material by the glass industry[1]. The remaining third is used for other purposes, being either transformed into filler aggregate for stabilising roads, filling embankments and raising the height of river banks, or into an insulation material for the construction industry.

The municipalities are responsible

Since January 2002, the manufacturers and importers of glass bottles have been obliged to pay a prepaid disposal fee (PDF) which ranges from 2 to 6 centimes depending on the size of the bottle. The money paid is then returned to the municipalities, special-purpose associations and other organisations responsible for collecting used glass. The PDF thus enables the cost of collecting the used glass to be covered. This tax is included in the sale price.

The right business model …

In Switzerland, it is the municipalities that are responsible for recycling glass: they manage the collection points and organise the transport of the used glass from the container to the receiving organisation. The municipalities do not earn very much from selling used glass - quite the contrary, they must often even make an additional payment to the receiving organisation so that it will take the used glass. This is because, in the last few years, the costs related to the processing of used glass have continually increased, whereas the cost of the raw materials used in the manufacture of glass has fallen steeply. This situation underlines the importance of using an appropriate business model to ensure that a channel is successful, and regulatory intervention can form part of this. Waste management is no exception, and the optimum solution requires compromises that depend on the objective to be achieved.

A loss-making activity

This is why, in many municipalities, collecting glass has become a loss-making activity. With the prepaid recycling fee, it is now the responsibility of those who are actually the source of the waste to pay these costs. This principle, according to which the manufacturers or purchasers of packaging and goods that afterwards become waste are also responsible for the disposal of that waste, is embedded in the Environmental Protection Act. This is why the prepaid disposal fee is also levied on PET bottles and aluminium cans.

As far as glass is concerned, it has been impossible to find a solution within the trade. For this reason, the Federal Council has ordered that the prepaid disposal fee should be levied on glass bottles. The Federal Office for the Environment (FOEN) has appointed the organisation VetroSwiss to collect the PDF and give it to those entitled to it.

Did you know ?

- Glass is 100% recyclable and can be recycled an infinite number of times.
- It takes three or four millennia to break down naturally.
- Producing «new» glass from recycled glass requires far less energy: one tonne of recycled glass saves ½ tonne of CO_2[1].
- Melting down pieces of used glass requires 25% less energy than the use of primary raw materials.
- Recycled glass is a valuable resource that is used in the manufacture of high-value materials for the construction industry[2].

1 Source: www.consoglobe.com

2 Source: Vetroswiss

2. Waste recovery in Switzerland

2.5.3 The electronic equipment and electrical appliances channel

For the last twenty years or so, three organisations have been responsible for collecting, recycling and disposing of electrical and electronic equipment with a view to saving resources: Swico Recycling (for computer hardware, see portrait p. 71), the SENS Foundation (for electrical equipment) and SLRS (light bulbs and light fittings). The increase in the quantities collected testifies to the success of their systems.

In Switzerland in 2012, over 60,000 tonnes of used equipment from the IT, consumer electronics and telecommunications sectors were collected for recycling. It is essential to provide a high-quality recycling system so that this equipment can be disposed of in an environmentally friendly manner. With a return rate of approximately 90%, Switzerland is the leader in recycling electronic equipment.

The activities of Réalise at Les Acacias, in Geneva, are worth noting. This company specialises in second-hand IT equipment, and has been selling a selection of superior-quality business-level PCs for almost 15 years. After the data has been wiped, the computers are serviced and subjected to stringent quality tests before being resold on the retail market. Defective or obsolete equipment is recycled by Swico Recycling.

From 2016, EU member states will have to collect 45 tonnes of electrical and electronic waste for every 100 tonnes of such goods placed on the market. The requirements will become even more strict in 2019, with the obligatory collection figure rising to 65 tonnes

Switzerland is several steps ahead

If the actual results of the recovery systems are taken into consideration, Switzerland is several steps ahead of most EU countries, having achieved a collection rate well above 75% in 2012. It has a network of thousands of collection centres, making it easy for people to bring their used equipment and consumables for recycling.

One interesting company is Ecoink in Geneva, which recycles laser and inkjet cartridges and places them on the market again. It has appropriate facilities for recovering these cartridges, so that it can ensure that their quality and print capacity match those of the original consumables. This is a good example of the circular economy.

Did you know ?

- 1 tonne of mobile phones contains 3.5 kg of silver, 340 g of gold, 140 g of palladium and 130 kg of copper[1].
- In the European Union, 190 million ink and toner cartridges are emptied each year, in other words, 6 cartridges per second, creating 60,000 tonnes of waste.
- It takes 3.5 litres of oil to produce a toner cartridge and 0.9 litre for an ink cartridge.
- A cartridge that is dumped takes 1000 years to decompose.
- Each year, over a billion ink cartridges are sold worldwide which, placed end-to-end, would be 129 times the length of the Great Wall of China.

1 Source: Econocom

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2. Waste recovery in Switzerland

2.5.4 The aluminium channel

In Switzerland, the IGORA cooperative in Zurich is responsible for collecting and recycling used aluminium packaging. It has achieved a remarkable success rate: already, 90% of cans, 80% of pet food containers and over 50% of tubes and coffee capsules are recycled.

Did you know[1] ?

- Using a kilogram of recycled aluminium saves 9 kg of CO_2 emissions.
- Four to five tonnes of bauxite are needed to produce a tonne of aluminium, so a tonne of recycled aluminium saves 4 tonnes of bauxite.
- In 2012, the Swiss recycled 10,000 tonnes of aluminium packaging, which is about 1.5 kg per person.
- A used aluminium can is recycled and returned to a shop as a new can in just under 60 days.
- Recycling just one can saves as much energy as a television uses in 3 hours.
- If an aluminium can is not recycled, it will persist in the environment for another 500 years.
- The motor industry is the largest market for the aluminium industry. Nowadays, each new car contains an average of 90 kg of aluminium; in 1955, this figure was 19.3 kg.

1 Source: IGORA www.igora.ch

2.5.5 The metals channel

«Switzerland has a wealth of primary raw materials - in secondary raw materials !» This quotation from Toni Brunner, president of VSMR, the Swiss association for iron, metal and paper recycling, gives a good illustration of the issue for Switzerland, particularly as regards metal recycling. In Switzerland, VSMR's member companies process over 1.5 million tonnes of scrap metal annually. Consumers take 86% of the cans sold in Switzerland to collection containers. This is well above the world average.

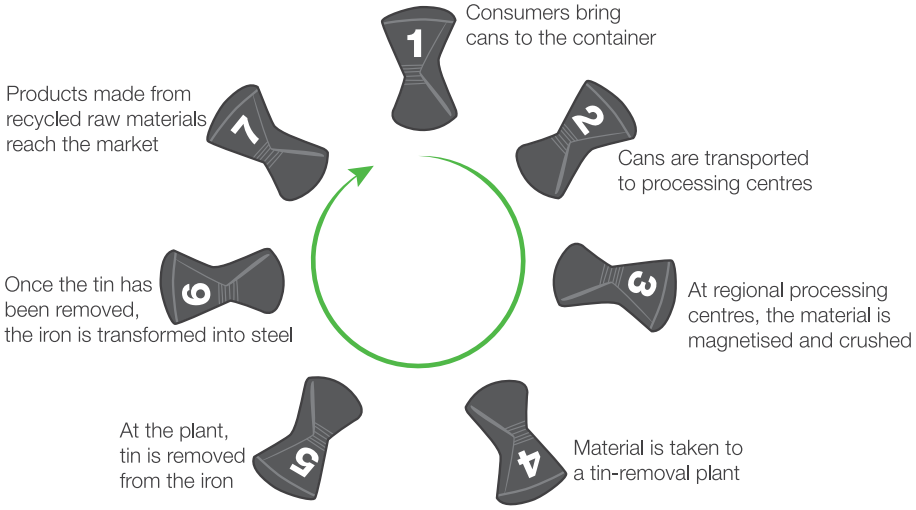
Metal waste can be recycled back into the economy indefinitely, with little loss of material. This means that adverse effects on the environment and health, related to the extraction and processing of ores, can be reduced.

The system for recovering metal

The recycling of used cans and other steel packaging enables high-quality steel to be recovered. The cans are crushed at one Switzerland's 22 processing centres, and then the steel either goes to a plant where the tin is extracted, or is sent directly to steel mills in other countries.

All the other metals are collected together as scrap metal, which is crushed and separated into iron and non-ferrous metal. The iron is taken to a steel mill or foundry, such as Stahl Gerlafingen AG in Soleure, where it is melted down and transformed into semi-finished products such as concrete reinforcing bars. After processing, the non-ferrous products are sold to a specialist metal works, which turns them into new products.

The recycling of cans made of tinplate



Source: Ferro Recycling

Did you know ?

› Producing steel from scrap iron requires 60% less energy than producing it from iron ore. This means that air pollution is reduced by 30%.

2. Waste recovery in Switzerland

2.5.6 The PET channel

PET (polyethylene terephthalate) is a synthetic material belonging to the polyester group and is made from crude oil. Compared with the disposal of PET bottles in a domestic waste bag (which means the production of new PET), recycling PET reduces all the effects on the environment by more than 50%.

In Switzerland, the organisation PET-Recycling Schweiz (PRS), founded in 1990, has dealt with the collection of PET bottles since the Beverage Containers Ordinance (BCO) came into force. It provides a PET bottle collection network that covers the whole of Switzerland and brings together 98% of Swiss beverage producers, importers, bottlers and wholesalers.

Until 2003, Serbeco SA in Geneva was the only company in western Switzerland that sorted and compacted PET. Since then, a fully-automated regional sorting centre has been brought into service at Roche, in the Vaud canton, to receive the PET collected from all the cantons in western Switzerland. For the Geneva area, Serbeco SA is still the only company authorised to collect and pack PET. It collects 1200 tonnes of the material each year, which is compacted into multi-coloured balls of 45,000 bottles then transported to Roche, where it is sorted by colour.

Nowadays, eight out of ten beverages are sold in plastic bottles. PET is lighter than glass and more environmentally-friendly than PVC or aluminium cans. To minimise its environmental impact, the packaging has to be collected, sorted and recycled.

The recycling rate in Switzerland reached 81% in 2012, exceeding the minimum rate of 75% required by the Beverage Containers Ordinance. Given that the total number of PET bottles in circulation is 1.5 billion, a recovery rate of 81% represents 37,571 tonnes of recycled PET, and therefore a major logistical effort as well.

The Swiss recycling rate is high in comparison with that of other countries. Although PET is the most commonly-recycled plastic in the USA, only 31% of it is recovered. The rate in the European Union[1] is 52%.

Did you know ?

- In Switzerland, the recycling of PET alone saved 36 million litres of oil in 2013[1]. This is enough to heat every house in the Appenzell Rhodes-Extérieures canton for a year.
- For every kilogram of PET that is recycled, Switzerland prevents the emission of more than 3 kilograms of greenhouse gases, because PET is 100% recyclable. In 2010, recycling PET therefore prevented the emission of 139,000 tonnes of greenhouse gases (mainly CO_2), which is the amount produced annually by all the cars in the Schaffhouse[2] canton.
- The manufacture of new goods using recycled PET represents a 50% energy saving.
- Five PET bottles produce enough fibres to produce an XL T-shirt or enough insulating material to fill a snow suit[3].

1 Source: RTS Info

2 Source: Petrecycling
3 Source: Petcore

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2. Waste recovery in Switzerland

2.5.7 The plastics channel

In Europe at the end of 2012, 26.3% of plastics were recycled, 35.6% were used to produce energy and 38.1% were still disposed of or at a dump[1].

The situation in Switzerland is somewhat different from that in Europe. It recycles around 25% of plastics. Of this 25%, a quarter undergoes «mechanical recycling», whereby the waste is transformed into new plastic products. There is some potential for improvement here, in comparison with PET bottles in particular, 90% of which are collected and recycled into new bottles.

The remainder (i.e. 75%) of the plastic waste that is recycled is incinerated. Both methods have a similar environmental impact, because incineration enables energy to be produced. The Swiss Plastics organisation, a federation of 830 plastics producers, is nevertheless looking for solutions to improve the recycling rate. One such solution could be eco-design, which means manufacturing products that contain a minimum of different materials, so that they are easier to recycle. This channel has yet to find the optimum balance between recycling and recovery of heat, given the diversity of the plastics on the market. The graph below gives a clear illustration of this sector's potential in Europe.

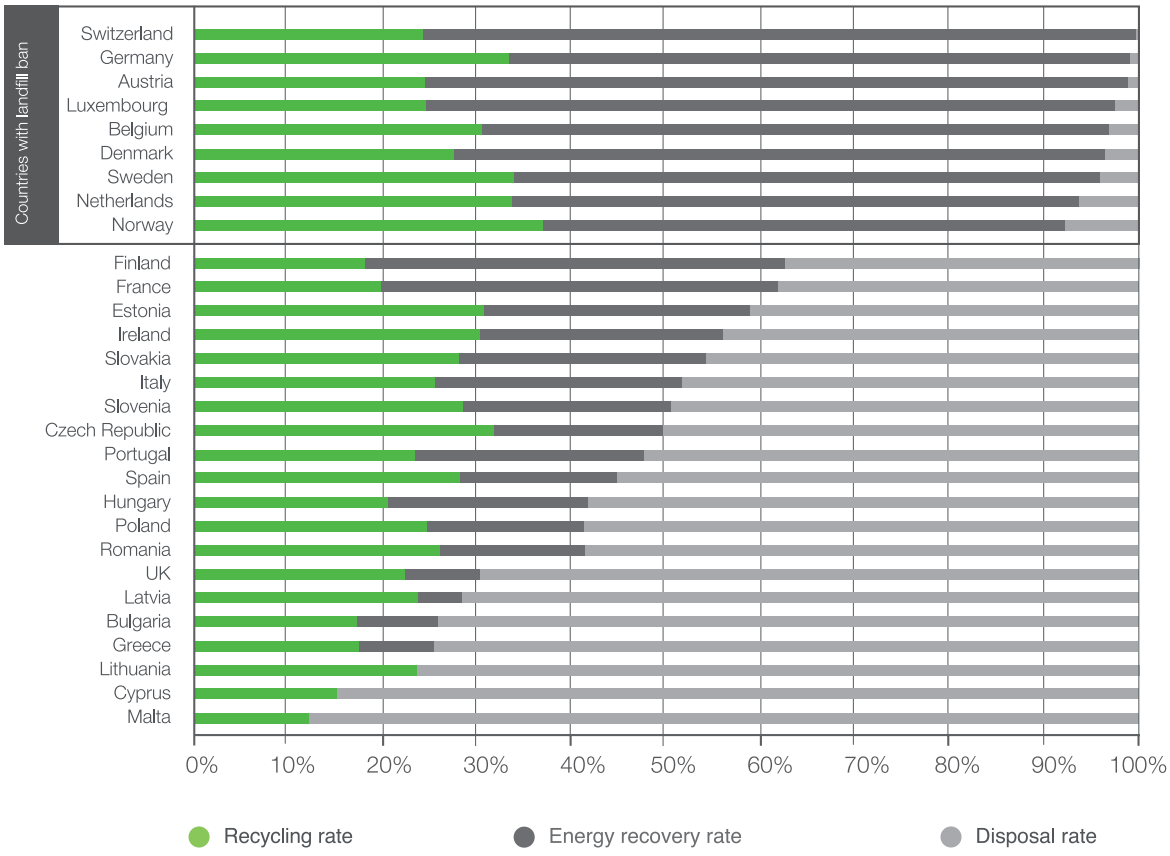
In this channel, Switzerland once again sets an example when compared with other European countries (see figure 5). The amount of plastic materials sent to landfill is insignificant (because it is prohibited). The recycling rate is no higher than in the other countries. On the other hand, the energy recovery rate is above average[2].

Le saviez-vous ?

- One tonne of recycled plastic saves 800 kilos of crude oil[1].
- Recycled plastic is used to produce a multitude of items used in daily life, such as synthetic fabrics, sleeping bags, and even shampoo bottles and packaging for chocolate.
- In Switzerland, almost 3,000 tonnes of plastic bags are used in transporting or packaging food products of the company BioApply (see portrait on p. 62), which offers an alternative to the traditional plastic bag.
- In 2010, Switzerland used around a million tonnes of plastics, or 125 kg per person. A third of this consists of packaging and a quarter of construction materials.

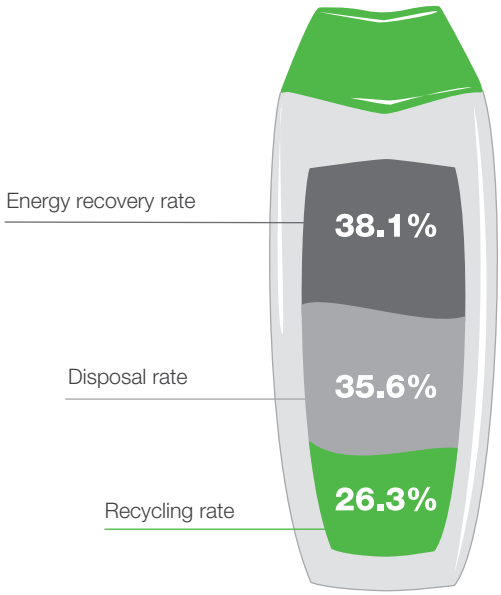
1 Source: Recycleurs de Genève

Figure 5 : The hurdle to resource efficiency



Source : PlasticsEurope

Figure 6 : Use of plastic waste, on European average



Source : Consultic

2. Waste recovery in Switzerland

2.5.8 The tyres channel

Every year in Switzerland, about 60,000 tonnes of new tyres arrive on the market and almost 30,000 tonnes of tyres have to be disposed of or recycled, which generates a large amount of waste.

Tyres consist essentially of rubber, carbon black and silica, plus steel and textiles. They also contain additives, including zinc, lead and sulphur. It is these additives in particular that are extremely hazardous to the environment if they are not stored or disposed of in accordance with accepted good practice.

Used tyres can be returned to garages or traders specialising in the sale of new or used tyres. These traders are obliged to send such tyres to accredited disposal companies.

At the moment, there is no clearly-defined system in Switzerland for recovering or recycling tyres, apart from cement works such as Holcim at Eclépens, which uses tyres as fuel because of their high calorific value. However, several pilot projects are being considered. Overall, a tyre is not a difficult product to recycle, despite its composition. Recycling can be performed by[1]:

- **grinding**: this involves shredding the tyres to transform them into granulate or powder. These granulates are used as ballast in railway construction, for bullet-proof screens at shooting ranges, noise protection walls, floor coverings, insulation material, control panels and pipes. The powder is used in the manufacture of new tyres, road construction, latex-based adhesives, and additives for sealing materials.

- **incineration**: the principle is to use the tyre as a combustible product in household waste incinerators.

- **pyrolysis**: the tyres are broken down under the effect of heat, in a low-oxygen environment. The combustible product is used in cement works and the carbon black that is recovered is used in rubber, paints, plastics and toners.

- **other thermal processes**: finely-ground rubber is liquefied and hydrated at high pressure and high temperature. This produces a synthetic oil that has the same properties as a petroleum-derived product. It is used as a fuel (in the production of kerosene, for example). Another process involves gasifying the used tyres in a low-oxygen, high-temperature environment. This produces a synthetic gas, used as a fuel.

- **retreading**: the idea is to mould a new tread onto a used carcass. This process is identical to that used for new tyres. This is currently the method that obtains most value from the tyre.

- **exporting**: used tyres can be exported in their existing state for reuse.

Did you know ?

- At present, over 10,000 tonnes of tyres (i.e. 20%) are dumped illegally in Switzerland[1].
- Manufacturing a new tyre requires about 35 litres of oil.
- When a tyre is described as worn, 85% of its weight is still in perfect condition. It requires 5.5 litres of oil to retread the 15% that is worn.

1 Source: Union professionnelle suisse de l'automobile [Swiss professional motor federation

2.5.9 The cardboard and paper channel

Paper has a very high impact on the environment. Its manufacture involves felling large areas of forest. The paper industry is known as being one of the five most energy-consuming industries in the world, and it also uses and degrades large quantities of water.

VSMR, the Swiss association for iron, metal and paper recycling, manages the paper and cardboard channel in Switzerland. Its member organisations process over 1.3 million tonnes of scrap paper annually.

At the moment, recycling appears to be more economical than incineration. However, the market is constantly changing and, as in the plastics sector, the optimum balance must continually be sought. As in the energy mix, choices have to be made in accordance with the main criterion (CO_2, environmental footprint, calorific value, etc.).

Over 900,000 tonnes of scrap paper are recovered and recycled every year in Switzerland. Scrap paper is most often used to produce corrugated paper, cardboard boxes, lavatory paper, paper towels and newspaper.

During the last few years, scrap paper collection has continued to reach record levels. Switzerland achieved a recovery rate of 97% in 2012. In the European Union, this rate has risen to 71.7%[1]. In France, the paper recycling rate reached 49% in 2013 (+2% compared with 2012)[2], lagging behind that of other European countries, particularly Germany (75%), the United Kingdom (69%) and Spain (64%).

Did you know ?

- In Switzerland, if the paper collected was not used as a raw material, it would be necessary to build 10 additional incineration plants, with a capacity of over a million tonnes per year !
- Every day, the Geneva canton produces 250 tonnes of paper waste, which if piled up, would be 5 times the height of Mont Salève[1].
- In 2012, every Swiss person collected 166 kg of scrap paper[2].
- Newspapers in Switzerland contain over 80% recycled paper.

1 Source: Geneva canton

2 Source: Verein Recycling Papier + Karton

2. Waste recovery in Switzerland

2.5.10 The biomass channel

This channel includes wood and could be the subject of a separate study in itself. We have chosen to present only an outline here, introducing the different technologies and concluding with a few examples of particularly interesting installations. It is this channel that makes the link with energy. We will come back to this subject in a later study.

Orange peel, garden waste and manure have at least one thing in common: they contain energy ! This energy can be used in the form of heat, electricity and fuel. From this point of view, biomass clearly has a part to play in the energy supply of the future.

On a global scale, biomass represents a vital renewable resource, particularly where it takes the form of foodstuffs whose residues can be recycled. It is also very important as a constituent of and raw material for everyday products, and as a source of energy. In Switzerland and other countries, the production, transformation and use of biomass makes a substantial contribution to the national economy.

A strategy and eight national objectives

Switzerland has considerable potential for biomass production, but because of its high population density, the limited percentage of productive ground and the mountainous topography, production cannot be increased ad infinitum. The multiplicity of possible uses for biomass, combined with the limited potential, brings the risk of a conflict of use. We therefore need to consider what is the most appropriate way to produce and use biomass in Switzerland, taking the socio-ethical, ecological and economic aspects into consideration. In 2010, with these observations in mind, the Swiss Federal Office of Energy (SFOE) published its strategy on the subject, with eight clear strategic objectives.

This strategy represents a decisive step towards responsible management of biomass. It provides a starting-point for a wider debate, and gives some impetus to the development of practical solutions. The Federal Offices and the cantons can draw inspiration from it in developing the various sectoral policies (energy, agriculture, spatial development, environment, etc.).

The channel is coordinated by the organisation Biomasse Suisse, which was created in 2011 by a merger between the Biogas Forum and BiomassEnergie. Chaired by Dominique de Buman, a member of the Swiss National Council, it brings together the main players within the field (constructors and operators of installations, energy distributors).

Biomass energy can be produced from different raw materials. Besides organic waste, high-energy plants can be considered provided that they are not grown for that purpose and do not compete with food production. The diversity of the raw materials allows plenty of possibilities for producing energy[1]:

- **Biogas**: produced by anaerobic digestion of non-woody biomass. The most appropriate organic wastes are household waste, food waste from the catering trade or farmyard manure and agricultural crop residues. Waste cooking oil and high-energy plants are also used. The biogas that is produced can be used either in a combined heat and power system, producing electricity and heat simultaneously, or, after conditioning, as a substitute for natural gas and as a fuel.

  There are many operational installations, and it is possible to arrange guided tours of sites operated by some of the most active players in this field, such as Biogaz Mandement at Satigny, Ecorecyclage at Lavigny (Groupe Holdigaz) or SATOM, whose Villeneuve site accommodates a large-scale digester connected to a district heating plant (Groupe E).

- **Biodiesel**: produced from oily biomass such as rapeseed, algae or animal fats. The fuel made in this way can be used in vehicles, either mixed with ordinary diesel, or in its pure state. For example, Eco Energie Etoy offers rapeseed-based biodiesel.

- **Bioethanol**: produced from starchy biomass such as cereals or maize. New processes are being developed to ensure that it is sustainable, with a view to producing ethanol from cereal waste, straw, or woodworking by-products. This fuel can be used in a mixture with ordinary fuel, provided that the vehicle's engine undergoes a few adaptations. Various second-generation (or even third-generation) pilot projects are under discussion.

Did you know ?

- In 2012, biomass accounted for between 4% and 6% of Switzerland's energy production[1].
- In Switzerland, biomass is the second renewable source of energy used for electricity generation after hydropower.
- Biomass installations (biogas and heating with wood) generated almost 511 million kilowatt hours (kWh) in 2012, which represents 0.75% of the country's total electricity production.
- According to forecasts from the SFOE, the generation of electricity from biomass could be increased by a further 250 to 400 million kWh by 2050.
- Biomass could eventually meet 5% of Switzerland's heating requirements and 4.5% of its electricity requirements.

1 Swiss overall energy statistics, SFOE (2012)

2. Waste recovery in Switzerland

2.5.11 The site waste channel

This channel concerns the different materials used in construction and civil engineering, from the tar used on roads to the complex materials found in residential structures. It also includes excavated material and rubble (gravel pits, quarries).

In Switzerland, 10 million tonnes of such waste is generated each year, 80% of which is recycled.

With the constant increase in adjuvants and additives in construction materials, recycling is becoming more difficult, but the presence of these compounds means that they have to be destroyed so that waste dumps are not polluted. In future, project owners will have to carry out more detailed analyses to detect these substances and dispose of waste that contains them.

Laboratories with special expertise in analysis methods (Eawag, Empa, ETHZ, EPFL, universities of applied sciences) are continually improving them. These laboratories receive support from the FOEN and also the Federal Roads Office (FEDRO), particularly as regards waste related to road construction.

Recycling of insulation materials

Companies like Swisspor, particularly its Châtel St-Denis site, are at the forefront in the recycling of insulation materials, such as bitumen strips, which are collected and reused in manufacturing (see portrait p. 72). This is by no means an easy exercise, because of the traceability of the material and of the additives that it may contain.

As part of this, a global concept of life cycle analysis, environmental impact and management of materials cycles is required. Institutes forming part of the HES-SO, such as the HEIG-VD, possess expertise in the subject. Companies such as the recycling and sustainability research bureau BIRD (Bureau d'investigation sur le recyclage et la durabilité) in Prilly, Quantis in Lausanne, and SOFIES in Geneva are able to conduct life cycle analyses and, where necessary, provide tailored support.

Recycled concrete

The recycling of concrete has really taken off, thanks to a pioneer in this field, La Gravière de la Claie-aux-Moines (GCM) at Savigny. In 2007, it began producing recycled concrete rated as suitable for load-bearing structures. This product enables the proportion of natural gravel used to be reduced by 40%, and at the same time reduces the amount of demolition materials that have to be stored by 40%.

GCM has been offering recycled construction materials for the last 30 years. There is also a not insignificant financial advantage because, for instance, non-structural recycled concrete is approximately CHF 30 cheaper than standard concrete.

This is a good example of know-how that may be of interest to public bodies in emerging countries.

2.5.12 The wood – energy channel

Each year, Switzerland consumes the equivalent of 10.5 million cubic metres of wood. A quarter is used in wood products (structures and furniture), 28% in paper and cardboard (hence the importance of the reprocessing channel – see 2.5.9) and 47% in producing energy (this includes recovered wood).

In 2012, wood heating systems installed in Switzerland consumed 4.29 million cubic metres of wood, which saved 880,000 tonnes of fuel oil. The use of wood to produce energy therefore prevented the emission of 2.7 million tonnes of CO_2 into the atmosphere.

Each year, wood produces almost 10,000 GWh of energy, or almost 4% of total energy consumption. Switzerland's 700,000 or so installations mainly produce heat. About 4% of the energy produced from wood is used to generate electricity .

In Swiss forests, wood consumption is well below the annual renewal figure: just under 10 million cubic metres of wood are grown annually, as compared with an average annual consumption totalling around 5 million cubic metres. Wood is therefore a source of renewable energy with obvious potential for further exploitation.

Stoves and boilers fuelled by wood chips or pellets are becoming increasingly popular. Wood chips are most often used in large installations for district heating systems, while pellets are more commonly used to heat individual houses or small apartment buildings.

Industrial ecology … the interface between waste management and energy efficiency

It is interesting to see that in this channel, most of the players operate in physical proximity to other players, if they are not actually on the same site, and in close partnership. For instance, woodworking requires (or produces) a fair amount of heat, which can be used directly at the site by the company's activity. The term «industrial ecology» is therefore often used, meaning that the waste from one industrial activity is used as a raw material for another. We are at the interface between waste management and energy efficiency. As an illustration, the players in this sector include Valpellets in Sion (pellet production), Enerbois in Rueyres, which has one of the largest plants in Switzerland for recovering energy from sawmill by-products (electricity, heat, pellets), and Proxipel, a young company that develops and markets mobile pellet-production machines aimed mainly at municipal organisations and forest-ownership authorities.

It is clear that Switzerland offers the full range in this field, in terms of production volume and flexibility.

The total amount of energy produced from wood in Switzerland could cover about 6% of total energy consumption or about 12% of thermal energy consumption. As the energy efficiency of buildings increases, there is a corresponding increase in the proportion of energy provided by wood. According to Energie-bois Suisse, it is therefore quite possible to envisage that, within a few decades, wood will heat about a quarter of Swiss buildings.

Did you know ?

- Wood releases exactly the same amount of CO_2 when it decomposes as when it is burned.
- When wood is burned, it throws out the same amount of CO_2 as it absorbed when it was growing. This is why wood heating is carbon-neutral.

3. Value chains in waste management: specialisations and technologies

The waste management sector is huge and complex. In representing the value chains, several approaches are possible. For the purposes of this study, we have chosen two complementary representations:

1. A representation of the players along the length of the specialisations value chain

2. A representation of the technology players along the generic value chain

The form of recovery (as energy, material or organic matter), as defined at the beginning of the study, is also indicated in the value chains. Representing this recovery can be complicated because, within a single channel, a category of waste can be recovered in more than one form.

In general, organic and inorganic waste can be dissociated. Whereas the latter is mainly recycled, the former can be recovered in the form of energy or recycled, insofar as the basic elements of which it is made can be isolated and recovered in a form sufficiently pure for future uses (plastics, phosphorus in sewage sludge, etc.).

3.1 The specialisations value chain

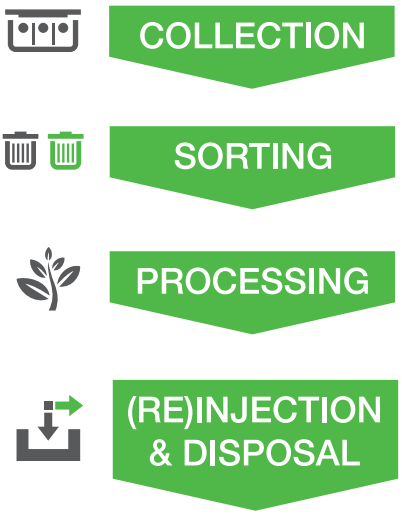
Given the information presented up to this point, and with a view to ensuring that the waste sector thrives in the long term, we will now analyse the composition of the economic fabric, list the players and examine their position in the value chain.

True to the CleantechAlps philosophy and role, we have adopted an approach that focuses on the technology players. This choice was dictated by the observation that one factor in the growth of liberal societies is the close link with innovation, which itself is closely linked to the technology players.

The second reason for focusing our approach on these players in particular is that technology providers represent precisely the point of introduction of these new technologies into the value chains. We have therefore chosen this option as the basis for figure 8 (p. 48), in which we zoom in on the major Swiss technology players.

As has been seen in the preceding sections, waste is a vast field made up of many different sectors (channels).

The specialisations value chain (see under) covers every stage from the generation of waste to the reinjection of new materials or waste disposal, and including collection, sorting and processing. The processing stage also includes pre-processing and conditioning.



A multiplicity of players

The sector includes a large number of companies that are active over a clearly delimited portion of the value chain, with specific expertise and know-how. A few players are involved over almost the entire length of the chain, such as recycling businesses and associated companies (e.g. BAREC, Serbeco, SFR, SOTRIDEC, Helvetia Environnement) and channel managers (Swico, IGORA, INOBAT, SLRS, etc.).

Figure 7 gives a non-comprehensive view of the players distributed along the length of the specialisations value chain according to their activities. It gives some idea of the diverse nature of the professions represented in this field, and also of the skills available to the businesses involved in it.

A comprehensive list of the players is beyond the scope of this study, but the final section includes portraits of several of them, so that their particular features can be better understood. Please do not hesitate to contact CleantechAlps if you require further information or would like to be put in contact with any of them.

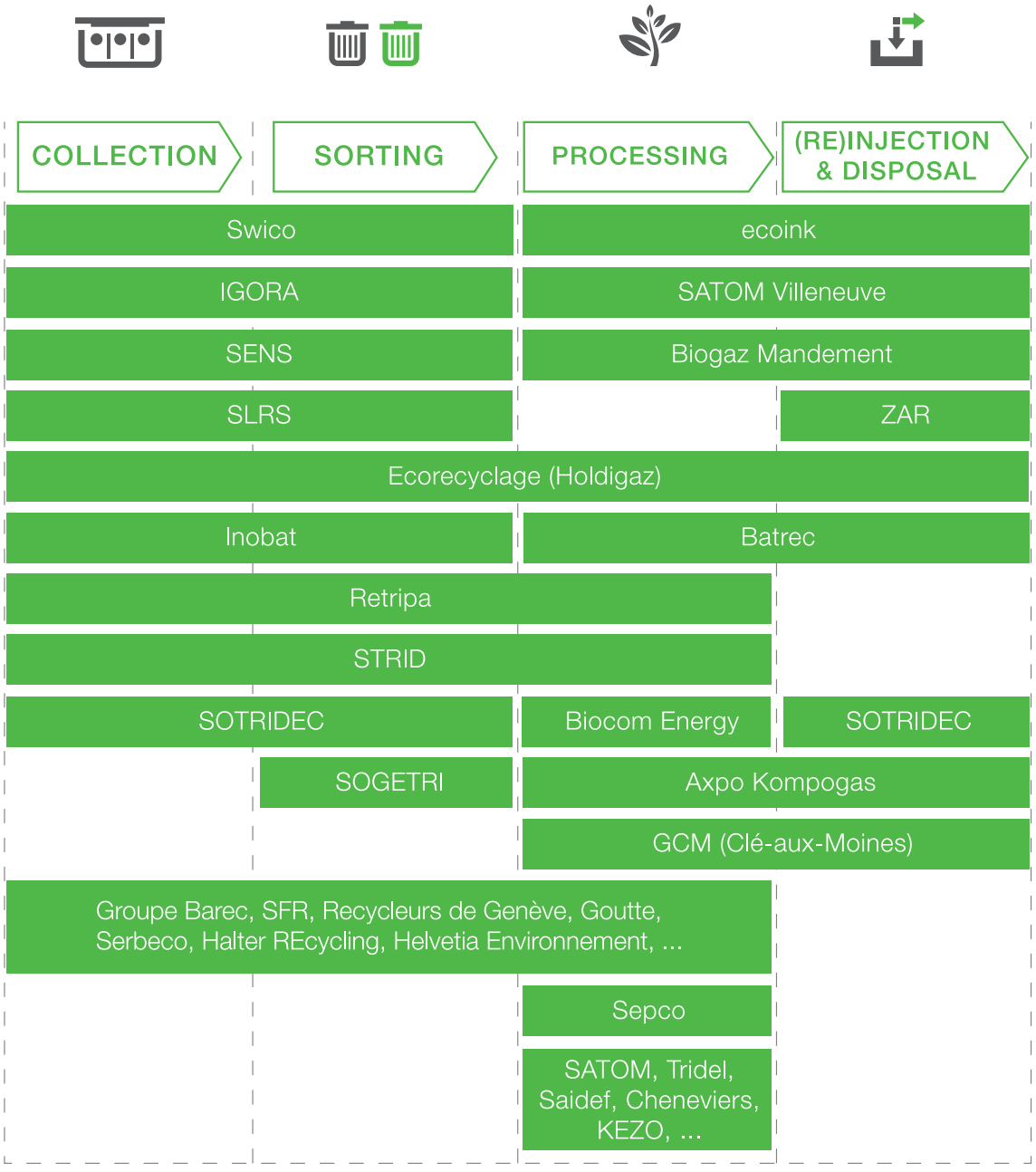


Figure 7: Management of waste: value chain «professions»

3. Value chains in waste management: specialisations and technologies

3.2 The generic value chain

The generic value chain for waste management (see figure 8) consists of R&D, followed by the development of new processes or materials (including those produced during recycling).

Then comes the production of components, systems, units and processing installations. The chain continues with an engineering stage that includes the overall development of projects (design, project planning, submission of planning applications for public scrutiny, etc.). It ends with operation, which includes, in particular, the management and maintenance of the entire installation.

We consider that this representation of the technology players along the generic chain is very important. It emphasises Switzerland's added value in a sector which is growing rapidly, thanks to the presence of players who cover all or part of this chain. The representation also indicates the channel in which the company operates.

Here again, a comprehensive list is beyond the scope of this study, but the company portraits given at the end of this publication supplement the view given here. CleantechAlps will be happy to provide further information or put you in contact with any of these companies.

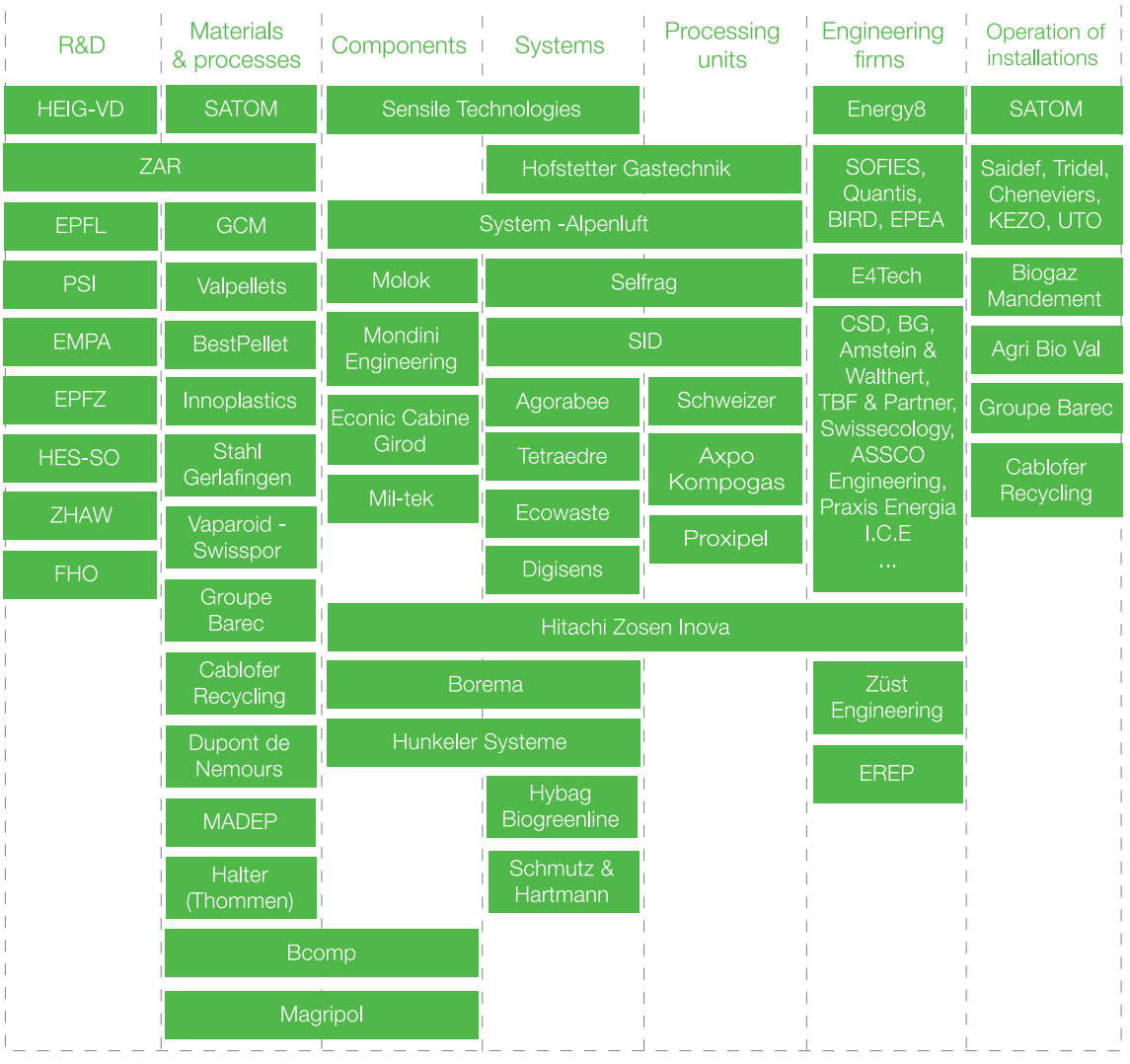


Figure 8: The technology value chain and the main Swiss players - Source: H3oC

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4. Innovations and turnkey solutions

In Switzerland, innovations in the field of waste processing and recycling can be seen at every stage in the value chains presented, affecting multiple channels. Here are a few examples:

4.1. Molok containers and Mondini Engineering

The Vaud-based Molok Recycling Company offers partially-buried container systems for public authorities and businesses (see portrait p. 67). These containers allow household waste to be stored at a low temperature. The effect of compression by gravity and the circular shape of the containers means that the intervals between waste collections can be extended and optimally adapted to seasonal variations. The temperature underground remains low, which minimises odour. A system for weighing bags individually can also be added to the containers (where waste is taxed by weight).

Various other electronic options can be added to Molok containers, such as waste level measurement and management of different fees. Amongst other things, these enable waste collection and container emptying to be optimised. Such technology is very widespread in Switzerland, where over 6,000 containers have already been installed, and the innovative concept is generating interest worldwide.

Mondini Engineering, based at Capriasca-Tesserete near Lugano, adds to Switzerland's range of underground containers. This company, which will celebrate its 61st birthday this year, is already exporting Swiss excellence in this field, with installations in the United Arab Emirates, Norway, France, Spain and Italy.

4.2. Traceability tools from Tetraedre and AgoraBee

Several Swiss companies, including Tetraèdre in Auvernier and AgoraBee in Renens, are developing electronic systems that measure the level of waste in containers and transmit the data at frequent intervals via the internet. These innovative tools enable the movements of waste collection vehicles to be optimised, which improves the efficiency of the service, saves fuel and makes the containers more pleasant to use.

4.3. Turnkey solutions: the example of eco-neighbourhoods

The eco-neighbourhood is a concept which is very much in favour at present. The idea is to build neighbourhoods that set an example as regards energy, architecture (Minergie is the Swiss standard for energy efficient buildings) and mobility. Waste management is fully integrated into the concept, the new Eikenøtt district in Gland being one example of this. Underground containers will be installed in various locations, forming mini waste dumps. These facilitate and encourage the sorting of waste. Ecoparc in Neuchâtel, the first eco-neighbourhood in western Switzerland, also offers an interesting approach.

Eikenøtt district in Gland

The Métamorphose project in Lausanne provides for the construction of two model eco-neighbourhoods. Within the area of waste management, the objective is to minimise vehicle movements related to waste collection, and establish sorting centres or «eco-points». The aim is that the companies that build these new neighbourhoods should be able to recycle as much material as possible, particularly as construction elements, either in situ or in the immediate locality.

The idea is also to evaluate the placing of underground containers, in order to reduce the frequency of waste collections, and to position the neighbourhood's refuse dump in its centre, with eco-points close to the majority of users. The concept aims to encourage direct sorting of waste by residents, for instance by creating special areas for waste sorting inside buildings.

It can be seen from the examples given above that eco-neighbourhoods are showcases for Swiss know-how in the field of waste management. They also demonstrate that the source of thinking related to waste recovery lies at the very heart of inhabited spaces, where individuals play a central role.

4.4. SELFRAG, a specialist in selective fragmentation systems

This company, based at Chiètres in the canton of Fribourg, specialises in high-voltage pulse power fragmentation. It develops highly-innovative systems that increase the value of extracted or recycled materials.

Selective fragmentation systems can break down composite materials of all kinds, enabling electronic components, materials based on carbon fibre or glass fibre, and construction waste such as scrap concrete to be recycled.

The technology that has been developed facilitates sorting and improves recycling, resulting in an increased yield. This solution enables elements to be recovered in their original form and frees up precious metals, and does so sustainably and competitively, because it requires less energy than conventional processes.

4.5. Hollow slabs … or how Cobiax reduced the need for concrete

Innovation in the shell of a building is no easy matter, but Zug-based Cobiax Technologies AG achieved it with its concrete slabs that incorporate hollow containers made of recycled material. This significantly reduces the amount of concrete required in the shell, thus combining efficiency with reduced costs. This solution has been implemented in buildings such as the UEFA headquarters in Nyon.

The hollow paving stones from Cobiax

5. Advantages for markets outside Switzerland

The Swiss market for businesses that offer technologies related to waste management is limited. However, there is still some potential: the Swiss population's expectations in terms of quality of life, plus the decision by the Federal Council to continue greening the economy are helping Switzerland to maintain its leading position as regards continued improvements in waste management.

The Council's decision will enable new projects and work to be launched, aimed at optimising overall use of resources. These will build on the high-quality image that Switzerland already has concerning its waste management, and its unspoiled landscapes and pure air.

This image is also being enhanced by the development of new solutions to eliminate micropollutants in water, and the discussions about establishing a national skills centre for resource efficiency.

Switzerland as a showcase

All these activities support the observation that where waste is concerned, the whole of Switzerland is a showcase in which one only has to walk around in order to see the various installations operating in real time. And it is precisely this that is our major advantage in foreign markets!

It is clear that in the medium term, growth in this sector will inevitably take place via the development of export markets. The players have in-depth knowledge of the channels and benefit from a communication tool in the form of a whole country, a tool that is virtually unequalled internationally and which many companies would love to have. Decades of experience enable these players to adapt each solution to specific regional requirements, an opportunity that the sector must not miss.

The dynamics of the market mean that it is not relevant to give a detailed analysis of the potential markets as part of this study. However, we can nevertheless take a brief look at three examples that illustrate the possibilities.

South-east Asia

South-east Asia, which includes Vietnam, Indonesia and Malaysia, is the market where everything is possible, because of its enormous latent potential, and also because its middle class is growing rapidly. This ensures stable and sustainable expansion for the whole region, because the middle class is always more inclined to buy quality products. Vietnam, for example, is becoming increasingly important as a manufacturing site for international companies.

The country is well aware of the challenges that this manufacturing role involves in terms of infrastructures, especially as regards the disposal, recovery, recycling and prevention of waste, because Vietnam's attractiveness as a manufacturing centre is inevitably accompanied by an increase in waste.

Hong Kong has just approved a plan for reducing solid household waste, with a 40% reduction in volume by 2022. Here again, the region's dynamism enables very specific niche markets to be addressed.

Emerging countries

On a different note, the construction/renovation market is booming in almost all countries, particularly emerging countries. The part played by recycling in this market is growing rapidly and solutions are being sought to set up channels for managing construction site/civil engineering waste, etc.

Traceability is at the forefront

And finally, the issue of monitoring and traceability of waste in landfill sites (emissions, leachates, stored compounds, etc.) is generating interest. There is a bright future for the development of sensors, techniques and measurement concepts for gas emissions and water pollution, and also related software.

SATOM, Monthey

6. Summary and conclusion

As we have seen, waste is no longer necessarily a cost for society. As technologies are developed, it is becoming an exploitable resource and a source of profit. The prospects are enormous, as are the business opportunities.

Analysis of the sector indicates that in Switzerland, the waste recovery ecosystem is fully-developed and homogeneous for all channels. The political environment is favourable and confirms its support for the sector. A national action plan for the green economy has just been launched, with the aim of reducing the country's overall environmental footprint and therefore reducing the pressure on resources.

Coverage of the channels

In this context, recycling absolutely has to be analysed globally and not on a channel-by-channel basis. Switzerland's advantage in this field is precisely the coverage of all these channels over a limited geographical area. It is absolutely invaluable for clients to be able to see for themselves, in a short period of time, the full-scale operation of a particular channel, from collection of the waste to its recovery in the form of recycled material or energy production.

Moreover, they can see it all within the context of the required statutory and regulatory framework. Visits to players in the channel concerned, aimed at professionals and focusing on a specific subject, can be organised quickly.

Waste management is not a subject that can be dealt with in isolation. It is so closely interwoven with people that a solution cannot be efficient in the long term unless it takes the customs and habits of the local population into consideration. It is essential that each solution is appropriate to the economic and social context of the society concerned. The multilingual, culturally diverse nature of Swiss society means that the players concerned have considerable experience in this type of adaptation.

It is clear that this sector has considerable potential and that solutions that have been tried and tested in Switzerland, over several decades in some cases, are ready to meet the growing needs worldwide.

CASE STUDIES

Ask for our case studies :
« For a better understanding of cleantech in western Switzerland »
« Water treatment in western Switzerland »
« Small-scale hydropower in Switzerland: a leading-edge industrial sector » (May 2014)

They are available on : www.cleantech-alps.com/etude

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CleantechAlps is an initiative of the Cantons of Bern, Fribourg, Vaud, Valais, Neuchâtel, Geneva and Jura.
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Schweizerische Eidgenossenschaft
Confédération suisse
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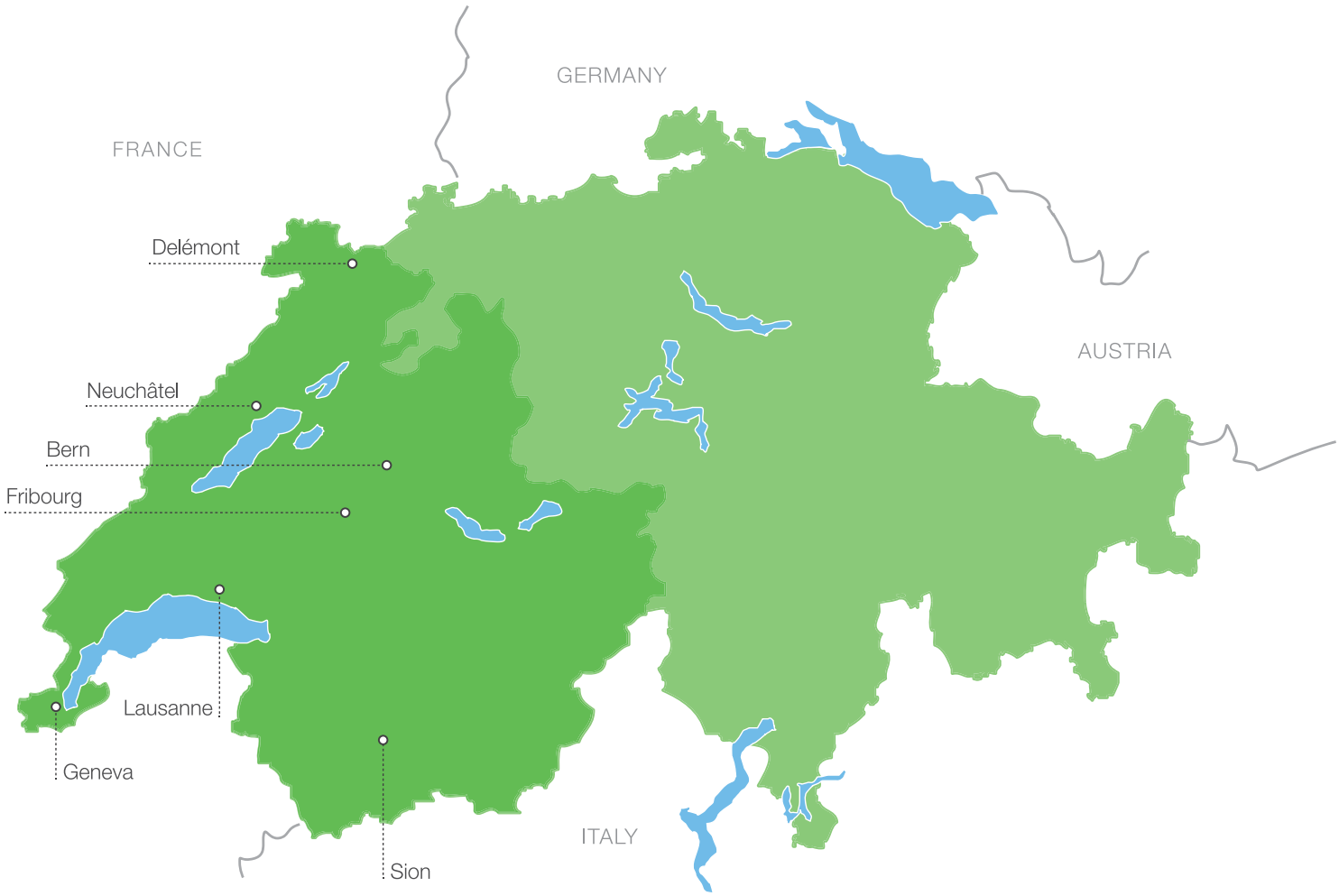
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Economic Affairs SECO

« We have discovered the incredible potential of the region in the form of a new, dynamic infrastructure for start-ups. »

David Crettenand, RedElec Technologie SA



Western Switzerland, a fertile ground for cleantech

The Greater Geneva Berne area has excellent business conditions such as:

- Political, legal and social **stability**;
- Multilingual, multicultural and diligent **workforce**;
- **Liberal labour** laws (long working hours, virtually no strike/absenteeism, no national minimum wage, liberal employment contract);
- Concentrated expertise in **science and technology**, **intellectual property and manufacturing**;
- Location at the center of **Europe** and privileged access to the **European Union**;
- Leading **academic institutions** collaborating actively with the private sector;
- Competitive **taxation**;
- **Excellent quality of life** (easy to attract and retain qualified foreign employees often without expatriate packages);
- **Good overall infrastructure** (transport, energy, telecommunication);
- Proactive **authorities** ready to help.

Additional information

GREATER GENEVA BERNE area
economic development agency

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15 portraits

Automated mobile object tracking by AgoraBee

Specialising in active RFID, AgoraBee designs and manufactures location-based telematics equipment and offers mobile asset tracking applications (for skips, compactors, construction tools, specialist equipment etc.). Forty per cent of the objects tracked are connected to waste transport and storage..

«Our technology is currently being used to track 200,000 objects in thirteen different countries,» says Pierre-Alexandre Nuoffer, chairman of the board of directors for AgoraBee SA. The engineering and production company was created in 2007, and operates mainly in Switzerland, France, the UK and Benelux, but is also present in the US and South America. «We have built up a reputation thanks to our position of developer and producer.» The company's active RFID (Radio Frequency Identification) tags allow its customers to geolocate any inert objects to which they are attached. These non-contact transmitters, which are simply stuck on with glue, use radio waves and can be read at a distance of 1000 metres. There are therefore applications for the solutions developed by AgoraBee in numerous business sectors, such as transport, construction, retail, aluminium production, gas network management and also in defence technology sectors.

Optimising container fleet management

«Our systems are particularly effective when you need to trace a high number of objects that are not powered by engines.» This is particularly the case in the field of waste management, where having to manually process the location of container fleets is a significant impediment to their optimal management. Fleet managers have a lot to gain from knowing at every instant where their skips are located and which are the ones that are available. «We have developed the ChisFleet® solution just for them: once mounted on the wall of a container, the device sends out a continuous signal so the container can be located.»

In practice, each container is listed and a number is assigned to it. An active RFID is then allocated to each object that, when read, displays its precise characteristics together with data such as its temperature. The readers are installed in the lorries: each time they pass close to a tagged skip, the latter's exact location is transmitted to a server. There, an online application charts the position of each element on a map and provides detailed information about it. «For example, if one of the skips is moved by a third party, its owner will still know where it is located.» This access to real-time data as well as to historical location reports means the containers' drop-off and collection routes can be optimised, and consequently costs can be reduced. This system is particularly cost effective for owners of large fleets of construction skips or centralised waste-collection containers. «You need to allow for an investment of around 65 francs per container, for a period of ten years.» Thanks to the ChisFleet® solution, inventories are equally easy to maintain and are more accurate. «Before putting this system in place, most of our clients only knew their stock levels of skips to within 20% !»

Since January 2013, AgoraBee's active RFID systems have been developed and produced in Switzerland. «We decided to repatriate the production of our transceivers from China to Renens, in the canton of Vaud, to be closer to our clients.» This cutting-edge technology is also sold on to a number of companies, including some that work in geolocation.

AgoraBee SA

2007

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Batrec Industrie AG: building a clean future

Established in 1989, Batrec is a high-tech company that is the European leader in battery recycling. It also specialises in reactivating activated carbon and treating heavy metals, particularly mercury.

«Thanks to our recycling method, we are currently the only company in Europe that recovers and treats all the metal components in batteries,» says Dieter Offenthaler, Batrec's managing director. Indeed the firm, based in the canton of Bern, is the only company in the world to have developed a system that completely isolates in a closed cycle the hazardous materials in spent batteries and treats them to extract the raw materials. The extracted materials are then re-injected into the production cycle. The market for this is enormous: in Switzerland alone, 120 million batteries are sold every year. «We have the capacity to recycle much greater volumes than we currently receive. We could handle 100% of the batteries used in this country. Unfortunately, too many batteries finish up in the household rubbish.» However, whether round, dry cell, lithium or rechargeable, all batteries contain toxic substances and need to be disposed of in an environmentally friendly manner.

Mercury specialists

Other European companies that work in the field of battery recycling only extract the steel parts, using a crusher and a magnet. In contrast, Batrec uses a system of high-temperature pyrolysis followed by fusion and reduction in a furnace at 1600°C. «We achieve a recycling rate of 66%. As far as the metals contained in a battery are concerned, we recover almost 90% of them, a real saving for the environment.» For every tonne of used batteries, the company produces more than 300 kg of ferromanganese and 180 kg of zinc, and recovers 50 g of mercury.

To treat this last, particularly toxic, substance, the company has invested more than 15 million Swiss francs in a new plant to develop specific distillation systems.

As a result, Batrec has increased its capacity to dispose of mercury-containing waste from 300–400 to 1000–1500 tonnes a year. A significant proportion of this waste comes from the petrochemical industry. Large oil companies such as BP, Exxon, Shell and ConocoPhillips send their waste here from all over the world so that it can be treated in Wimmis. «We have the technology to handle all the mercury-related problems for our clients.» At the end of the treatment, the liquid metal recovered has a purity level of 99.995% and can be re-injected into production cycles without harming the environment in any way.

Another of Batrec's specialisations is reactivating the activated carbon used not only in industry in the purification of exhaust and wastewater gases, but also in many domestic applications (swimming pool filters, for instance). Most of the used or saturated carbon can, in fact, be reactivated and reused a number of times. This process takes place at temperatures reaching 800°C, in a furnace specially designed for this purpose. The activated carbon is heated and regenerated with steam, while the pollutants are selectively separated in the gas-scrubbing unit. «We are the only company able to treat mercury-contaminated carbon.» The technology can also be used to recondition used catalytic converters. These contain up to 40% sulphur and 15% mercury, which are distilled and separated. The metals used in the catalysts themselves are recovered by the metallurgy industry and used in the manufacture of new units, thus completing the recycling circle.

Batrec Industrie AG

1999

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Bcomp's commitment to «eco-superior» solutions

Created by two ski enthusiasts and two young researchers, this Fribourg start-up specialises in the development of natural-fibre composites. From sports to watches and car frames, they have a multitude of applications.

«It all started with skiing, in 2003,» says Cyrille Boinay, the company's co-founder and managing director. «I wanted to design a model that was lighter than a traditional ski, so I had a carbon-fibre material developed. But we very soon came up against a problem with vibrations.» It was then that he was approached by two young researchers from the Swiss Federal Institute of Technology in Lausanne, Christian Fischer and Julien Rion. They offered to improve the structure of the existing ski core. After many months of research in a garage and trials on the snow-covered slopes, the team moved towards using natural fibres, developing new technologies for composites. They were joined by Andreas Brülhart, and the four men founded Bcomp in 2011. «We now use flax as our raw material: we weave it to produce fibres and fabrics that are glued together with a biosourced resin and then moulded using a patented process.» The result is a material that makes structures more effective in terms of weight, stiffness, and damping and shock-absorbing qualities. This material is also lighter than carbon, more resistant than aluminium and stiffer than glass composites.

Ecology and performance

In practice, Bcomp offers three product groups: bCores (structural cores), ampliTex® (fabrics) and bTubes (tubes). The bCore cores are primarily used in ski manufacturing. They are made of balsa wood or recycled PET foams, combined with a web of composite fibres. «These cores make it possible to trim 30% off the weight with respect to traditional boards.» This technology has already won over a number of manufacturers, including Stöckli and Idris Ski. But the advantages of flax-fibre biocomposites are not reserved for ski enthusiasts alone. There are plenty of applications for this technology in the field of sporting and leisure activities: skateboards, cycles, surfboards, rackets and fishing rods, to name just a few.

«Flax-fibre composites also have some excellent acoustic properties. In fact, one of our customers has just developed a ukulele that has a much better sound than what can be achieved using carbon fibres.» The company also has several projects under way with car companies to develop bodywork or interior parts using renewable fibres. These biocomposites have already been tested on the bioMobile, a vehicle thought up by hepia, the school of landscape engineering and architecture in Geneva. As a result, they are expected to be used in commercial cars very soon.

Another use that is surprising, to say the least, is in watchmaking. «This year, Hublot will be presenting a range of ladies' watches whose cases are made of Bcomp fibres. This is a first for this type of equipment.» The start-up and the watch manufacturer are also working on a plan to establish a flax plantation in the Emmental. Currently, the flax used in the biocomposites comes from a number of different European suppliers. «This is the simplest solution to ensure a constant quantity and quality.» At the same time, Bcomp is very interested in abaca, a type of banana plant that grows in the Philippines. «Not only does this fibre have some very interesting qualities, it will also play a part in enabling us to export our technology to Asia.»

Bcomp LTD

2011

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BioApply wants to replace plastic bags

BioApply specialises in biosourced, biodegradable and compostable packaging and products, and has been developing environmentally friendly alternatives to plastics and petroleum-based products since 2006.

Before co-founding BioApply with his wife Olivia, Frederic Mauch headed a company that developed accessories for high-end department stores. «We quickly saw how little sense it made to have short-lived products manufactured from non-renewable materials at the other end of the world. We came to the conclusion that it is perfectly possible to offer products with a short shelf life as long as they are biosourced, biodegradable and compostable,» he says. This is how they came to contact manufacturers and the patent holders for these kinds of raw materials, with an aim to developing, as a first step, compostable shopping bags. «Our first customer was the association of artisan bakers of the canton of Geneva.» The first of a long line, because these bags have brought in over 300 customers. Today they can be found in the colours of numerous shops, including those of the Swiss retailer Migros Vaud – who started providing them at its supermarket tills on 1 November last year – and the e-tailer LeShop.ch. And although, eight years after BioApply's creation, the compostable bags are still the company's flagship product, the company has widened its scope to offer other biodegradable and biosourced products. BioApply also helps its customers with their own research and development projects on innovative and durable packaging applications. While 85% of the company's activities are in Switzerland, it also works with France, Germany, Africa and the US.

In your garden compost

«Obviously we support the motion by Dominique De Buman to prohibit the use of plastic bags in Switzerland: compostable bags have contributed to rendering them obsolete. It's a great victory, particularly as they are the ideal alternative.» Leading the way are BioApply's supermarket-type bags made of plant starch, which decompose in a maximum of twelve weeks, in a bacteriological environment at 60°. «These bags have also been certified OK Compost Home, which means that they can simply be composted in people's gardens. So you can use them to do your shopping, and then reuse them for your organic waste.» The company also sells bin bags in rolls for home use, to help with sorting this type of waste. Naturally these, too, are biodegradable and compostable. Yet another technology developed by BioApply is used to produce thick, reusable, biosourced bags made of wheat starch. «They are designed to be treated in waste incineration plants at the end of their life; their carbon footprint is excellent and their price is very competitive.»

As for the Re-Bag, the result of the company's latest development work, it was launched on the market at the end of March. «This is the first ultra-reusable bag that is 100% biodegradable and 97% biosourced.» This unique product completes the BioApply range. «It is our aim to offer a comprehensive range, to be able to satisfy all our customers' expectations.» In 2011, Michel Pikhanov, the company's head of sales, also became a partner in BioApply.

In addition, Frederic Mauch helps businesses that want to develop biobased products and packaging through his company BioApply Polymers. «We have a patent for a biodegradable material.» BioApply has also been awarded the CTI (Commission for Technology and Innovation) Label.

BioApply Sàrl

2006

5

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Unity brings power at Biogaz Mandement

The result of a horticulturist and a farmer joining forces, this Genevan company uses organic waste of agricultural origin to produce biogas, which in turn generates «green» electricity. The heat produced operates the installation and is used in horticultural greenhouses.

«We process over 12,000 tonnes of organic material a year», says Charles Millo, a horticulturist who is the joint founder, with farmer Marc Zeller, of the company Biogaz Mandement. Their installation is the first in the Geneva canton to have been set up by individuals. It was thirteen years ago that an idea began to take root in the minds of these two neighbours: they could use waste from the farm run by one of them to produce energy for heating the greenhouses belonging to the other.

«Two-thirds of these cosubstrates consists of waste from the region's restaurants.» This organic matter is fed into the digester six times a day, where it is broken down by over 250 types of bacteria.

«The anaerobic digestion process lasts 30 days and works best at a temperature of 42 degrees.» The result of this process is biogas, with methane making up 60%. This methane is then converted into «green» electricity via a combined heat and power system, using a truck or boat engine running 24/7. Seven per cent of this electricity is used to run the installation itself, and the rest is sold to the electricity grid at the feed-in tariff. The heat released during the operation enables the temperature in the digester to be maintained at 42 degrees. The rest – about 70% - is used to heat Charles Millo's greenhouses.

«Our long-term vision was to be self-sufficient in energy, and we also wanted to provide ourselves with an additional income, on top of what we earned from our businesses.» After countless studies, searches for funding, contract negotiations and other preliminary formalities, the two entrepreneurs started to build their installation in October 2011. It has now been operating for almost two years. «Everything's automated, except for handling the solid waste, which requires a man and a tractor.»

Closing the organic matter cycle

Thanks to the performance of this biogas plant, over 1,500 tonnes of CO_2 emissions are saved each year. «We use two types of waste. The first is putrescible agricultural waste, in other words, manure, slurry and crop waste; they come from our businesses and the nearby farms run by our eight partners.» This waste is liquid or solid and represents 85% of the tonnage used. «The other 15% consists of cosubstrates.» These cosubstrates come from centres that collect organic waste, such as the Cave de Genève (grape residues), the Cercle des agriculteurs (waste from grading cereals), or from the agrifood industry.

Lastly, the liquid fermentation residue is used to fertilise the soil, as this digestate is taken up very quickly by plants. Unlike slurry, it also has the advantage of not giving off a foul smell when spread on the ground. The solid residues make a good quality compost. And so the material cycle is closed, through the transformation of organic waste into natural fertiliser. «Nothing is wasted!» The process generates 1.8 MWh of «green» electricity each year. «Enough to supply about 400 households.»

Biogaz Mandement

2006

3

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From the earth to the earth, with Ecorecyclage SA

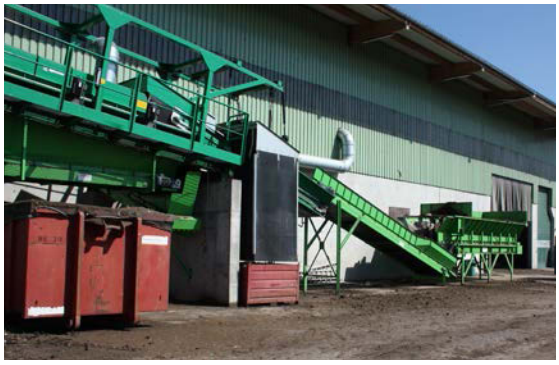
Ecorecyclage SA, a subsidiary of Holdigaz Group, operates primarily in garden and food waste management. The company runs Lavigny's regional composting facility and also produces biogas, which is injected directly into the Group's distribution network.

Before moving into recycling, the business, then called Germanier SA, worked in garden design and maintenance. «It was at the beginning of the 90s that we started to take an interest in the commercial exploitation of organic waste,» says Luc Germanier, executive director of Ecorecyclage SA, the company created in 2004 from the legal separation of the recycling business and the landscaping component. After the ban on burning garden refuse came into effect in Switzerland in 1988, composting seemed to be the ideal solution for getting the most out of this waste. Luc Germanier has been running the regional composting facility in Lavigny, in the canton of Vaud, for over twenty years. «In 2008, we completed our infrastructure with an anaerobic digestion plant that produces biogas from household and industrial organic waste.» The range of products treated on the site is now complete, and the company handles 26,000 tonnes of organic matter a year. «Our area of operation stretches from Nyon to the municipalities of West Lausanne, which amounts to a potential of 200,000 inhabitants.» Currently the Lavigny site processes the organic waste of 150,000 people. «The material is delivered to us by the waste collection vehicles; we also pick up garden refuse ourselves from the municipal waste reception centres in our area.»

Making people more responsible

A little less than half this waste is transformed into compost, making up 20,000 m^3 of «brown gold» destined to return to the earth. This mixture has been awarded the prestigious Bud label from Bio Suisse, and is used in agriculture and gardening. Meanwhile, wet materials or ones with poor structure, which are badly suited to composting, are treated in the biogas production plant. «These are essentially catering waste, that is to say the waste from household kitchens or from the agri-food industry, to which garden refuse is added.» The biogas production process is based on an anaerobic biological treatment in a digester at 53 degrees, fed around the clock. The plant's daily treatment capacity is 40 to 45 tonnes of material. It takes 15 to 20 days for the treatment to be completed; the result is an annual production of biogas – 60% methane – equivalent to 1 million litres of fuel. After purification, the resulting biomethane is odorised, compressed and injected into the natural gas network of Holdigaz Group. The digestate (the solid by-product of the anaerobic digestion process) is composted.

«The extracted liquid mass constitutes an organic fertiliser that improves the physical, chemical and biological quality of the soil, so that it can be easily used in place of artificial fertilisers.»



To be able to make the most of all organic waste and in particular that deriving from the food in private households, Luc Germanier appeals to every individual to take responsibility. «I think the German term for kitchen waste – Grüngut, «green good» – speaks volumes. This isn't just any old rubbish, and it is essential that it be looked after properly. In other words, anything that could compromise its recycling should be removed at source, in particular any plastic, which is a real disaster for composting!» Naturally, the composting facility is equipped with extraction systems for removing any remnants of plastic, and the compost also undergoes a very careful screening to ensure that no undesirable fragments are returned to the earth.

Ecorecyclage SA

2004 / Integration into Holdigaz Group in 2011

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EREP SA, 34 years' experience in biogas production

EREP SA is a design and consultancy bureau that specialises in the treatment and recovery of organic waste and effluents, with specific expertise in the production and use of biogas. The company also works extensively in the field of professional training.

Biogas, nothing but biogas. Since it was founded in 1980 by Yves Membrez, the company has concentrated on the engineering of organic waste and effluent treatment and recovery in anaerobic digestion plants. «We offer all the usual services of an engineering firm, providing assistance both at the project definition stage and with its realisation,» says Membrez. From the preliminary market study to the environmental impact report, project specifications and study of the plant's potential, right through to the site supervision, the company's five engineers support their clients in their biogas production projects, whether they involve recovering household waste, municipal sludge or agricultural and industrial waste and effluents.

The complete monitoring service, carried out several times a year, consists in substrate analysis, digestion-medium monitoring, digestate analysis, biogas analysis and leak detection. «We remain involved over the long term.»

These are skills that Membrez is also keen to share through the many seminars and conferences at which he and his team are frequent participants. «Many of these events are organised under the auspices of Suisse Energie and Biomasse Suisse, for whom we work: they give operators the opportunity to share their experiences.» EREP SA also works extensively in the field of professional training for biogas plant operators and future operators. There is effectively no specific basic training at present. «Biogas production requires multidisciplinary skills. However, we have set up an option module for students at the School of Business and Engineering Vaud (HEIG-VD), in Yverdon.»

These are installations that complete the cycle for organic material at the same time as generating energy during the anaerobic digestion process: biogas, heat and/or electricity. «There are currently four operations under way, two of which are in France, on farms that are setting up facilities to treat their own waste.» The Vaud-based company makes more than half its turnover in France, where it has a liaison office in Lyon. «The French market is pretty lively in the biogas sector.»

A Biogas module at HEIG-VD

EREP SA has also recently developed monitoring services for biogas production facility operation. Thanks to its investments in analytical equipment and partnerships with specialised laboratories, the company is now able to carry out physical-chemical and biological tests aimed at optimising production yields from digesters.

The production of biogas from organic waste is undoubtedly a promising sector in a context where renewable energies will find themselves playing an increasingly important role. «All the same, it is the political and regulatory incentives that will really get things moving. With the tax on rubbish bags, the volume of organic waste has increased; we are seeing a small upturn for specific projects. For farmers, everything will depend on the incentives from the Swiss Confederation. For the time being, these are still very slow in coming.»

EREP SA

1980

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The greedy bacteria at MADEP SA

Founded in 2002, this laboratory in Neuchâtel develops and applies biotechnologies based on natural microorganisms, in particular for treating municipal and industrial waste water, remediating contaminated sites and producing biogas.

MADEP SA is one of the few Swiss companies specialising in microbiology in the field of green energy and the environment. « Biotechnologies are very environmentally friendly because they don't consume a lot of energy. They make it possible to reduce or even eliminate the use of chemical products and to substantially reduce treatment costs, » says Trello Beffa, the company's founder and CEO. He and his team isolate, select and cultivate bacterial strains and fungi in the laboratory, with a view to using them to improve the functioning of existing processes, whether they relate to decontamination, waste-water treatment or the production of biogas from organic waste. And all made to measure, because these strains from the MADEP SA collection (4,000 available strains), or new, specially isolated ones, are tested and selected directly on samples taken from the sites that are to be treated. « For the past two years, one of our priorities has been increasing biogas production yields from biogas plants. To this day, conventional processes are essentially based on physical-chemical techniques that use up a lot of energy and are not at all ecological. »

Improving biogas yields

Thanks to a very rigorous selection, the organic waste can in fact be very efficiently digested to produce considerably higher yields of biogas. MADEP SA has developed a number of processes that boost methane production, called DIGESTO-M (sludge), DIGESTO-AGRI (agricultural waste), DIGESTO-T (organic waste at thermophilic temperatures), DIGESTO-LIXI (bioactive waste at both thermophilic and mesophilic temperatures) and DIGESTO-PAP (paper industries).

These are made up of mixes of anaerobic, hydrolytic, fermentative and acetogenic strains, capable of digesting even complex and refractory compounds. « Their efficacy means that we can continue to improve biogas yields, as well as the quantities of heat and electricity generated by the installations. The results obtained from industrial biogas plants are positive, and there is still potential for improving their performance. » With the benefit of 25 years' experience in microbiology, Trello Beffa deplores the presence on the market of irresponsible vendors. « These charlatans selling powders and snake oils have made the biogas operators and experts very wary of the biological approach. »

The bacteria intended for waste water treatment are also subjected to an extremely rigid selection process. « Industrial and municipal WWTPs are a very important market for us. It is our job to improve and stabilise the microbe populations. » Waste-water treatment requires regular bio augmentation – in other words the addition, every one or two weeks, of fresh bacteria, to improve the plant's microbiology and thus its treatment performance. « We deliver to our customers 5–20-litre cans of concentrated, fresh bacteria, so they can then cultivate the micro-organisms on site, in 1–5 m^3, aerated cubitainers. » The fresh and extremely active bacteria produced in this way are poured into the WWTP either at the top of the process, or at the point where the biological phase starts.

In the case of remediation of contaminated sites, soil or groundwater, MADEP SA works together with a great number of specialists to provide them with specially adapted, efficient microorganisms together with the conditions for their implementation. « We continue to invest in research and development to improve the strains so that we can treat as many pollutants as possible, whether they be hydrocarbons, chlorinated solvents, pesticides or other refractory chemical residues. »

MADEP SA

2002

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Z.i. Maladières 22, 2022 Bevaix

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OptiWaste, or how to optimise waste management

Making waste collection rounds as efficient as possible is one of OptiWaste's guiding principles. The brand combines the distribution of Molok containers with intelligent solutions developed by EcoWaste.

« The brand OptiWaste includes all the products and services offered by Molok Recycling Company and EcoWaste SA : marketing large-volume underground and semi-underground waste containers together with value-added solutions for all-round, intelligent refuse management, » says Jean-Luc Schlaeppi, managing director of both companies. Schlaeppi took over the distribution of the Finnish « Molok » product range throughout Switzerland in 2001. « We quickly became interested in on-board ultrasound fill-level measurement systems. » Using the « solutions écologi(sti)quesTM » developed by EcoWaste, the load in the containers can be calculated to work out exactly when they will need to be emptied. « Our value-added systems go beyond a simple fill-level measurement. The electronics on board the containers also provide RFID access control as well as weighing devices for setting up pay-by-weight taxation. » These systems make waste-management optimisation possible not only for local communities, but also for the transport companies responsible for its collection.

Intelligent containers

Today EcoWaste is the market leader in weighing systems and other solutions écologi(sti)quesTM ; the company operates mainly in Switzerland and France, but also in Belgium, Holland and Italy. The products themselves are developed, manufactured and assembled in Switzerland. « Our technology can be fitted on any sort of container, not just the Molok containers we market. » In other words, any large waste disposal bin can be made « intelligent ». In fact, the company recently won a tender to equip with electronic probes 3000 containers installed by a number of different competitors.

For Schlaeppi, optimising waste collection rounds is a key element of waste management. Thanks to the EcoWaste technology that measures the containers' fill level, it is possible to precisely schedule the rounds, in terms of both route and frequency. « This optimisation can be taken even further if local communities also abandon the system of doorstep collection and couple this with the principle of pay-by-weight taxes. In Switzerland, around thirty municipalities have opted for this type of tax, and it's a practice that is spreading. » This involves users depositing their rubbish bags in this kind of intelligent container themselves. In practice, every household has a card that gives them access to a « night-safe »-style chamber where the rubbish is weighed before being deposited in the receptacle. This information is then transmitted to a website.

The data is used, on the one hand, to calculate the tax to be charged to the user and, on the other, to monitor the fill level in the bins and consequently plan the best collection schedules.

« Ending doorstep collection means significant savings, and not just in environmental terms. It's calculated that it takes an hour to collect one tonne of rubbish with doorstep collections, using one driver and two loaders. With a system of intelligent containers, a productivity rate of four to five tonnes an hour can be achieved, with just one operative. » And this doesn't only apply to small communities. The city of Nantes, in France, has put out a tender to install 2000 units, allowing it to abandon doorstep collections and put in place a system of electronic household waste taxation.

OptiWaste

2001 (Molok Recycling Company) and 2003 (EcoWaste)
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Pellets «on wheels» with Proxipel Sarl

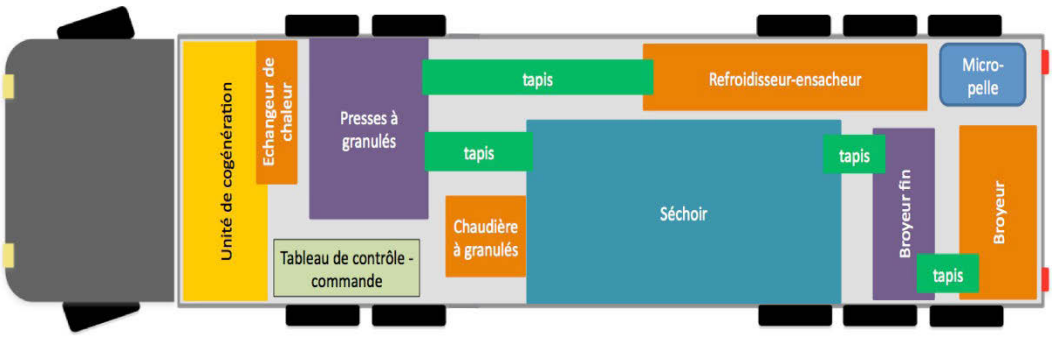
Proxipel, a concept that means that pelleting can be carried out in situ, was developed by engineers and renewable energy specialists in response to the shortage of biomass that can be economically transported for pellet production. The first unit is about to go into testing under field conditions.

Proxipel is the name given to the mobile unit that will make it possible to produce pellets from wood residues derived from many different types of biomass. To do this, the unit will have a complete production chain inside a semi-trailer. The production chain will consist in a chipper and a granulator, a dryer and a pellet-fired boiler, two presses, a cooler and a bagger, as well as a cogeneration system and heat exchanger. It will be possible to transport the entire system using a tractor unit. The idea of this mobile unit first germinated in the mind of André Corthay, head of the promotional department of the association for wood energy Energie-bois Suisse in Lausanne for thirteen years. To put it into practice, he approached Richard Pfister, co-founder of Praxis Energia SA, a company that specialises in managing renewable energy projects. Proxipel Sarl was founded in 2013 and is still in the process of testing its first prototype. «Our innovation will make it possible both to convert into energy the biomass that currently isn't being treated and to optimise this conversion,» says Richard Pfister, the company's executive director. The first mobile unit will be finalised in the summer of 2014.

«We have only identified a few competitors so far. In fact, it seems that only three machines of this kind have been developed anywhere in the world. In any case, we are doubly sure of standing out from the others, because Proxipel will also have a dryer, which will enable it to treat wet materials, so it will be able to pellet all sorts of biomass, not just straw.» Among the materials already tested are branches with leaves, vine shoots, different types of wood (with and without bark), straw, manure, coffee grounds, cereal crop residues, and combinations of these.

They are all biomass that can be transformed into pellets by the pellet presses included in the trailer. «It will be possible to slightly adapt each unit to the clients' specific problems. We expect to manufacture one or two this year, in addition to the prototype.» After that, the company's founders have forecast a production of six or seven units next year, reaching ten units in 2016. «There's a large potential market: we've estimated a demand for 3000 Proxipel in Europe, of which 80 in Switzerland.»

The concept certainly offers a number of advantages in comparison to centralised pelleting units. With it, it will be possible to convert raw materials available in a multitude of tiny, scattered volumes, and that without tying up capital in real estate, or facing problems with planning permission. Proxipel's mobility will also ensure its independence in relation to wood residue production sites. «Its other main strong points are great operational flexibility and a reduced environmental footprint.»



A potential of 80 mobile units in Switzerland

«Lots of trials have already been carried out on the different elements that will go to make up Proxipel. And it all works! On top of this, we undergo regular checks by the Federal Office for the Environment, who verify our analyses.» The tests under field conditions, in other words in the trailer, will take place this summer, first internally and then at the School of Business and Engineering Vaud (HEIG-VD), in Yverdon. These final trials on a fully functional machine will make it possible to start production on the first complete units intended for the market.

Proxipel Sàrl

2013
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Industrial ecology according to SATOM SA

Over its almost forty years of existence, SATOM SA has considerably developed its activities. While the company's plant was initially intended just for waste combustion, today SATOM is a key player in the region's energy provision and intends to play an increasingly important role in regulating the electrical grid.

« We have to stop thinking of incinerators as installations that pollute the atmosphere and are not energy efficient, it's completely wrong ! » says Edi Blatter, managing director of SATOM. The Monthey plant was constructed in the seventies to destroy the waste from the surrounding municipalities of the Valais and Vaud cantons. Bit by bit, however, its mission has evolved, and now it plays a major part as a power station. The time when it was enough to burn incinerable waste in order to avoid it building up in unattractive landfill sites has passed. « Already, in the early eighties, we developed systems for improving the flue gas treatment. The plant was then completely renovated in 2003, and since then it's undergoing constant transformation to improve its energy efficiency. » The energy released by the waste combustion is converted into electricity, which is used to power the district heating plant in Villeneuve. Additionally, four projects have been in progress in Monthey since 2010 with the purpose of extending SATOM's thermal network. In 2007, the company also bought the composting facility in Villeneuve : here it produces biogas from organic waste, as well as heat and electricity.

Regulating the electrical grid through waste

The waste incineration process generates a significant amount of steam, at a pressure of around 50 bar. This is used to power a turbine, producing more than 130 GWh of electricity a year. « Part of the steam is also piped to the Tamoil refinery in Collombey, enabling it to burn fewer hydrocarbons during its processes. In return, the refinery sends us its waste heat, which we inject into the district heating network. » This is an excellent example of industrial ecology, started in 2010 with the construction of four pipelines connecting the two installations. And nothing is lost, either, from the way the heat is used. « The hot water is pumped into the district heating network at a temperature of around 70°C. When it returns, its temperature is still high enough to heat some greenhouses whose installation we have encouraged. » So the water doesn't return to the waste incineration circuit until it has completely cooled down.

To further establish its role of power station, SATOM also intends to play a part in regulating the electrical grid. « The value of electricity currently fluctuates considerably, mainly as a result of photovoltaic energy. At the same time, it is essential to offer production flexibility in order to be able to adjust to consumption. And SATOM is able to contribute to this regulation by storing waste and by adjusting the use of its combustion chambers. » To do this, the company has just put out a tender to construct an enormous storage depot for incinerable waste. « We are particularly interested in plastics as they have a very high calorific value. And, contrary to a widely held view, it is much better to convert them into energy than to send them to the other end of the world to be recycled. »

It is a pity, then, that with the adoption of the tax on rubbish bags by a large number of Swiss municipalities, people are actually being encouraged to reduce their waste, when 70% of this is made up of plastic. « It's precisely the adoption of this measure that's creating a problem, because it places a higher tax on the things that should stay in the rubbish bags. And at the same time it creates excessive costs for municipalities, who have to develop separate collection chains for plastics. Costs that are then passed back to the public in any case. »

SATOM SA

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SID SA, shredding to optimise waste treatment

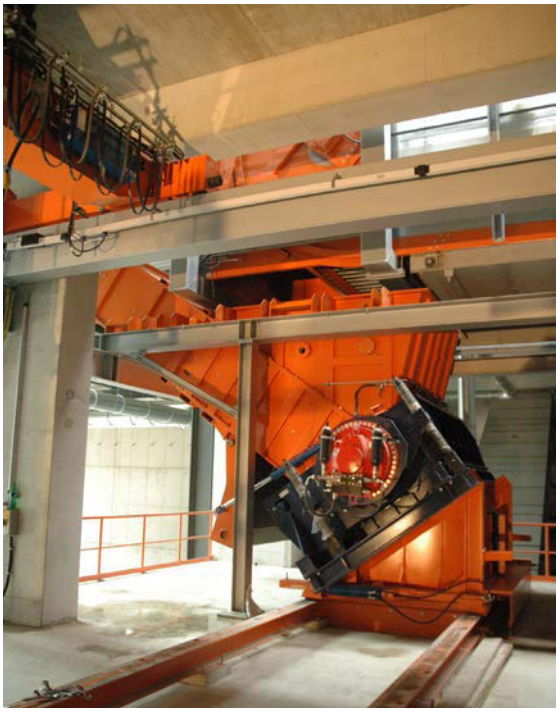
SID SA was created over forty years ago with the objective of shredding waste. Today, in its design studio and workshops, the company develops a wide range of shredders for recycling and waste-treatment plants.

Société industrielle de la Doux (SID) was established in 1972 and was originally a repair shop of Electricité Neuchâteloise SA (ENSA). The company started specialising in rotary shears, and became independent ten years later. « The shredding machines produced by SID SA were originally intended for cement manufacturers. Bit by bit, the market developed in the direction of waste management and recycling, » says Kai Zolleis, the company's CEO.

Today, SID SA offers a wide range of shredders for use in recovery and treatment facilities. The machines, most of which are hydraulic powered, are able to shred all kinds of waste to reduce its volume prior to incineration or recycling. They are also used for chipping wood primarily intended for the paper-making industry. In addition, the company has solid expertise in the field of pumping difficult products. The purchase in 2003 of SolidPumps HHE AG, which has since been completely integrated into the SID group, effectively extended the group's competence in waste maintenance. « We manufacture pumps to feed the waste into combustion chambers or recycling equipment. » This process sits well alongside shredding and has allowed SID SA to develop complete SMP systems, in which the waste is shredded, mixed and pumped before being incinerated. These SMP systems are used wherever a homogeneous flow of combustible material is required; in incinerators, they also reduce costs by significantly increasing the flow rate in the combustion chambers.

The biggest shredder in the world

« Our machines are built in Switzerland for the whole world. » The technical office of SID SA, based in Saint-Sulpice (canton of Neuchâtel), brings together a multidisciplinary group of engineers specialised in mechanical, electrical and hydraulic engineering. This skills pool enables the company to complete complex projects successfully. « SID SA is a machine shop with integrated development. We have a standard product range that we adapt according to our customers' requirements. » The company's client list is very varied. « Our machines are just as likely to be found in huge cement works as in associations of municipalities or in water companies. But even though we are involved in a number of areas, we always remain closely in touch with each one's specific requirements. » This is how SID SA came to build the largest shredding plant in the world. Run by the Stuttgart facility of the German electric utilities company EnBW, this plant allows them to treat household waste and bulky items in a continuous flow capable of reaching 5 x 100 tonnes an hour.



« Central Europe means large markets for us: these countries have long been engaged in a process of optimising their waste management. » The company also works in Switzerland and elsewhere around the world. « We manufacture machines for customers in France, the UK and Spain, as well as in India, Chile, Brazil, Korea, Japan and China. » In fact, SID SA has just set up a subsidiary in India. Over the past two years, the constantly evolving company has developed a new range of machines that offer greater flexibility. The range features single-shaft shredders, four-shaft shredders and mobile shredders, and is now already available in Europe.

SID SA

1972

100 around 100 throughout the world

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Swico Recycling, taking back discarded equipment to conserve resources

Swico Recycling is a national not-for-profit system that has been organising the return of used electrical and electronic equipment in Switzerland since 1994. Operated by Swico, it has more than 700 signatories to date and covers 90% of the Swiss market.

« Twenty years ago, Swico Recycling was one of the first systems of its kind in the world, » says Jean-Marc Hensch, managing director of Swico, the Swiss Economic Association for the Suppliers of Information, Communication and Organisational Technology. This voluntary system, started in 1993 by a majority of its members, organises the collection of equipment used in the areas of IT, consumer electronics, office automation, telecommunications, the graphics industry, and measurement and medical technology. « What is remarkable is that it was the manufacturers who took the initiative to get together to find a solution for this waste. A typical example of Swiss self regulation ! » In fact, until then consumers had had to pay when they took any electronic equipment to the waste collection centre. As a result, quite a few chose to dispose of it by dumping it in the countryside. The solution was based on an advanced recycling fee (ARF) being levied by the manufacturers and importers of electrical and electronic equipment at the time of purchase. When it was adopted, it immediately won over 36 businesses operating in the office automation and IT sectors.

Bit by bit, key players from other sectors joined, and in 2014 – twenty years after its creation – Swico Recycling has more than 700 signatories of the convention. And even if the Confederation passed legislation on electrical and electronic waste return, taking back and disposal in 1998, it is still industry that leads the way with regard to recycling it. « In fact, if you look up this subject on the website of the FOEN, the Swiss Federal Office for the Environment, it redirects you to the Swico/SENS regulations. »

Reduction in advanced fee

The system now covers more than 90% of the Swiss market. Almost 130,000 tonnes of discarded electric and electronic equipment were collected in 2012 – twice as much as ten years ago. And the level of raw materials recovered came to 75%.

In practice, the ARF is levied on all new equipment sold in Switzerland, so consumers pay for its disposal at the time of purchase. In exchange, they can return their used equipment free of charge to specialist retailers, manufacturers, importers or collection points. Some thirty million Swiss francs are collected in this way every year and are used to finance the collection centres, logistics, dismantling, recycling, and the strict monitoring of the entire system. « Swico doesn't make any profit from this : if there is any excess, we reduce the level of ARF. » The fee has been reduced by 30% since 2008.

This is an exemplary system that gives Swico significant credibility at an international level, where the company is particularly involved in the European network of associations, contributing to the development of new standards. « We have also financed a number of studies, including the project on Recycling of Critical Metals from Electronic Waste (E-RECMET), which was started off in January 2013, with joint funding from Swico and the FOEN. » The project is being led by the Swiss Federal Laboratories for Materials Science and Technology (Empa) and has the task of defining the technical and organisational criteria required to recover these raw materials. As metals are a non-renewable resource, and some rare metals are present in large quantities in electrical and electronic equipment, manufacturers risk eventually being left without if they are not recycled.

Swico Recycling SA

1989

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swisspor reduces the environmental impact of bitumen

swisspor designs environmentally-friendly products and has been involved in sustainable development for several years. It has just begun marketing swissporBIKUTOP ECO, a high-quality recycled bitumen developed after years of research and practical testing.

The history of the group swisspor Holding AG goes back to 1971, when Georges and Bernhard Alpstaeg not only founded the parent company in Boswil, but also two manufacturing subsidiaries, Kork AG and Baukork AG. The group, which now comprises three companies (swisspor, swisswindows and swisspearl), is Switzerland's leader in the design, manufacture and distribution of materials for the building envelope that combine aesthetic appeal and high energy efficiency. «We look at the whole lifecycle of a product, from its manufacture to its recycling», explains Michaela Björk, marketing and communications manager for the subsidiary swisspor Romandie SA, which deals in insulation materials. The company's guiding principle is «Saving energy». This slogan is more than just a selling point for the company, which pays attention to the consumption of non-renewable resources and is committed to minimising their use.

Over ten years ago, this approach resulted in its research and development department inventing an infinitely recyclable expanded polystyrene. This invention was a catalyst for the development of a superbly organised recycling sector that operates in conjunction with PSE Suisse, an organisation for promoting expanded polystyrene. On the strength of this successful initiative, the company recently took up the challenge of doing the same thing with bituminous elastomer strips.

Features identical to non-recycled bitumen

Bituminous elastomer strips are made from a petroleum derivative and are sold in rolls, which are used in roofing for their waterproofing properties. After several years of research and tests, the recycled product, named swissporBIKUTOP ECO, went on the market in January 2014. «Its appearance and mechanical properties are identical to those of non-recycled bituminous strips.» What's more, the price is almost the same, just a few centimes more. The recycling sector is the result of cooperation with the Lausanne office of the BIRD, an advisory organisation with expertise in rational management of resources and waste. «Our partner delivers to us the waste collected from construction sites.» In practice, this cutting waste represents a substantial amount of material that can be exploited. It is ground up and the bitumen melted down again to produce new strips.

This processing is performed by Vaparoid AG, at its site at Turtmann-Unterems in Valais, where standard strips are also manufactured. «New bitumen strip is always added to the recycled strip. An ECO strip therefore contains 50% recycled material and 50% new material.»

Like the expanded polystyrene, the bituminous strips are infinitely recyclable. However, polystyrene can be recycled when buildings are renovated, whereas this is not yet the case for bitumen. Only waste from new rolls can actually be recycled. Research is therefore under way so that used bitumen which has been laid on roofs can also be recycled. This is a particularly interesting proposition as it would enable the waste created during renovation work to be exploited.

By recycling cutting waste, the environmental impact of swissporBIKUTOP ECO bituminous strips is immediately reduced significantly, and they achieve values that are 50% lower than the generic values of the KBOB, the Swiss federation of public works project owners. «Using these strips also means that points can be gained when construction is being carried out to Swiss Minergie ECO standards.»

swisspor Romandie SA

2001 (year that the group swisspor AG was formed)

150

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Tetraedre Sarl makes containers intelligent

For the past fifteen years, Tetraedre has been developing, producing and distributing on-board electronic devices for remote measurement and control. In particular, the company has designed a device for fitting to waste containers that measures their filling level.

The electronic devices developed by Tetraedre Sarl offer solutions for remote measurement and control. This technology has a great number of applications, including the remote reading of electricity, gas and water meters. It can also be applied to the fields of hydrogeology and geotechnology, where it is used in alarm systems to detect land movements, for instance. « All these applications have been developed in response to a specific, real demand, » says Thierry Schneider, the company's managing director. This is also the case in waste management, where Tetraedre has devised a telemetry system for Ymatron AG, which markets the system under its own name.

« With the arrival of underground waste bins, this type of technology has become indispensable in knowing the fill level at all times and optimising waste collection. » The device created by Tetraedre, called TRMC-15, uses ultrasound to measure the height of the rubbish in a container. It then transmits this information at regular intervals by GSM/GPRS to a server where the data is analysed in order to calculate the fill level. A dedicated internet or intranet site allows the user to access this information at any time, with the final objective being collection schedules that reduce the number of journeys made by the waste collection vehicles.

Technology that has proved its worth under difficult conditions

Today, the technology developed by the company is fitted in 1000 containers in Switzerland, Denmark and Norway. « Our great strength in the different fields of application for our measurement devices is that they consume very little energy : they can therefore operate for a long time without any maintenance. » In order to prove the capabilities of the technology as applied to waste management, Tetraedre put it to the test under difficult conditions. « Together with our partner Swisslogix, we installed a 200-litre bin, manufactured by Brüco Swiss AG, on the Jungfraujoch at an altitude of 3471 metres . » The results were excellent: the battery held up in temperatures of -20°C and the reliability of the GPRS communication also withstood the test.

« Waste management now accounts for around 20% of our turnover. » The users of the technology developed by Tetraedre are essentially container manufacturers. « Ideally, the system should be integrated in the design stage of these waste bins. » In Switzerland, it is Zurich that has the largest number of intelligent containers equipped with TRMC-15 devices. « Through Ymatron, the city has installed 200 units. » The technology is also in use in St. Gallen, where it has been coupled with a smart card that allows households to access the containers to empty their bins. « These underground bins have been installed in the historic district, around the cathedral. Nothing is visible on the surface. »

There is no doubt about the profitability of this kind of device for those sites equipped with a large number of underground containers. However, for bins that can be emptied by hand, its cost may make people think twice about an investment of this type. « We have some small projects in hand for equipping the bins in shopping centres and optimising the work of maintenance staff. We are devoting our efforts to ensuring that these projects are worthwhile in terms of their paying for themselves. »

Tetraedre Sàrl

1999

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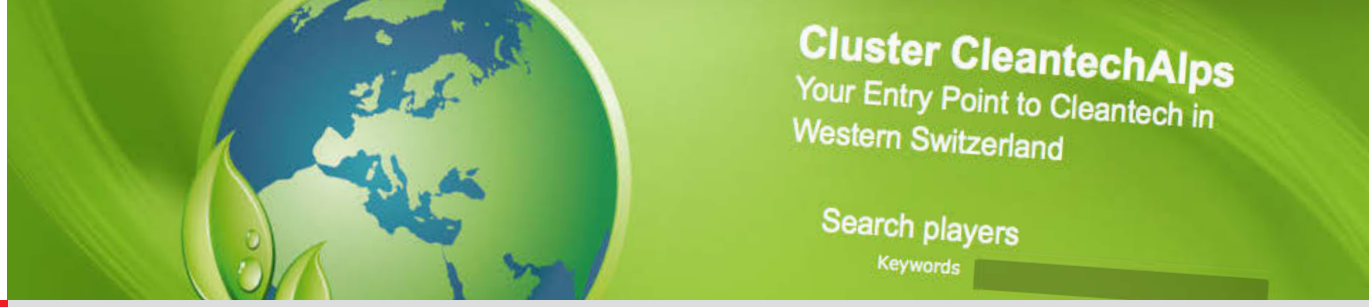

CleantechAlps, serving businesses and institutions

CleantechAlps, the platform dedicated specifically to clean technologies in western Switzerland, was launched at the initiative of the seven cantons of western Switzerland. It is supported by the State Secretariat for Economic Affairs (SECO).

The missions of CleantechAlps are as follows:

- To ensure the reputation of and to promote western Switzerland as a European hub for clean technologies related issues.
- To enable the introduction of cleantech players on international markets.
- To develop synergies between regional and national cleantech stakeholders.

CleantechAlps is the intercantonal driving force behind the development of cleantech and is the enabler at the interface of the economic, academic, financial and political worlds. In this context, CleantechAlps is definitively the main point of contact for coordination in western Switzerland of national initiatives such as the «Cleantech Switzerland» and «Cleantech Master Plan».

Join CleantechAlps

Businesses and institutions of western Switzerland who wish to join CleantechAlps and benefit from good visibility may do so simply by e-mailing info@cleantech-alps.com (free subscription).

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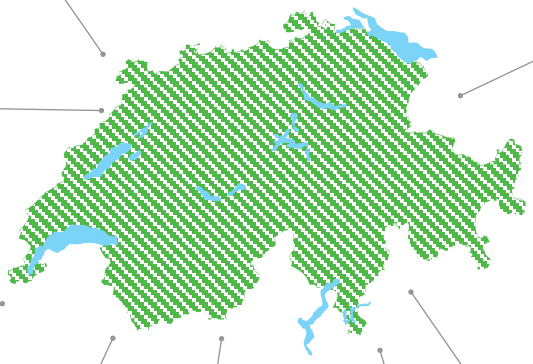
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Economic Affairs SECO

Cleantech ecosystem in Switzerland: who does what?



Incubators & science parks

- TecOrbe (VD)
- BlueFactory (FR)
- BlueArk (VS)
- Neode (NE)
- Cleantech Genève (GE)

Ambassadors project

- PlanetSolar
- Solar Impulse
- Icare
- Biomobile
- Monotracer
- Monte Rosa Hütte

Confederation

- SFOE
- FOEN
- SERI
- SDC
- SECO
- CTI

Enablers

- CleantechAlps
- ÖBU
- Swiss Water Partnership

Academic institutions

- EPFL/ETHZ
- Universities
- Universities of Applied Sciences (HES)
- EMPA
- PSI

Industry

- SME Start-up
- Big companys
- Engineers'offices
- Industrial services

Semi-public organism

- Cleantech Switzerland
- Swissnex
- Swiss Business Hub
- Switzerland Global Enterprise

Associations

(sectorial theme)

- Swiss Solar Technology Cluster
- Swiss Solar
- SuisseEole
- energie-cluster
- eco-net

Lobby

- Swiss Cleantech
- AEE
- Swissmem

Local actors

- Cantons
- CoC
- Cleantech Fribourg
- Cleantech Cluster ZH
- i-net
- Cleantech Cluster ZG
- Cleantech Aargau …

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References

Page 16
1. Environmental Protection Act, EPA, article 2
2. The definition used in Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008
3. http://www.dechets.ch/Informationen_Merkblaetter/pdf/CH06_Types%20de%20dechets.pdf (in French)
4. Source: ADEME

Page 20
1. Overview available from http://www.uncrd.or.jp/env/spc/docs/plenary3/PS3-F-Veolia_Hierso-Print%20abstract.pdf http://mdia.veolia.com/924/veolia/ressources/files/4/17143,752,Abstract_2009_FR.pdf
2. Source: 2009 World Waste Survey
3. Source: Eurostat

Page 21
1. Hong Kong blueprint for sustainable use of resources 2013-2022 – Environment Bureau, 2013

Page 25
1. Swiss Cleantech Report 2011

Page 26
1. Federal Office for the Environment (FOEN)
2. Federal Statistical Office (FSO)
3. Analysis of the composition of waste carried out by the Federal

Page 30
1. Source: Batrec

Page 31
1. Source: VetroSwiss

Page 36
1. Source: PET Resin Association

Page 38
1. Source: Plastics Europe
2. Source: Consultic/PlasticsEurope

Page 40
1. Source: InEddy Geneva

Page 41
1. Source: European Recovered Paper Council
2. Source: Ecofolio

Page 43
1. Source: Biomasse Suisse

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