


AN OVERVIEW OF CLEANTECH START-UPS

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Give cleantech start-ups the visibility they deserve

It is an established fact that the cleantech (or clean technologies) sector is responsible for almost 5% of Switzerland's GDP, with a growth of 25% in people employed in the sector over the last five years.

Start-ups are an important element of the cleantech sector in Switzerland and have the potential to form a substantial part of tomorrow's economic fabric and prosperity. At present, however, there is relatively little information available on the ecosystem of the young cleantech enterprises in our country.

Clean technologies are not actually an industrial sector in themselves, and their image is still somewhat scattered. Any company that develops or offers a technology, product or service that involves a response to an environmental issue is a cleantech enterprise.

The feedback we receive, not only from the general public but also from the media, indicates to us that there is a failure to understand the diversity and numbers of companies who operate under this umbrella. In these days of energy transition, the signature of the COP21 climate agreement, and with the subsequent implementation of the measures discussed at the Paris conference, it is opportune, if not essential to provide those involved, and the cleantech ecosystem in general, with the visibility they deserve.

We regularly receive comments about the absence of a guide on funding for cleantech start-ups, and propose to remedy this situation with a section dedicated specifically to the various parties involved in funding, together with the instruments and programmes available to them.

Since this study is the first of its kind in Switzerland, it may be that certain enterprises have slipped through the net, and we apologise in advance for this. This publication is merely a first step towards increased support and visibility for Swiss start-ups.

We hope you enjoy reading our report.

Eric Plan

Secretary General of CleantechAlps



An overview of Swiss cleantech start-ups in figures



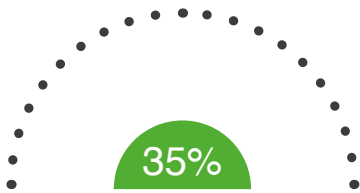
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clean technology start-ups created over the last 10 years and still active




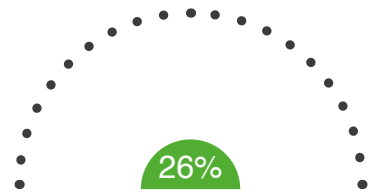
10%

of Swiss start-ups are in the cleantech sector



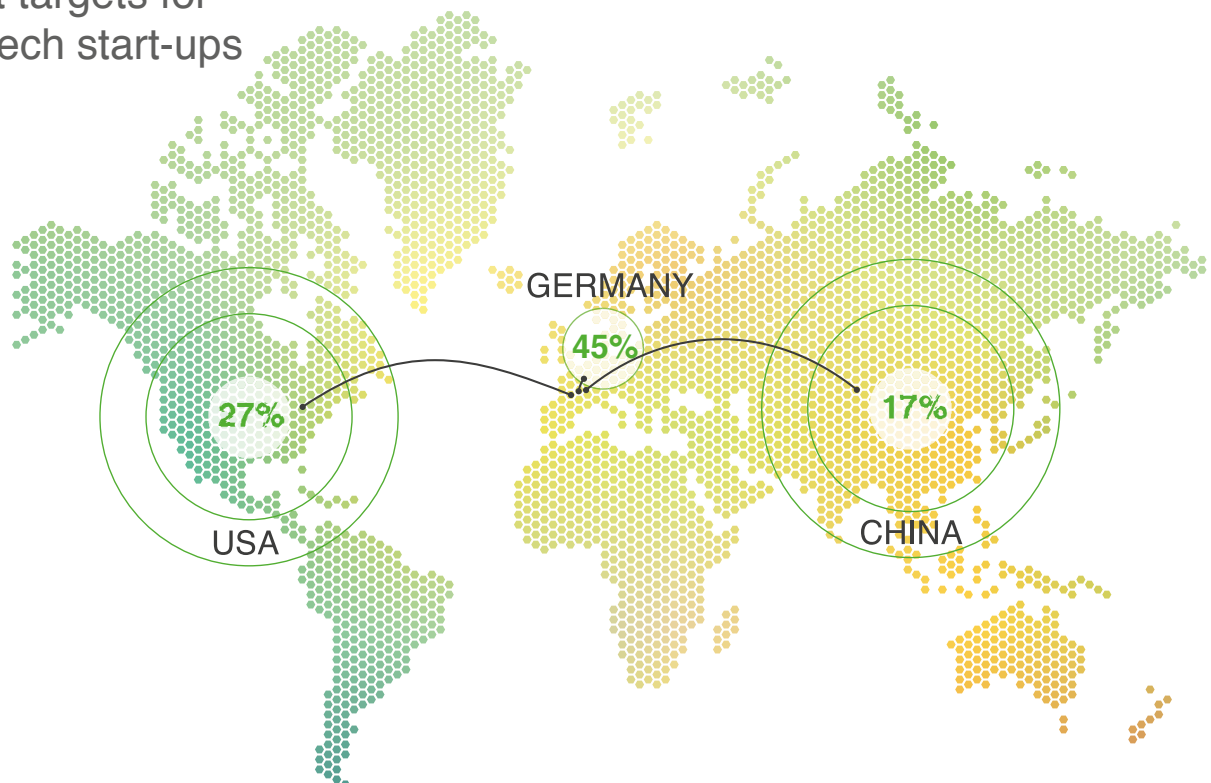
of start-ups consider funding to be their main challenge

57 key players recorded in the area of funding 



of cleantech start-ups are spin-offs of the Swiss Federal Institutes of Technology in Lausanne (EPFL) and Zurich (ETHZ)

Export targets for cleantech start-ups



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OVERVIEW OF ENTERPRISES

INTRODUCTION

This overview lists and gives a perspective on the whole of the cleantech sector in Switzerland. It covers all those Swiss companies involved in innovation or technology, and operating in the field of clean technologies, that have a strong potential for growth and have been entered in the commercial register since 2006.

This study excludes those companies that had ceased trading by the date of publication, those that have been bought out, individual tradesmen, companies that develop sustainable activities in capacities such as environmental consultants and engineering practices, as well as foundations and NGOs.

The global objectives of this overview are:

- to increase the visibility of this sector;
- to highlight its dynamism and diversity;
- to demonstrate its importance for the Swiss economic fabric;
- to give (future) entrepreneurs suggestions for ways of funding their ventures.

MUCH MORE THAN MERE TECHNOLOGY...

Clean technologies are not only about the simple utilisation of innovative technologies that safeguard natural resources. Cleantech reflects an attitude, practices and a way of life, which inspires individuals and companies in all sectors to act in a way that conserves

natural resources. Human activities and economic processes therefore need to be reconsidered to incorporate the principle of the efficient, respectful use of raw materials, energy and water.

In this overview, the cleantech sector, interdisciplinary by nature and constantly evolving, has been divided into 7 broad categories, then further divided into 17, closely following the segmentations proposed by the Cleantech Group and Roland Berger Strategy Consultants. Figure 1 shows the structure used.

A FAVOURABLE CONTEXT

As in all areas of the economy, new companies in the cleantech sector are seeking to develop. They currently benefit from a favourable context as a result of the Internet revolution, which heralded the era of the start-up. Since the turn of the twenty-first century, and in particular, during the last ten years, Switzerland has built up an environment of professional support for young companies.

Incubators – physical or virtual structures dedicated to the development of new enterprises – have been created throughout the country; such as the TecOrbe, dedicated to environmental technologies in Orbe (canton of Vaud). A wide range of specific support services, including coaching for start-ups, have been developed alongside these incubators. Gradually, entrepreneurial training programs were launched, as well as multiple competitions for ideas, business plans and prizes.



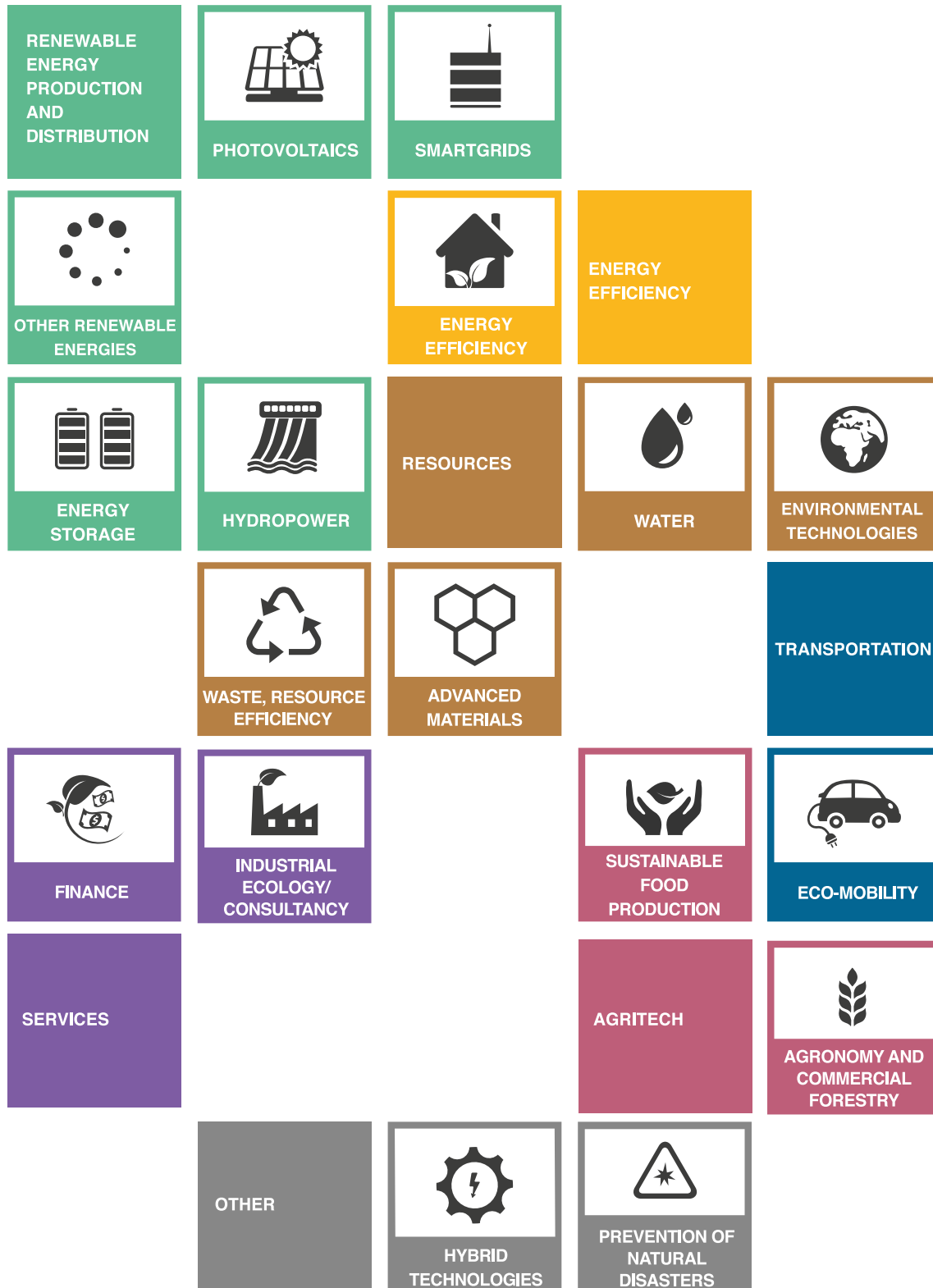
WHAT IS CLEANTECH?

Cleantech (or clean technologies) covers those technologies, products and services which have the aim of sustainable utilisation of natural resources and which provide for the production of renewable energy. They aim, in particular, to reduce the consumption of these resources and to conserve natural ecosystems. New technologies have a key role here, although importance is increasingly attached to the role of users and the understanding of their behaviour.

The environment has thus become structured and specialised. The underlying principles of entrepreneurship may remain the same, but the management and development of innovation has to adapt to the demands of each business sector. Clean technologies are no exception; it therefore comes as no surprise that the new entrepreneurship programme from the Commission for Technology and Innovation (CTI) integrates a vertical approach depending on the sector in question, one of these sectors being cleantech (energy/environment).

CATEGORIES AND SUB-CATEGORIES OF THE CLEANTECH SECTOR

Figure 1



MAPPING THE LIFE-CYCLE OF START-UPS...

We will not be examining coaching or innovation in this study, as these aspects have already been widely covered. We intend to map out cleantech start-ups to identify their level of development and their main orientations, in line with the categories referred to in the introduction, so that it will eventually be possible to measure their dynamics. To this end, we have chosen to analyse the ecosystem of these technological enterprises from the point of view of their life cycles (cf. Table 1).

Broadly speaking, a business venture emerges from an idea, which may be for the development of a technology or product with the aim of filling a gap in the market. This is typically referred to as a technological or commercial approach. This is the first phase in the life cycle of the start-up, which we will call the "R&D" or research and development phase. This is followed by the "Creation" phase, the moment when the company comes into being once an apparently viable business model has been drawn up. During the third phase, the "Launch", the business model is validated on the ground with an initial product or pilot project, before entering into the fourth phase, "Development", which is defined as the stage at which the company begins to achieve repeat sales.

The company then continues to develop in the "Growth" phase, in which it expands its product range and explores new markets, before entering into the sixth, final phase of the cycle, the "Maturity and Sale" phase. This marks the end of the life cycle of a start-up, with several options that include purchase by a competitor, entry into the stock market (IPO), or renewal with different products or services, which would generally correspond to a return to the previous phases. Another option, though less ideal, is a downscaling of the company's activities or even liquidation if the company's market has eroded and what it offers is no longer in line with customers' requirements.

...BUT NOT STRICTLY OR RIGIDLY

It is clear that in the day-to-day reality of a company's activities, the boundaries between the various phases overlap, and so this model should be viewed as a point of reference rather than a strict, rigid framework. The phases and their content may also vary depending on the specific sector. In the cleantech sector, the phases involving demonstrations,

pilots and pre-industrialisation of the product require more resources than in the majority of other sectors such as medical or information technology, for example. The problem of overlapping is similar for those offering funding and their relative positioning along these phases of the life cycle.

The different phases are summarised in Table 1, with an indication of the degree of maturity of the business venture.

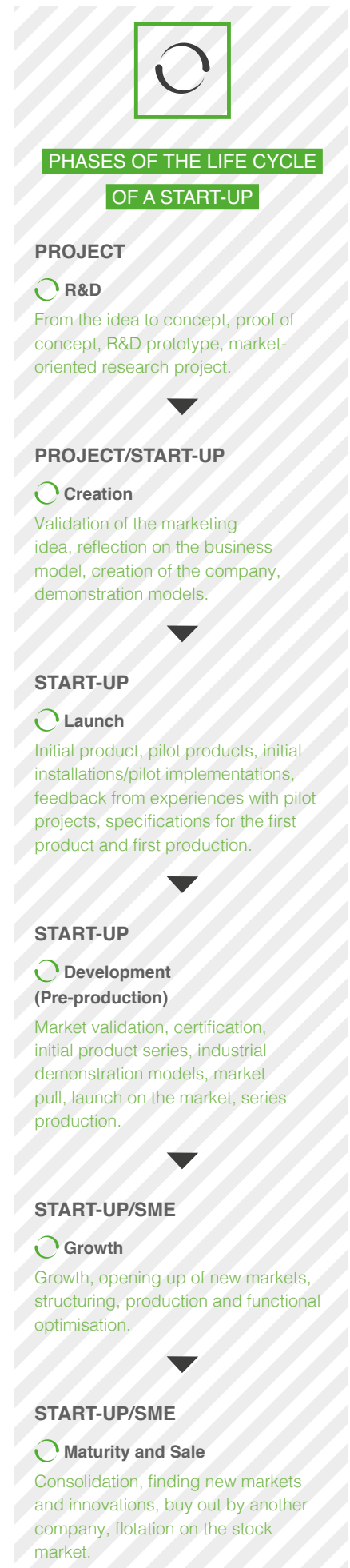


Table 1

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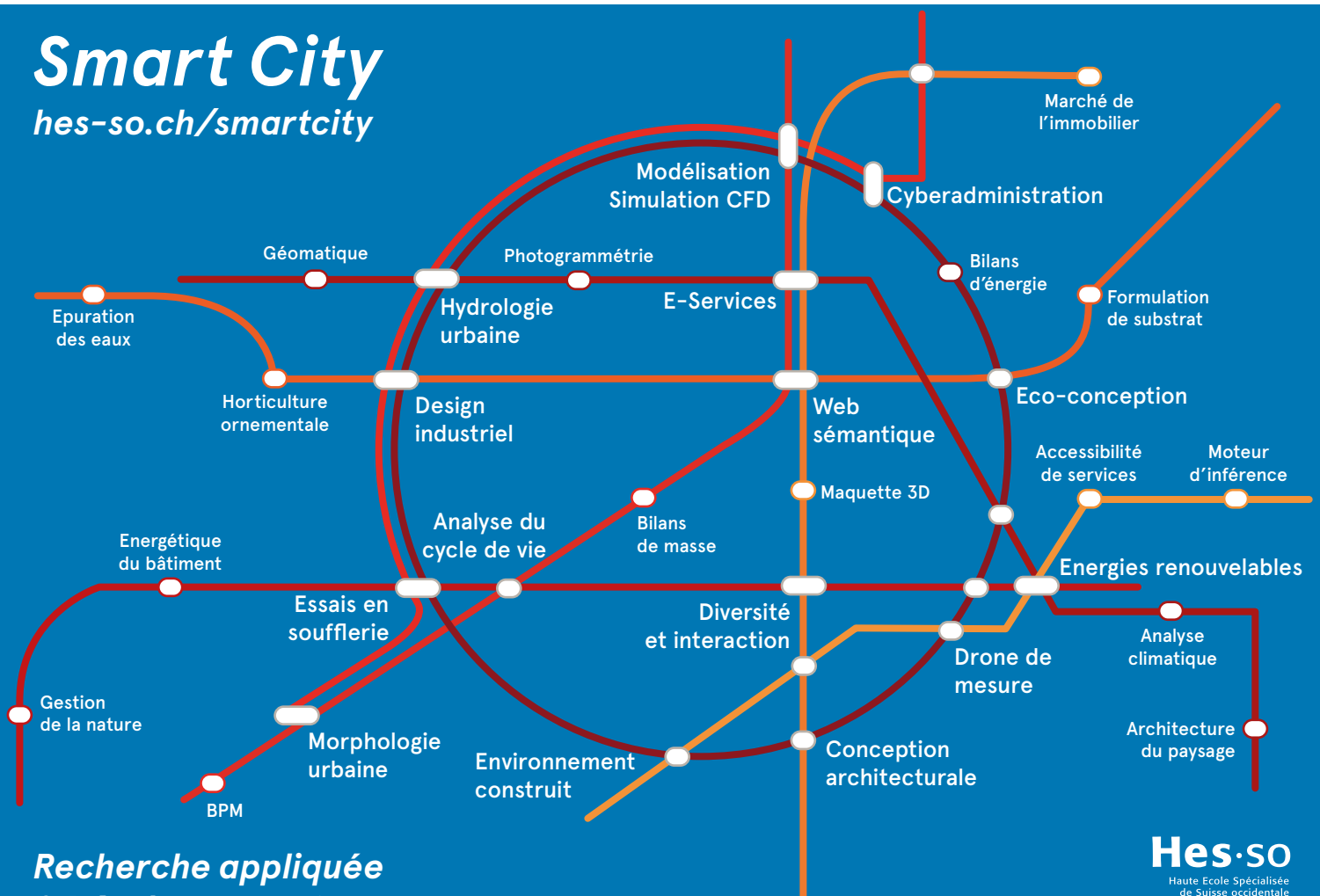


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- Suivi individualisé des premiers pas de votre société.
- Promotion de vos activités par des séminaires dédiés et un vaste réseau de partenaires.
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hes-so.ch/smartcity



**Recherche appliquée
& Développement**

TRENDS IN THE NUMBER OF START-UPS

This overview, drawn up in 2017, has identified 207 start-ups founded in 2006 or later, that are active in the cleantech sector. Between 2006 and 2016, an average of 20 new start-ups per annum were created, with a peak of 34 new companies entered in the commercial register in 2011. The period between 2012-2014 saw the emergence of almost twice as many cleantech start-ups as the three-year period prior to the 2011 peak. On 12 June 2015, the journal “Le Temps” estimated that Switzerland created around 200 start-ups per annum. According to these figures, the cleantech sector would represent around 10% of start-up creations. Since 2015, however, there has been a slow-down in the number of start-ups created per annum in the cleantech sector.

It should be recalled that this overview only includes those start-ups that are still in business. Those which ceased trading during the period in question (collapse, purchase or “dormancy”) are not taken into account for the purpose of this study. It is estimated that there is a greater probability of this in relation to companies founded during the period 2006 to 2010 than after 2011. It is more likely that a company would experience financial difficulties over a prolonged period versus only a few years. Generally, purchases made are of mature companies, which would explain why there are fewer examples of companies from the earlier years. Another explanation is simply that the support programmes for cleantech advanced in 2010 with the Conference on Innovation and Cleantech Masterplan launched by the Federal Councillor Doris Leuthard. Since clean technologies are strongly dependent on the legal framework and on medium and long-term visibility, it is an area where we can readily observe the impact of political decisions on the dynamism of the sector.

EXPLAINING THE REDUCTION FROM 2015 ONWARDS

The reduction in the number of companies started in 2015 onwards can be explained by a loss of confidence in the cleantech sector, in particular energy, due to uncertainty regarding future legislation, or at least a lack of medium-term visibility. An analysis by category can be used to refine this explana-

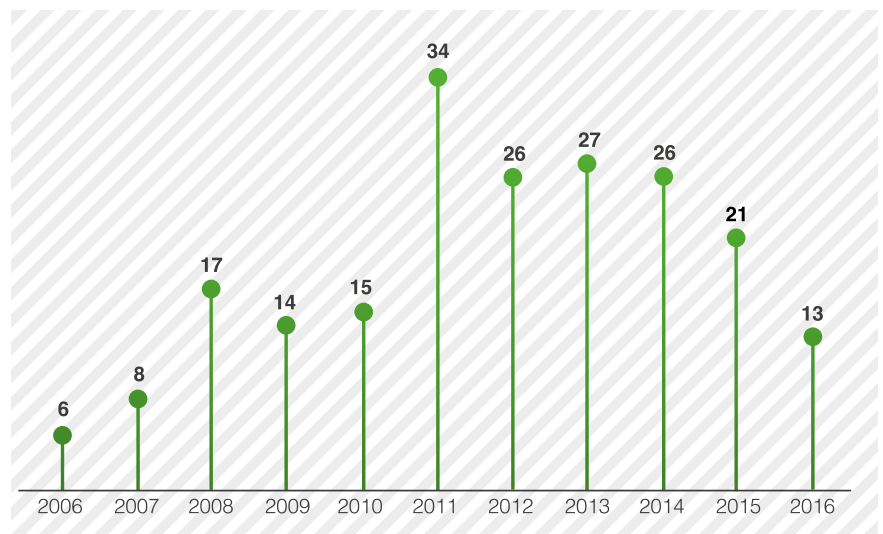
tion. A second reason for this reduction in the number of companies created in 2015 and 2016 could also derive from the fact that these young companies are still less visible and therefore harder to record. Time will tell on this issue.

A third explanation lies in the sometimes negative reputation of the cleantech sector among investors. Founders therefore prefer to position their companies in sectors that are considered more profitable, purely on the grounds of image and perception. In this context, a company developing water treatment applications will communicate itself as a biotech start-up, while others that market products or software for the energy or transport sectors will describe themselves as IT start-ups. This shows entrepreneurs’ creativity in seeking the greatest chances of success for their venture.

THE SAME TRENDS WHEN INCLUDING CONSULTANCIES

The trend is the same if the analysis includes enterprises in the area of sustainability in the broad sense of the term, covering in particular consultancies and service companies, which are not con-

Figure 2: The number of innovative or technological cleantech start-ups with high growth potential, created in Switzerland each year and still active in 2017. ▼



dered in this overview. This group of companies – almost 220 enterprises in the period in question – has undergone a similar drop from 2015 onwards.

This contradicts the suggestion that the observed fall in the number of cleantech start-up creations benefits the foundation of non-technological companies that are not only less risky to develop, but which above all generate a faster return on investment due to the appearance of new energy and environmental requirements (audits, certification, etc.).

NUMBER OF START-UPS PER CANTON

The canton of Vaud leads the field for the greatest number of start-ups in the cleantech sector with 61 companies created since 2006, followed by Zurich with 44. This can be explained by the two Federal Institutes of Technology, EPFL and ETHZ, in these regions.

These are real drivers in the generation of start-ups, and since almost a quarter of Swiss start-ups – around 50 companies – are spin-offs of these two institutions, they are ahead of the other Swiss research centres. The phenomenon of concentration around the two Federal Institutes of Technology and their role as driving forces behind the proliferation of spin-offs across all sectors has already been discussed.

This force of attraction has not escaped the attention of the cantons of western Switzerland, where a dedicated structure has been implemented to facilitate access by top foreign companies to this innovation hub (see box).

It is interesting to note that Valais is in third place even though it does not have

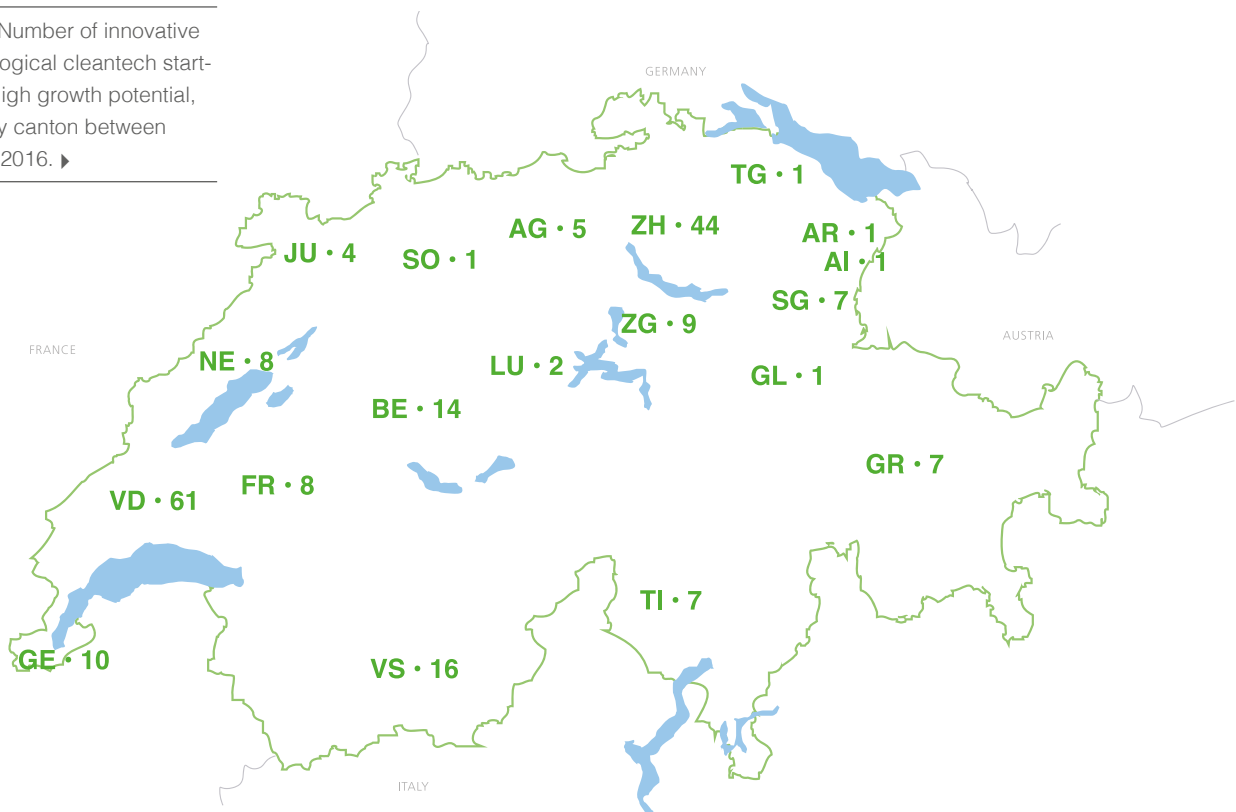
a university. The canton's dynamism can be attributed to its strategy for supporting innovation, which has been in place for more than 10 years and which revolves around The Ark Foundation. This Foundation, whose mission is to "build tomorrow's technology and industry in Valais", offers dedicated support for innovation along three main axes, one of which includes engineering sciences and energy. The concept implemented in this canton with regard to innovation strategy and deployment on the ground is cited as an example by the Swiss State Secretariat for Economic Affairs (SECO) in its New Regional Policy (NPR).

Greater Geneva Bern area, your partner in Switzerland

The Greater Geneva Bern area (GGBa) is the agency for economic promotion in the cantons of Bern, Fribourg, Vaud, Neuchâtel, Geneva and Valais. A region of excellence and innovation, western Switzerland has academic expertise and state-of-the-art knowledge in energy and environmental technologies. The GGBa is the preferred partner for leading companies who wish to establish a presence in the region and establish relations with the academic world and R&D institutes.

www.ggba-switzerland.ch

Figure 3: Number of innovative or technological cleantech start-ups with high growth potential, created by canton between 2006 and 2016. ▶



DISTRIBUTION OF START-UPS BY BUSINESS SECTOR

The sectors of resources (drinking and waste water treatment, waste processing and recycling, environmental and materials technologies) and renewable energy (photovoltaic, smart grids, storage and renewable energy in general) have a strong lead over the transport sector.

More than 30 Start-ups are classed in the “Other” category, with a majority of these considered “hybrid technologies” (cf. Figure 4). In other words, these are technologies that enable the provision of products, services or activities under the cleantech banner, i.e. ones that address an environmental or energy-related issue. These are found, for example, in the fields of the Internet of Things, with start-ups such as Orbiwise or Stemys, electronics with Kandou Bus, and traceability with Fairtrace.

ECO-MOBILITY AND HYBRID TECHNOLOGIES ARE GAINING IN SIGNIFICANCE

A closer analysis of the subcategories (cf. Figure 5) reveals the significance of the fields of eco-mobility and hybrid technologies.

2011 could be considered a turning point in the development of the cleantech start-up ecosystem in Switzerland, due to the large number of new companies created in that year. Hybrid technologies have remained stable throughout the whole period, while green transport has grown by a factor of 3 during the second period (from 2012 to 2016).

In the case of transport, it is interesting to note that bicycles, motorcycles and other electric scooters account for 30% of the new companies, a further third for other vehicles, while other modes of transport (rail, marine and aviation) account for around 20% with seven companies involved. Overall, around 60% of new companies are involved with road-based transport.

This is followed by a grouping of the water, recycling and waste processing, photovoltaic solar power and energy efficiency sectors.

Regarding the growth of these sectors in and around the year 2011, the analysis indicates that it is almost zero for the water-related sectors, shows a slight increase for energy efficiency, a stronger increase for photovoltaics and a very strong increase in the field of recycling and waste processing.

SMART GRIDS AND AGRITECH ARE ALSO EMERGING

The emerging fields of smart grids and agritech (agricultural technologies) are found on a third level together with environmental measurement technologies and advanced materials, with each group comprising around ten companies. The first two sectors show very strong growth over the second period, with their activities effectively taking off in 2011.

No increase is seen in the number of companies created in the field of environmental measurement technologies. The evidence suggests that the effects of COP21 have not yet been realised. It should be noted, that the materials sector has increased in strength since 2011, a trend which is set to continue due to factors such as government targets relating to energy efficiency in buildings.

FALLING FIGURES FOR STORAGE

The low number of start-ups in the field of energy storage – a topic that will have a central role in the future – is surprising. The level of technology required is significant, and Switzerland would therefore be well-placed to make a sizeable contribution here. With one exception, the new companies in this sector have emerged since 2013. This all suggests that the development of this field will follow that of smart grids, which emerged at the third level as seen above. As the specification of subcategories develops along with the sectors, it is quite possible that storage will eventually be integrated with smart grids.

The energy storage and battery industry is nevertheless a specific one. Companies in this sector are often older ones that are reinventing (or renewing) themselves, as described in the 6th phase of the life cycle of a start-up (cf. Table 1). These companies, such as Leclanché to name but one, are not start-ups because of their age; though their business models, management and development strategies and their funding methods are very similar.

This perspective once again illustrates the complexity of the world of cleantech and the need to exercise caution when analysing a particular sector or category, and when discussing trends. It is often essential to take a step back to gain the necessary distance and to identify the reference points, thereby avoiding analyses that are marred by shortcuts,

which may be unrepresentative or even misleading on occasion.

SERVICES, FINANCE, HYDROPOWER, FOOD PRODUCTION AND DISASTER PREVENTION

The categories of services, finance, hydropower, disaster prevention and sustainable food production have very little representation in this overview. It would nevertheless be wrong to suggest a lack of dynamism in these sectors. Young companies active in these areas are often not considered cleantech start-ups due to their lack of technological focus and a lower potential for growth, which means they have not been included in this overview. Taking as an example the categories of “hydropower” and “prevention of natural disasters”, the developments mainly involve consultancies, SMEs and individual tradesmen who incorporate innovation in the services and equipment they provide, without founding a new entity to market the new product. A large number of companies have been created since 2006 in the fields of services, food production and finance. Services, especially in the field of energy audits or environmental consulting, have seen healthy development, with companies such as Quantis, Sofies, Myclimate, and South Pole, which now operate successfully on an international level.

The field of food production is also enjoying growth, with a net increase in the number of companies created during the last five years compared with the years from 2006 to 2011. Companies such as Pakka, Opaline, Entomeal, Choba Choba and Farmy are examples that illustrate the desire to take a new look at production and distribution methods in food production.

BREAKDOWN OF START-UPS BY CATEGORIES AND SUB-CATEGORIES

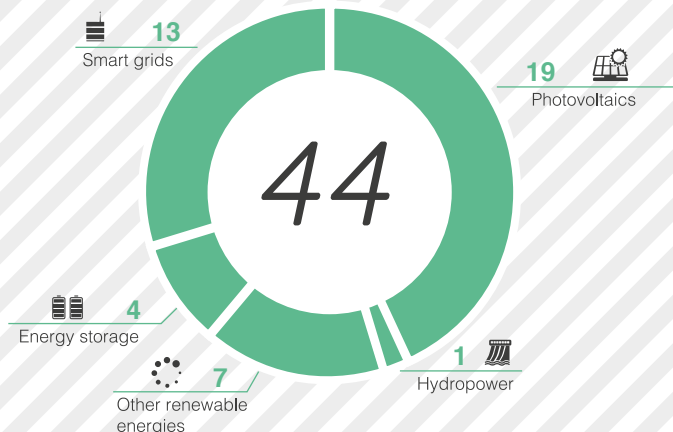
Figure 4

ENERGY EFFICIENCY



19 Energy efficiency

RENEWABLE ENERGY PRODUCTION AND DISTRIBUTION

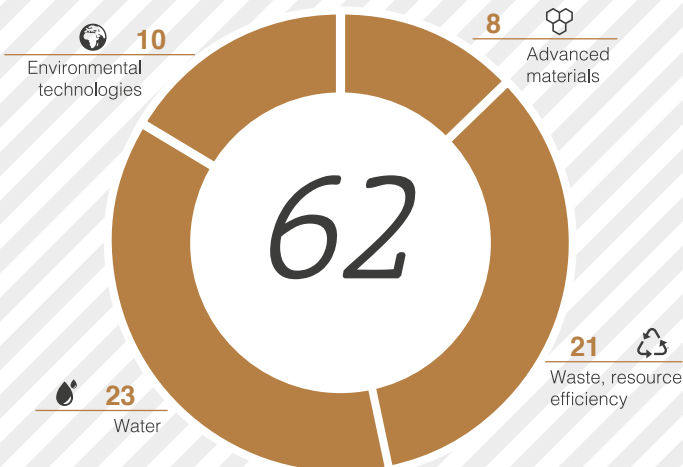


TRANSPORTATION

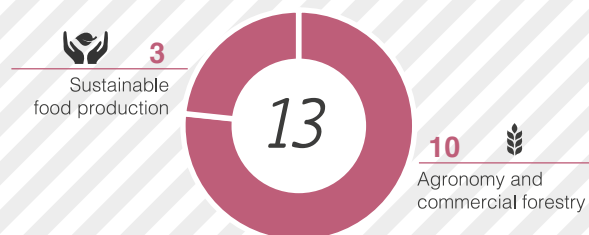


32 Eco-mobility

RESOURCES



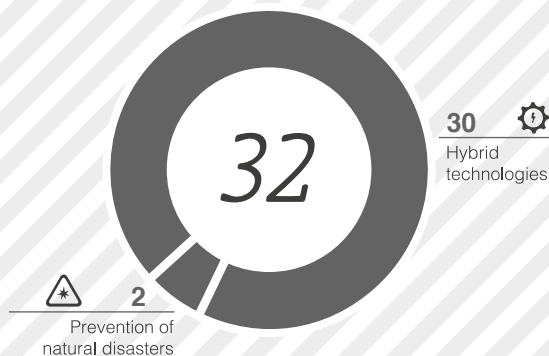
AGRITECH



SERVICES



OTHER



DISTRIBUTION OF START-UPS BY ORIGIN

Regarding the origins of cleantech start-ups, it is interesting to note the dominance of the federal institutes of technology in young companies emerging from the academic sphere, with 31 start-ups originating at EPFL and 19 at ETHZ. These are followed by the universities of applied sciences and arts or UAS (10), universities, EMPA and other research centres, each with 6 companies.

Figure 6 shows that the sources of start-up creations vary widely, offering a wonderful illustration of Switzerland's wealth of research and development facilities. The dynamism of SMEs, with almost 20 spin-offs from small and medium enterprises, is also characteristic of the capacity for innovation of the Swiss industrial fabric. The figure also shows a high density of start-ups arising from personal initiatives.

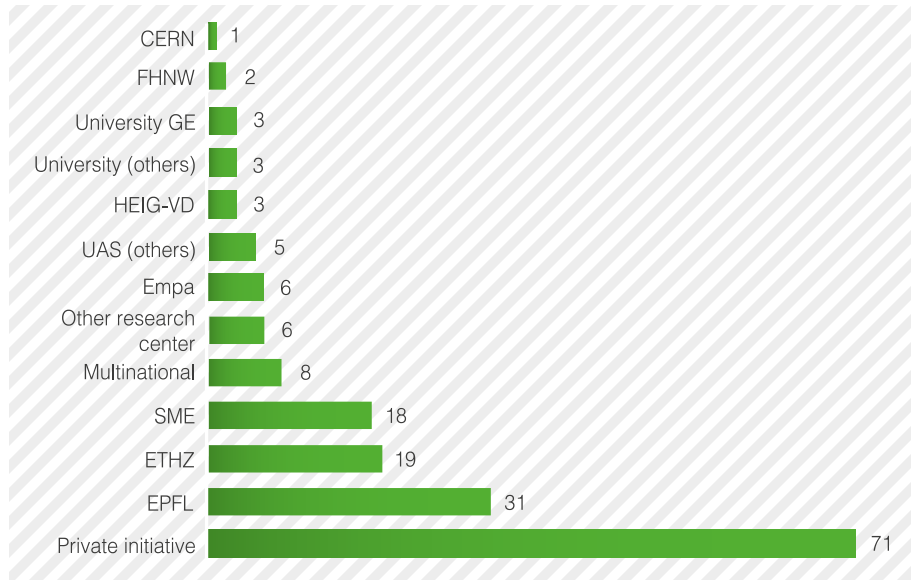
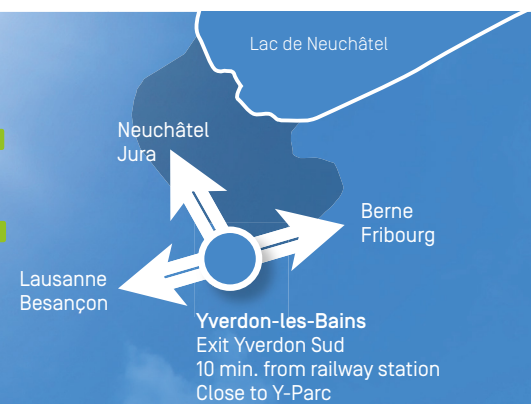


Figure 6: Distribution of start-ups according to their origin. ▲

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TARGET MARKETS

More than 80 start-ups responded to a questionnaire aimed at finding out more about their activities, the main challenges they face and the markets they intend to prioritise.

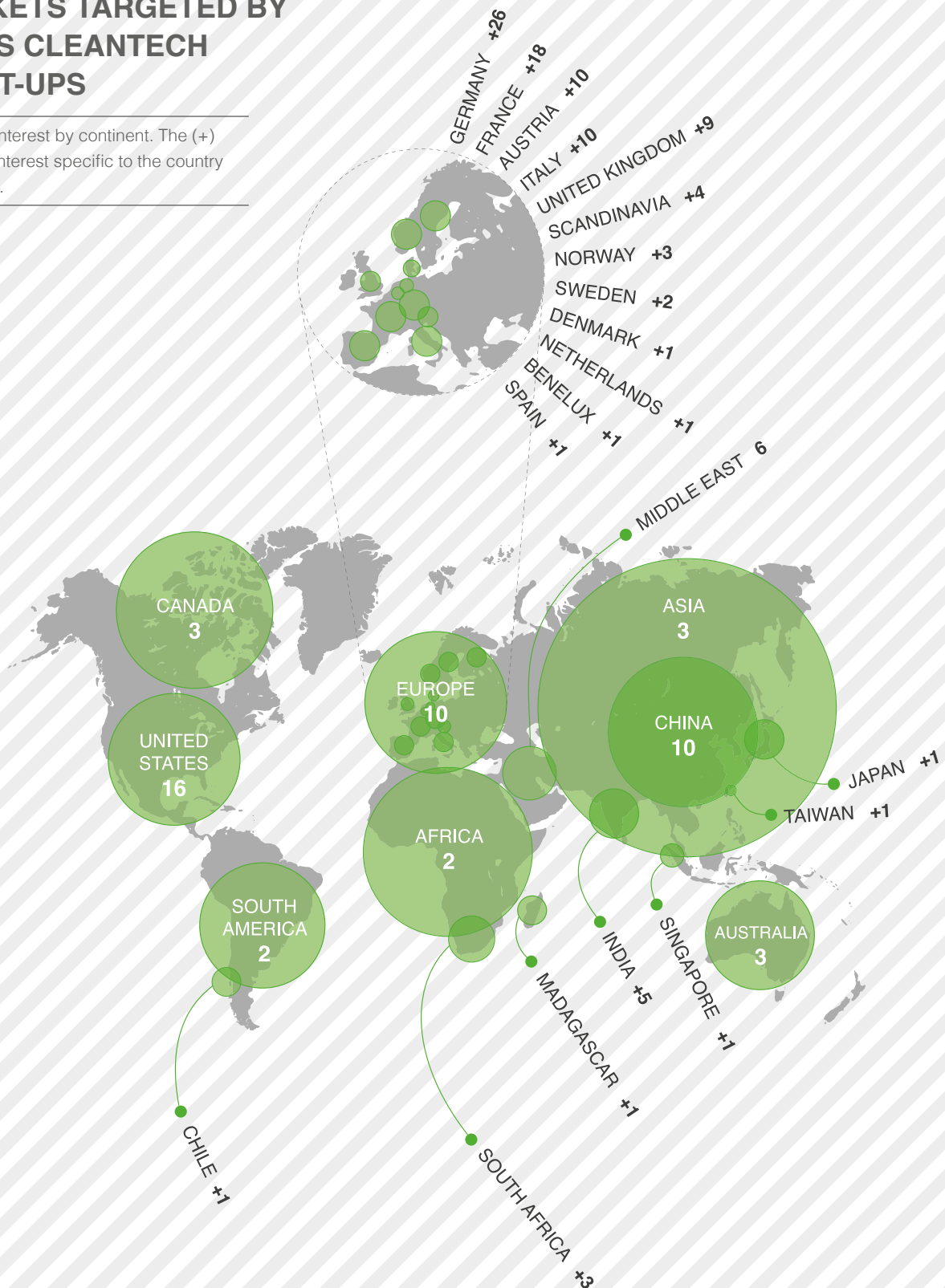
58 of these (72 %) stated that they have an ambition to develop on an interna-

tional scale and therefore have target markets abroad. Europe emerged on top, with 10 start-ups interested in Europe generally and, most significantly, 26 start-ups, almost half (45%), targeting the German market. France (31%), Austria (17%) and Italy (17%) are also natural markets that many start-ups want to conquer.

When it comes to looking beyond Europe, the main target markets are the USA (16, or 27%) and China (10, or 17%). The Middle East (6, or 10%) is also significantly represented.

MARKETS TARGETED BY SWISS CLEANTECH START-UPS

Figure 5: Interest by continent. The (+) indicates interest specific to the country mentioned.



WHAT DO START-UPS NEED?

The survey identified the current major needs of start-ups in the cleantech sector. The main results are illustrated in Figure 7.

The ideas proposed by start-ups to public authorities as possible areas for consideration include in particular:

- Centralisation of the information concerning support and assistance available at the federal or cantonal level. Assistance is very fragmented and therefore difficult for young entrepreneurs to identify and decode.
- Support that is less focused on very technological companies (e.g. assistance from the CTI), but aimed equally at all types of start-ups.
- More opportunities to meet investors. These exist, but cannot always be readily found.
- More links with the local markets, more confidence in start-ups expressed by public authorities and public enterprises.

- Administrative support, more incubators, reduced costs when establishing a new company.
- Programmes that encourage companies to collaborate with start-ups.

GREATER EFFORTS TO PROVIDE INFORMATION ARE NEEDED

It is symptomatic that what is already available within the ecosystem corresponds to two-thirds of the points raised above by the start-ups. This ecosystem is represented in Figure 8 showing the players grouped according to their roles and activities.

It clearly shows that the players need to make greater efforts to disseminate information, to ensure that young companies are aware of their services. The report “Promotion offering for energy innovation in Switzerland to SMEs and research institutes” gives an overview on the various offers regarding innovation promotion. The report is available on the website of the Swiss Federal Office of Energy (SFOE):

www.bfe.admin.ch/cleantech (Promotion of energy innovations in Switzerland).

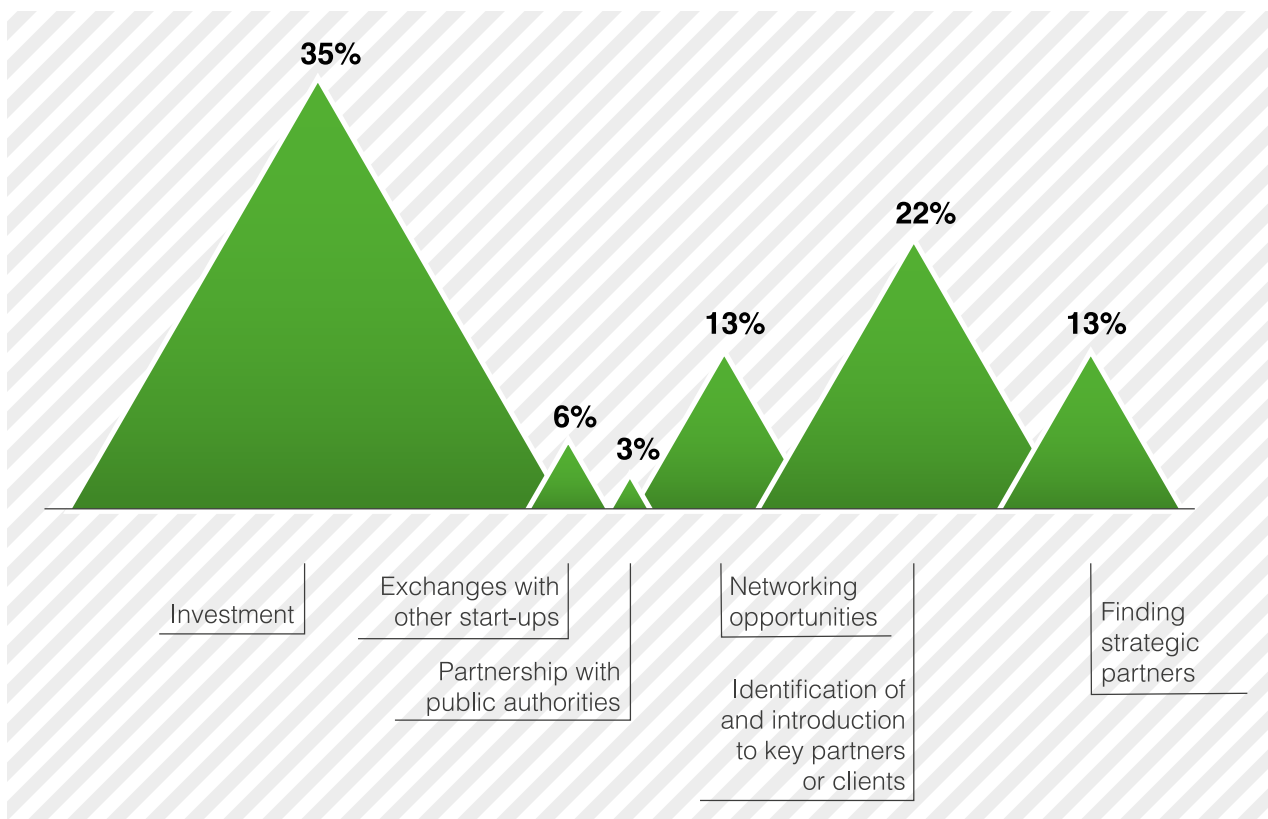
A detailed list of those involved in providing support for innovation in western Switzerland can be found on the CleantechAlps portal under the following link:

www.cleantech-alps.com/en/soutien.

There is also a page dedicated to events in the sector, including investment forums: www.cleantech-alps.com/en/actualites/evenements.

The overview of the players involved in funding, together with their tools, as presented in the second part of this overview, is also a partial response to the points raised above.

Figure 7 : Current needs of cleantech start-ups. ▼



THE **CLEANTECH** ECOSYSTEM IN SWITZERLAND

Figure 8

AMBASSADOR PROJECTS

- › Planet Solar
- › Solar Impulse
- › Solar Stratos
- › Cabane Monte Rosa
- › Aventor
- › Biomobile
- › Waste incineration plant ZAR
- › Swisswoodhouse

INDUSTRY

- › Start-ups
- › SMEs
- › Large companies
- › Engineering practices
- › Utilities

ASSOCIATIONS*

- › Swiss Solar Connect
- › Swiss Solar
- › SuisseEole
- › Energie-cluster
- › Reffnet
- › SSIGE

* (with sectoral interest)

ACADEMIC INSTITUTIONS

- › EPFL/ETHZ
- › Universities
- › Universities of Applied Sciences (UAS)
- › Empa
- › PSI
- › EAWAG
- › CSEM
- › SCCER (CREST, FURIES, ...)
- › eEnergy Center & Gridlab
- › Bits to Energy Lab
- › i-Home Lab

INCUBATORS AND TECHNOLOGY PARKS

- › TecOrbe (VD)
- › BlueFactory (FR)
- › Energypolis (VS)
- › Tripole (VD)
- › Neode (NE)
- › Bluebox (GE)
- › BlueArk (VS)
- › TECHNOPARK (AG, ZH, LU, etc.)

FACILITATORS

- › CleantechAlps
- › ÖBU
- › Swiss Water Partnership

LOCAL PLAYERS

- › Cantons
- › Chamber of Commerce
- › Cleantech FR, Cleantech cluster AG, ZG, etc.
- › Impact Hub ZH/GE/BE
- › Basel Area

SWISS CONFEDERATION

- › SFOE
- › FOEN
- › CTI
- › SDC
- › SERI
- › Seco

SEMI-PUBLIC ORGANISATIONS

- › Swissnex (Boston, SF, etc.)
- › Swiss Business Hub (EAU, F, etc.)
- › Switzerland Global Enterprise
- › GGBa

INTEREST GROUPS

- › swisscleantech
- › Swissmem
- › AEE

FUNDING MECHANISMS

Sounding out the situation among start-ups confirms, without a doubt, that funding is their major preoccupation. Public authorities, individuals, venture capitalists and banks are among the numerous players involved in the entrepreneurial ecosystem who handle the all-important topic of funding. The objective of this second part is to clarify the situation regarding the players, their roles, the instruments or tools they have available to them and the funding stages within which they operate.

START-UPS FUNDING STAGES

The course of a start-up is difficult, tortuous, beset by obstacles and problems, but nevertheless brings satisfaction and rewards. The start-up constantly has to adapt in order to overcome the challenges it faces. These challenges gradually evolve over the course of the company's development, as do its responses to them, including investments.

Figure 9 illustrates the funding stages in terms of investment volume and funding requirements in relation to the phases of development of a start-up.

Figure 9: Investment volume according to the maturity of the start-up. ▼

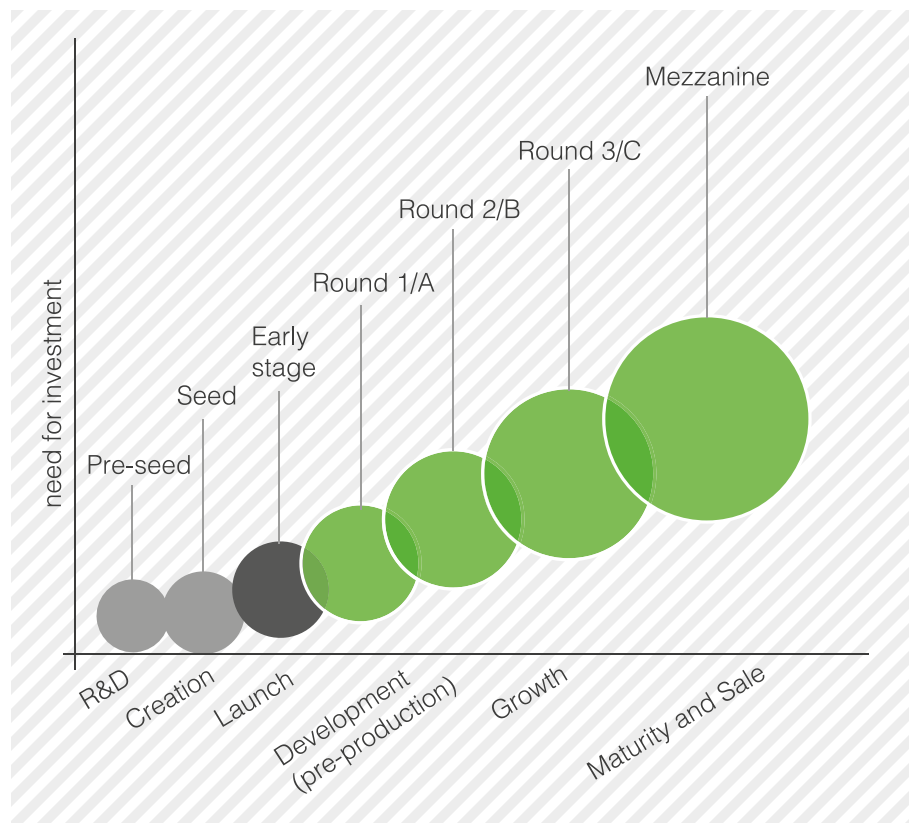


Table 2 describes the main phases involved in funding a start-up.

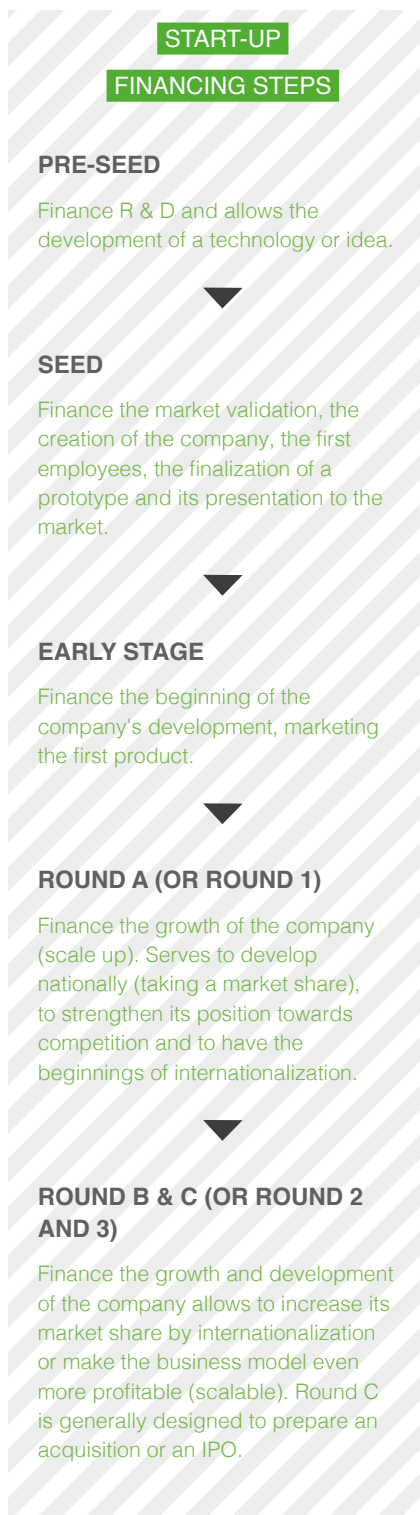


Table 2

FINANCING MECHANISMS

There are various funding mechanisms, each with its advantages and disadvantages, that may be more or less suitable depending on the development phase, type of company and any specific requirements. Table 3 gives an overview of these various mechanisms.



Table 3

THE VARIOUS KINDS OF FUNDING SOURCES

There are various kinds of organisations who support or interact with start-ups and the world of entrepreneurship.

Although they can be classified into categories, it is also true that each has its own specific characteristics. The diagram in Figure 10 sets out to describe which organisations intervene when in the development phases of a start-up. Nevertheless, every start-up is different and every investor has its own set of rules.

For example, although an “impact investor” (an investor concerned with the sustainability of the projects it supports) tends to be interested in companies at a certain level of maturity and to use a loan mechanism, some may still invest capital in younger start-ups.

Public institutions implement research and development programmes, security

schemes, awards and various initiatives such as MAtCH, launched by the Swiss Federal Office of Energy (SFOE), or the CTI's Business Bootcamp. Some business angels may invest tens of thousands of Swiss francs, others running to hundreds of thousands. In general, the more a start-up develops, the more funds it will need to move on to the next phase, obliging it to approach funding sources with larger sums at their disposal.

The key for start-ups is without doubt to be able to show an increase in value at each stage of development.

Figure 10: Which financial actors are involved in financing start-ups and in which stages? ▼

FINANCIAL ACTORS	FUNDING STEPS					
	Pre-seed	Seed	Early stage	Round A	Round B	Round C
Accelerator (acceleration programme)		●				
Bank					●	●
Business Angel		(●)	●	(●)		
Venture Capitalist - VC			(●)	●	●	●
Cooperative			●	(●)		
Corporate Venture			(●)	●	●	●
Family Office				(●)	●	
FF&F (Fools, Family & Friends)		●				
Founder	●	●				
Foundation		●	●			
Impact Investor				●	●	●
Incubator		●	●			
European Public Institutions (H2020, ...)	●					
National Public Institutions (CTI, SFOE, FOEN, ...)	●	●	●			
Cantonal Public Institutions		●				
Industrial Partner (R&D)		(●)	●	●	●	
Crowdfunding Platform		(●)	●			

● Core target (●) Possible Intervention

THE PRINCIPAL FINANCIAL ACTORS

Accelerator	A programme dedicated to entrepreneurs, the objective of which is to accelerate the growth of start-ups or enterprise projects. An accelerator may offer numerous services, infrastructures, networks or funding. Acceleration programmes vary widely.
Bank	A financial institution whose main function is to offer financial services such as holding savings, receiving deposits of money, granting loans, managing payment methods.
Business Angel	A “providential investor”, an individual who invests some of their wealth in a young company with strong potential for innovation. In addition to investing capital, a business angel also provides the entrepreneur with their personal networks and experience.
Venture Capitalist	Investors who contribute capital, their networks and their experience to the creation and early stages of development of innovative enterprises or technologies that they deem to have a strong potential for growth and return on their investment.
Cooperative	A combination of a group of people and an enterprise founded on the basis of economic participation by its members, in terms of capital or sweat equity. Its organisation and functioning are characterised by principles and values that give the cooperative a universal character whatever its objects or sector of activity.
Corporate	A private enterprise (large company, industrial group or multinational) that wishes to support start-ups, for example by means of a prize or specific programme, often with the objective of promoting their own image, in the interests of business intelligence or in the spirit of open innovation.
Corporate Venture	Venture capital funds originating with large industrial groups. “Corporate ventures” generally have a financial objective and a strategic intelligence objective in a specific sector.
Family Office	An organisation made up of people in charge of managing the assets of one or more wealthy families.
FF&F (Friends, Family and Fools)	Friends, family and acquaintances of the project initiator or the company founder.
Founder	An individual or legal entity who participates in the creation of a business and who is responsible for undertakings made in the name of the business prior to the date of the definitive constitution.
Foundation	A legal entity under private law created for non-profit aims by one or more donors, who may themselves be persons or legal entities, to accomplish works in the public interest.
Impact Investor	Investors with a dual objective: to have a positive social or environmental impact while making a financial gain.
Incubator	A public or private organisation that supports the launch of start-ups. Incubators provide various different types of support (premises, equipment, expertise, networks, etc.); some also offer grants and financial assistance to get businesses off the ground.
Public institutions (European, national, cantonal)	All the public bodies that provide services in the public interest.
Industrial partner (R&D)	An industrial group or SME that (co-)finances the development of a start-up (which in general represents a strategic interest in terms of R&D).
Crowdfunding Platform	These offer tools and methods for financial transactions that appeal to a large number of people who come together to fund a project. This type of funding source currently suffers from an unfavourable legal framework that, among other things, limits private investments for projects beyond territorial boundaries.

Table 4

KEY SWISS FUNDING PLAYERS AND INSTRUMENTS IN THE CLEANTECH SECTOR

As part of this overview, we present an outline of the key players in the cleantech field who have actively supported or invested in start-ups in Switzerland. They are presented by category in this section.

Among these organisations, 80% are private entities, including six foundations and four crowdfunding platforms. Eleven major public bodies have been listed. Some are specially targeted at the cleantech sector, offering dedicated assistance schemes such as:

- the Swiss Federal Office of Energy (SFOE) with its pilot and demonstration programme, as well as the flagship projects programme;

▸ the Swiss Federal Office for the Environment (FOEN) with its Technology Fund and its programme for the promotion of environmental technologies;

▸ the Swiss Climate Foundation and Climate-KIC.

Many other organisations, such as the CTI, the Zurich Cantonal Bank and the platform investiere.ch, aim their programmes at start-ups, whatever their field of activity.

PRIVATE SOURCES OF FUNDING

The following table gives a global view of the private sources of funding in the Swiss cleantech start-up ecosystem.

Family offices and business angels are probably the hardest to record. In the case of business angels, we have indicated the associations with a national reach. It should be noted that they are often organised through local representatives. These usually take the form of clubs where businesses can meet investors, or centralised platforms, such as Investiere, which facilitate obtaining funds from this kind of source.

MA+CH Start-Up Exchange Massachusetts (MA) Switzerland (CH)

Grow your cleantech business in Massachusetts (CH-companies) or in Switzerland (MA-companies)

- Receive up to three months of complimentary membership at a cleantech incubator
- Attend selected networking events
- Participate in workshops on how to enter the respective foreign market
- Gain direct access to experts and individuals in the cleantech sector
- Win a grant of up to \$5,000



Program flyer, application and further start-up-offers:

www.bfe.admin.ch/startup

A3 Angels	A club of private investors and mentors, alumni of EPFL, who provide support for, and may offer kick-start funds for, start-ups originating at EPFL or having a connection with the institution. <ul style="list-style-type: none"> ▶ www.a3angels.ch
ABB Technology Ventures - ATV	Particular interest in industrial and energy-related technologies, without geographical limitation, investment between USD 1 and 20 million. <ul style="list-style-type: none"> ▶ http://new.abb.com/about/technology/ventures
Alternative Bank Switzerland	The innovation fund encourages various initiatives, making capital (seed capital) available in the form of participation or by granting loans or providing security. <ul style="list-style-type: none"> ▶ www.bas.ch
Aravis Ventures	A private equity fund with a particular interest in companies in the field of renewable energy production (wind, solar, hydro). <ul style="list-style-type: none"> ▶ www.aravis.ch
b-to-v Partners AG	80% of the funds are invested in start-ups in Switzerland, Germany and Austria, mainly in the fields of the Internet, medtech and cleantech. b to v invests from the creation phase onwards, with amounts between EUR 20,000 and 10 million. <ul style="list-style-type: none"> ▶ www.b-to-v.com
BKW	BKW offers tailor-made commercial and technological partnerships with start-ups including, in certain cases, acquiring a holding. <ul style="list-style-type: none"> ▶ www.bkw.ch/fr/le-groupe-bkw/notre-engagement/start-up-bkw
Business Angels Switzerland	A private investors' club for start-ups whose capital requirements are between CHF 50,000 and CHF 2,000,000. <ul style="list-style-type: none"> ▶ www.businessangels.ch
Capital Risque Fribourg SA	The maximum funding is CHF 750,000 per project, and the first amount is generally limited to CHF 300,000. A minority holding is acquired on a time-limited basis. Start-ups must have operations and create jobs in the canton of Fribourg. <ul style="list-style-type: none"> ▶ www.capitalrisque-fr.ch
Climate-KIC	An 18-month programme, organised in 3 phases, enabling companies to draw on up to EUR 20,000 (stage 1), EUR 25,000 (stage 2) and EUR 50,000 (stage 3). <ul style="list-style-type: none"> ▶ www.climate-kic.org/for-entrepreneurs/accelerator
DuPont Ventures	Equity shares and technological support in a wide variety of sectors, focusing in particular on fields that promise rapid growth and those in the cleantech sector. <ul style="list-style-type: none"> ▶ www.dupont.com/corporate-functions/our-approach/innovation-excellence/science/science-collaboration/dupont-ventures.html
Emerald Technology Ventures	Particular focus on energy, materials, agriculture and water. Manages more than CHF 375 million and supports 55 start-ups. Launched an evergreen fund with various industrial partners in 2016 (Emerald Industrial Innovation Fund LP). <ul style="list-style-type: none"> ▶ www.emerald-ventures.com
Energy Uster AG	Development of pilot projects and other specific projects in cooperation with start-ups in the field of energy. <ul style="list-style-type: none"> ▶ www.energieuster.ch
Fongit Seed Invest SA - FSI	Investments of CHF 50,000 to 500'000 in various sectors, including cleantech. <ul style="list-style-type: none"> ▶ https://go-beyond.biz
Foundation of the Founders (Venturekick)	CHF 130,000 for the launch of a start-up, granted in three stages of CHF 10,000, 20,000 and 100,000. Reserved for projects originating in a Swiss academic institution. <ul style="list-style-type: none"> ▶ www.venturekick.ch
Gebert Rűf Foundation	Financial support for start-ups that are not yet able to satisfy the requirements of venture capitalists. <ul style="list-style-type: none"> ▶ www.grstiftung.ch
Go Beyond Early Stage Investing	A group of private investors who can respond to requests for amounts between CHF 100,000 and 2,000,000. <ul style="list-style-type: none"> ▶ https://go-beyond.biz

Innovaud	Give visibility to high growth start-ups, in particular, those with an annual employee growth rate larger than 20%. <ul style="list-style-type: none"> ▸ www.scale-up-vaud.ch/en/our-action
Investiere - Verve Capital Partners	A crowdinvesting platform that brings together private investors for projects with strong potential whose funding requirements are between CHF 500,000 and 2,500,000. <ul style="list-style-type: none"> ▸ www.investiere.ch
LUKB Wachstumskapital AG	A venture capital tool from the Luzerner Kantonalbank, for the acquisition of equity or mezzanine financing. The fund seeks investments of between CHF 250,000 and 800,000 for acquisitions of 10 to 33%. <ul style="list-style-type: none"> ▸ www.lukb.ch/web/lukb/-/unternehmensportrat
MassChallenge Switzerland	An accelerator that provides an intensive 4-month programme and may make funds available. <ul style="list-style-type: none"> ▸ http://switzerland.masschallenge.org
Microsoft	The Microsoft programme enables companies to benefit from free services and support, for an amount up to USD 120,000. <ul style="list-style-type: none"> ▸ https://bizspark.microsoft.com/about/plus
ONE CREATION	Acquisition of holdings in activities that produce goods and services aimed at measuring, predicting, limiting or correcting adverse environmental events affecting water, air or soil, and problems relating to waste, noise and ecosystems. <ul style="list-style-type: none"> ▸ www.onecreation.org
P&TS SA (Patentattorneys.ch)	CHF 20,000 in annual grants provided in the form of intellectual property services to socially responsible SMEs/start-ups aiming at protecting inventions in areas such as renewable energies, global warming or environmental protection. <ul style="list-style-type: none"> ▸ www.patentattorneys.ch/en/industries/innovation-ethique
Polytech Ecosystem Ventures	A venture capital fund focusing on technological start-ups in the early stage. <ul style="list-style-type: none"> ▸ https://polytechecosystem.vc
Romande Énergie	Implementation of pilot projects in the field of energy. <ul style="list-style-type: none"> ▸ www.romande-energie.ch
Sandoz Foundation	This foundation tends to invest in projects by start-ups that are in line with the foundation's mission. <ul style="list-style-type: none"> ▸ www.sandozfoundation.ch
Seed4Equity	An impact investing fund that also invests in start-ups. <ul style="list-style-type: none"> ▸ www.seed4equity.com
Services industriels de Genève -SIG (utilities)	This Fund finances projects in French-speaking Switzerland relating to research, academic studies, the development of experimental systems, the construction of prototypes in the field of electricity production and heat generation, based on new sources of green energy, and in the field of energy savings. <ul style="list-style-type: none"> ▸ www.sig-ge.ch/onglets/Pages/electricite-vitale-vert-fonds-sig.aspx
StartAngels Network	The StartAngels investors seek out early-stage Swiss companies in various sectors, generally investing between CHF 50,000 and 200,000 per member. In the case of co-investments, the total amount may be increased to CHF 1 or 2 million. <ul style="list-style-type: none"> ▸ en.startangels.ch
Statkraft Ventures	Projects in the energy sector and any related sector, at the build-up and growth phase, in the geographical zone of Europe. Investment between EUR 500,000 and EUR 4 million. <ul style="list-style-type: none"> ▸ www.statkraftventures.com
Stiftung für innovation Entwicklung und Forschung Graubünden (Foundation)	This foundation awards financial contributions and loans to exceptional projects with particular added value. The projects must be innovative and be oriented towards sustainability in the canton of Graubünden. <ul style="list-style-type: none"> ▸ www.gr.ch/DE/institutionen/verwaltung/dvs/awt/innovation/ueberuns/Seiten/default.aspx

SUSI Partners	SUSI Partners is an investment fund that specialises in the field of energy infrastructures. <ul style="list-style-type: none"> ▸ www.susi-partners.ch
Swiss Climate Foundation	This foundation provides financial support for innovative projects that contribute to a reduction in the impact of climate change. Companies with less than 250 employees are eligible, provided that less than half of their capital is held by a large group and/or a public organisation. <ul style="list-style-type: none"> ▸ www.klimastiftung.ch
Swiss start-up Invest	A platform bringing together various investors interested in technological and innovative start-ups in Switzerland. <ul style="list-style-type: none"> ▸ www.swiss-startup-invest.ch
Swisscom Ventures	Since its launch in 2007, the fund has supported more than 35 start-ups. It invests amounts below CHF 1 million in Switzerland, in companies in the early stage. <ul style="list-style-type: none"> ▸ www.swisscom.ch/en/ventures
The Ark Foundation	Loans and funding for innovation project development, amounts typically range between CHF 50,000 and CHF 100,000. <ul style="list-style-type: none"> ▸ www.theark.ch/incubator
The Foundation for Technological Innovation (FIT)	FIT SEED : loan of max. CHF 100,000 granted essentially for the launch of a company's activities (after less than 12 months of existence). The project must be realised in cooperation with a Swiss university, or originate from one. FIT EARLY : interest-free loans of CHF 300,000 to CHF 500,000, subject to the condition of match funding for the project by private investors. The project must be realised in cooperation with a Swiss university, or originate from one. FIT GRANT : funding such as Innogrant (EPFL), InnoTREK (UNIL/CHUV), etc. for projects with the objective of creating an innovative company with strong added value. <ul style="list-style-type: none"> ▸ www.fondation-fit.ch
VI Partners	VI Partners is a venture capital fund of the evergreen fund type with paid-in capital of CHF 101 million, established by McKinsey & Company and ETH Zurich. <ul style="list-style-type: none"> ▸ www.vipartners.ch
VNT Management	A fund based in Finland and Germany, active in the German-speaking regions, with total capital of over EUR 150 million, focusing on renewable energies and energy efficiency. <ul style="list-style-type: none"> ▸ www.vntm.com
Volkswirtschaftsstiftung (Swiss Federal Foundation for Promotion of the National Economy through Scientific Research)	Interest-free loan up to maximum CHF 150,000, awarded each year to 4 to 6 start-ups. <ul style="list-style-type: none"> ▸ www.volkswirtschaft-stiftung.ch
Zühlke Venture	Venture capital fund focusing on technology start-ups. <ul style="list-style-type: none"> ▸ www.zuehlke.com/ch/en/ventures
Zurich Cantonal Bank Start-up Finance	CHF 15 million invested every year in start-ups in the Zurich region. The amounts invested are between CHF 300,000 and 1 million. <ul style="list-style-type: none"> ▸ www.zkb.ch
4FOVentures	An early stage investment fund (capital of CHF 50 to 80 million) aimed at Swiss start-ups, reserved for family offices and qualified investors. Its objective is to invest between CHF 2 and 5 million per company in the first funding rounds.

PUBLIC SOURCES OF FUNDING

These mainly concern the federal offices (SFOE, FOEN, SDC), the CTI and the European Union. The primary initiatives and programmes are shown in the table below.

These institutions, like those at the cantonal level, are in touch with the needs of companies and regularly offer schemes specific to their context. It would be unrealistic to attempt to draw up a truly comprehensive catalogue

of all that is on offer, since services evolve just as the markets for cleantech do. It is advisable to check the portals of the relevant public administrations regularly.

Commission for Technology and Innovation (CTI)	<p>Grants for R&D projects carried out in cooperation with a Swiss university (federal institute of technology, university of applied sciences, university). The CTI funds half the costs of a project for activities by the institutional partners.</p> <ul style="list-style-type: none"> ▶ www.kti.admin.ch
CTI Market Entry Camp, Swissnex and SFOE	<p>Offers support for export-oriented start-ups. An example in the energy domain is the MAtCH program, which supports exchanges between Switzerland and Massachusetts (USA).</p> <ul style="list-style-type: none"> ▶ www.bfe.admin.ch/cleantech (Start-Up Promotion)
Department for Development and Cooperation (SDC)	<p>A public-private partnership granting interest-free loans of a maximum of CHF 250,000 for start-ups active in the field of water.</p> <ul style="list-style-type: none"> ▶ https://swissbluetecbridge.ch
European Space Agency - ESA	<p>ESA BIC is an ESA programme that supports start-ups whose technology and applications are connected with the field of aerospace. ESA BIC in Switzerland can give assistance to up to 10 start-ups per annum, with amounts from EUR 50,000 to 450,000. The support is arranged in several phases and also includes networking and coaching.</p> <ul style="list-style-type: none"> ▶ http://esabic.ch
European Union	<p>The H2020 is a grouping of a number of mechanisms for funding multi-partner programmes at European level. The H2020 programme is one of the main contributors to R&D on a European level.</p> <ul style="list-style-type: none"> ▶ https://ec.europa.eu/programmes/horizon2020
Joint initiative by several Swiss Federal Offices	<p>A grant for Swiss projects in the field of renewable energy and/or energy efficiency. The project must provide a response to a local need and must be able to be managed locally in a way that is independent and sustainable. The REPIC contribution does not exceed 50% of the cost of the project and is subject to a maximum amount of CHF 150,000.</p> <ul style="list-style-type: none"> ▶ www.repic.ch
Privately managed public initiative (FOEN/Emerald Venture)	<p>The Technology Fund provides security for loans to Swiss enterprises offering innovative products that enable a sustainable reduction in greenhouse gas emissions to be achieved.</p> <ul style="list-style-type: none"> ▶ www.technologyfund.ch
Stadtwerk Winterthur (utilities)	<p>Programmes arranged by the town of Winterthur for investment in projects that enable greenhouse gas emission to be reduced.</p> <ul style="list-style-type: none"> ▶ http://stadtwerk.winterthur.ch/nachhaltigkeit/klimafonds
Swiss Federal Office for the Environment (FOEN)	<p>The programme for the promotion of environmental technologies may award a grant of maximum 50% of the total costs of the development of a product, a technology or a process in the environment field.</p> <ul style="list-style-type: none"> ▶ www.bafu.admin.ch/bafu/fr/home/themes/formation/innovation/promotion-des-technologies-environnementales.html
Swiss Federal Office of Energy (SFOE)	<p>A support programme from the Swiss Federal Office of Energy (SFOE) for pilot projects, demonstration projects and flagship projects, which encourages the development of innovative technologies and solutions with a market focus, especially in the fields of the economic and rational use of energy and renewable energies. A maximum grant of 100% for research projects and up to 40% of non-depreciable costs for pilot, demonstration and flagship projects.</p> <ul style="list-style-type: none"> ▶ www.bfe.admin.ch/cleantech

COMPETITION AND AWARDS

Awards are also an interesting funding instrument in the early phase of a company, especially because of the visibility they confer.

The awards shown below have been

chosen either because they draw on large amounts of money or because they are specifically aimed at start-ups in the cleantech sector. As part of organisation of the “Suisse des Talents” event, an overview of all the awards in

Switzerland (www.theark.ch/guide) was drawn up by The Ark Foundation.

Climate-KIC	Climate Launchpad	A prize of EUR 17,500 per annum shared between 3 prizes (10K, 5K and 2.5K). The prize is awarded following a 2-day boot camp and intensive coaching. http://climatelaunchpad.org
Dr. René Liechti Foundation	Liechti Prize, “Coup de Pouce”, for young entrepreneurs	A prize for start-ups, endowed with CHF 50,000 per annum, which rewards an innovation or sustainable progress in fields such as the economy, ecology, health, combatting poverty, and vital needs. www.fondation-liechti.ch
Lausanne Region	PERL “Prix Entreprendre Région Lausanne” (Lausanne Region Entrepreneurship Prize)	Prizes of CHF 100,000 per annum for 3 companies in the Lausanne region (50K, 30K, 20K). www.prixentreprendre.ch
Robert and Ruth Heuberger Foundation	Young Entrepreneur Prize/Heuberger Winterthur Prize	An annual prize of CHF 150,000 for the top three and CHF 50,000 to three runners-up. www.jungunternehmer-preis.ch

«Our business association supports the concerns of start-up companies: networking, innovation and an optimum policy framework. That is why we have joined **swisscleantech**.»



Social Entrepreneurship Impact & Finance - SEIF	Prize: SEIF Awards	Four prizes of CHF 10,000 are awarded each year to social enterprises whose aim is to generate a profit while having a positive impact. ▶ seif.org
Swiss start-up awards	AXA Innovation Award	CHF 50,000 per annum for innovative start-ups. ▶ www.axa.com
Swiss start-up awards	Axpo Energy Award	CHF 50,000 per annum for start-ups in the field of energy production, energy technologies, energy transfer and storage and electrical engineering. ▶ www.axpo.com/axpo/ch/en/about-us/engagement/innovation.html
Swiss Sustainable Development Forum - eco.ch	eco.swisscanto Prize	Prize of CHF 30,000, divided among several recipients. ▶ www.eco.ch
W.A. de Vigier Stiftung	Young Entrepreneur Award	A prize endowed with CHF 100,000 per annum (awarded to up to 5 companies per annum). ▶ www.devigier.ch
Zurich Cantonal Bank - ZKB	ZKB Pioneer Prize	Prize of around CHF 100,000 per annum. ▶ www.pionierpreis.ch
Zurich Assurance	Zurich Climate Prize Switzerland & Liechtenstein	Prize of CHF 150,000 per annum and a special prize for start-ups. ▶ www.prixclimatique.zurich.ch

CROWDFUNDING PLATFORMS

Crowdfunding platforms are a special kind of private funding currently emerging within the ecosystem. They have been increasing in popularity in the past few years, offering an interesting alternative source of funding, although the total amount of funds raised by this type of source is currently very low when compared with the funds from classical investors.

A distinction should be made between crowdfunding platforms that enable pre-sales to be offered (such as Kickstarter) and equity crowdfunding platforms (also known as crowdinvesting) that enable shares in a company to be bought, although some platforms offer both types.

There is also donation-based crowdfunding (no returns or payments to

backers), crowd supporting (backers receive modest rewards such as free tickets, acknowledgements, etc., but not an actual return on investment) and crowdlending (a loan with a return that includes a repayment of the principal plus a specified yield).

A successful crowdfunding campaign involves both skill and excellent preparation. This activity is more suited to companies with B2C (business-to-customer) activities, which have access to a large community of users. The idea of using a crowdfunding campaign as a marketing exercise should not be ruled out, thereby killing two birds with one stone.

In the United States, the company Nebia has successfully run an excellent crowdfunding campaign, raising more than USD 3 million for the pre-sale

of a particularly high-performance shower system, which is currently being launched on the market.

In Switzerland, the company Velohub has also used this approach to raise CHF 50,000.

The Swiss association of crowdfunding platforms provides further information on this subject and has some interesting links:

www.swisscrowdfundingassociation.ch

Indiegogo	A crowdfunding platform that in particular, together with Microventures, provides for capital crowdfunding (crowdequity) for buying shares in start-ups. ▶ www.indiegogo.com
Kickstarter	A crowdfunding platform enabling a project to be financed by pre-sales. ▶ www.kickstarter.com
Raizers	Crowdfunding platform for raising capital to finance a project. ▶ www.raizers.com
Veolis	A crowdfunding (donation-based crowdfunding, crowdlending, crowdinvesting) platform for renewable energy infrastructure projects and companies operating in the cleantech sector. ▶ http://veolis.ch

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INVESTMENTS IN THE CLEANTECH SECTOR IN SWITZERLAND

There is no systematic survey in Switzerland of investments made by cleantech start-ups and even fewer consolidated figures throughout the life cycles of these companies.

Figure 11 shows the amounts invested since 2006 in the start-ups featured in

this overview, categorised by the different funding stages. Although only partial, these figures, based on information gathered from start-ups or available publicly, are the first of their kind. Collating this information with that available from our partners who are active in funding and innovation (Venturelab, Kickstarter and Platinn) indicates that the figures given are not only representative of the

sector, but also very conservative. The results shown in Figures 11 and 12 are partial to the extent that the information obtained relates to around half of the start-ups.

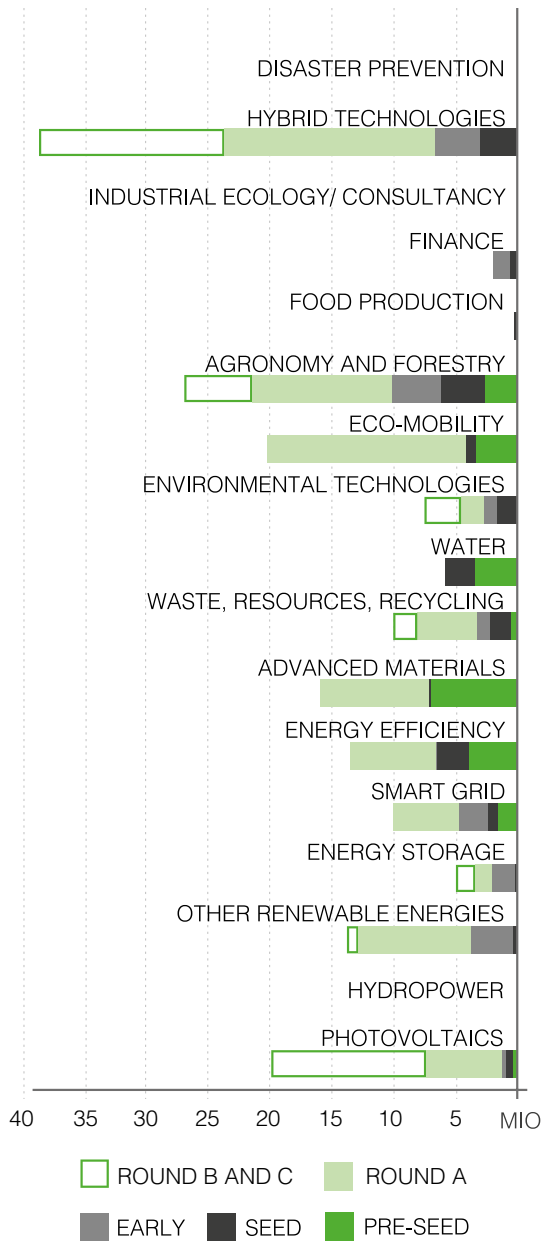


Figure 11: Amounts raised between 2006 and 2016 for cleantech start-ups in Switzerland. Partial results. ▲

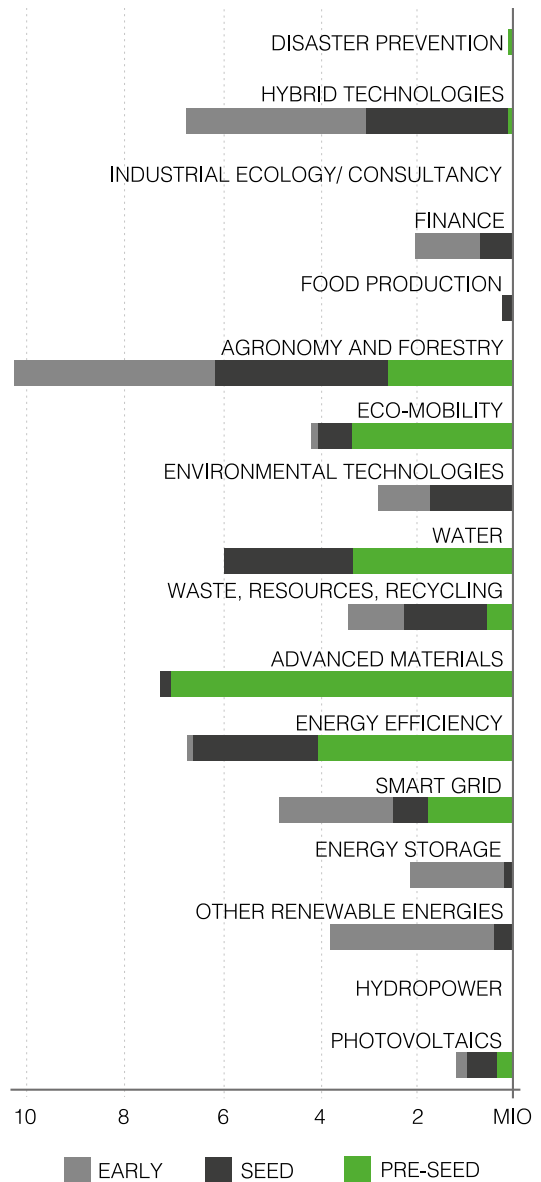


Figure 12: Amounts raised for the pre-seed, seed and early financing phases between 2006 and 2016 for cleantech start-ups in Switzerland. Partial results. ▲

AROUND 200 MILLION FRANCS INVESTED

The total amounts invested since 2006 in the identified start-ups add up to CHF 191 million, of which 23.8 (12%) is at the pre-seed stage, 22.1 (11%) at the seed stage, 19.5 (10%) at the early stage, 88.5 (46%) for Round A and 40.6 (21%) for Round B, see Figure 13.

It is interesting to note that investments in the first three funding stages are relatively similar to one another, around 20 million, during the period in question.

It is no surprise, that the amounts are much greater for Round A and B, even though they relate to a limited number of start-ups. The fields of green mobility, photovoltaics, agritech and hybrid technologies have benefited the most.

An analysis of investments in the pre-seed, seed and early stages (Figure 12) reveals that photovoltaics and the energy sector in general – apart from energy efficiency – have received limited amounts. Advanced materials, smart grids, water treatment, agronomy and forestry, and hybrid technologies are the sectors that have been granted the greatest amounts.

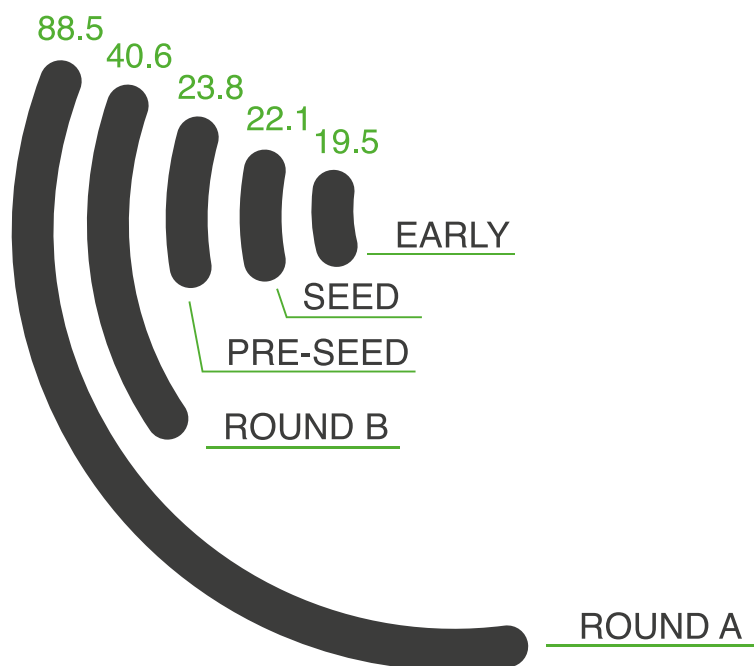


Figure 13: Amounts invested, in millions, in innovative or technological cleantech start-ups identified between 2006 and 2016. Representation according to the financing stages. Partial results. ▲

CONCLUSION

A first step in identifying the issues and challenges that is facing the cleantech start-up community in Switzerland.

The cleantech sector is extremely varied and therefore difficult for the nonprofessional to grasp in its entirety. This overview has raised a number of interesting aspects, but it merely represents an initial move towards more in-depth knowledge of this sector that by its very nature touches on and overlaps a substantial part of the economy.

This interdisciplinarity also explains why it is difficult to obtain precise figures. We are confident that the sums invested, which we have published here, are far below the actual amounts, if nothing else because we have deliberately excluded from the study those companies that have been the object of acquisitions.

The primary intention of this, the first edition of the overview, is to provide a detailed catalogue of the companies in the extremely diverse cleantech sector, subdivided by fields of activity. Its aim is also to clarify the investment chain and to outline the various players and the tools they use. This objective has been met.

But a more comprehensive study of the amounts raised during the different development phases of young Swiss companies will certainly be at the heart of a second edition. The need for more precise figures in this sector is such that we cannot imagine leaving it at that.

At the end of March 2017, the Federal Council was presented with a report on young companies showing strong growth in Switzerland. This report, which

was not confined to cleantech companies but covered start-ups in general, underlines that the situation of young companies in our country is generally good. Like the findings described in this overview, there are some gaps in certain areas, in particular a need for improvement of the framework conditions. Similarly, the funding of young companies remains a delicate question.

This overview of cleantech start-ups is the first step in outlining the issues and the potential problems. It is now a matter of taking action to give visibility to the young enterprises (or particularly promising start-ups) of our country and to help them raise the funding they need.

Only with this level of investment and effort can we ensure that our country remains at the forefront of global innovation rankings, including in the field of cleantech. In the wake of showcase projects such as Planet Solar (now Race for Water), Solar Impulse, and Solar Stratos, Switzerland certainly has an important role to play in the development of clean technologies, both at home and abroad, building on the strength of its industrial and academic expertise.

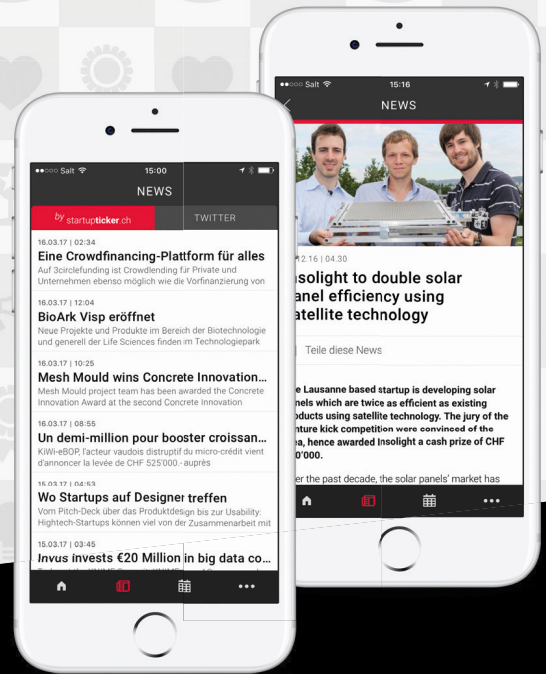
Clean and clear information: The start-up news app



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The cleantech sector will grow rapidly and find its place in the economy

Switzerland is the cleantech nation par excellence, how do you explain this?

Switzerland is a small country whose most valuable raw material lies not in the ground, but in the heads of the men and women who work and perform research there. Certain strong points and political concepts have made the Swiss Confederation the world champion in innovation, and, particularly during the last few years, the subject of sustainable use of resources has become more important. The CTI is the Confederation's agency for promoting innovation. It supports innovative companies, start-ups and people who are interested in starting a business. In the field of energy, we have been commissioned by the Federal Council and Federal Parliament to set up centres of excellence in energy research, which are becoming increasingly self-sufficient and have revitalised the Swiss system of innovation.

As you have said, Switzerland regularly tops the ratings for innovation. How do you account for the fact that these companies have so far failed to produce a significant increase in GDP?

The cleantech sector is a relatively recent addition to the Swiss system of innovation and needs time to become more mature. In this field, turning an idea into a marketable application requires expensive facilities, a legal framework, and, above all, a change in behaviour patterns. At the moment, this sector is still a fledgling, but it is going to grow rapidly and find its place within the economy. The different examples of promising solutions described in this report show that there is considerable potential in the cleantech sector.

In this context, wouldn't it be appropriate to involve some industrial partners, to accelerate the movement?

You have a point there: when the right partners in the economy and in research combine forces, almost anything is possible. Regional organisations play an important role in this, because they know the local system and its actors, and they promote networking. This is a key element in the emergence of innovation. CleantechAlps maintains good and productive relationships with different partners and, in this way, it makes a major contribution to developing and strengthening the cleantech sector.



Walter Steinlin graduated from ETH Zurich with a degree in electrical engineering. In the course of his professional career he has held various managerial positions in the field of research and innovation. He has been President of the Commission for Technology and Innovation (CTI) since 2010. He has three adult children and lives in Bern.

The development of sustainable projects is the only possible future

Your company's main aim is to develop sustainable projects.

Why?

First of all, we're motivated by the firm conviction that it's the only possible future. Secondly, it's a fundamental trend and the opportunities are endless. There are two very big trends today that are having a major impact on our way of living and working, and on the way society is organised: digitisation and sustainability. Finally, it's a field that we know particularly well and within which we are very well-connected.

The profitability of this type of project is often debatable. What is your motivation for continuing to work in this particular niche?

The profitability is disputed, and it's an area where there are a lot of preconceptions. For some reason, quite wrongly, people think that sustainability means voluntary work, ethical values, additional costs. It's an idealistic, activist approach to sustainable development, but it isn't ours. There are a lot of young companies in Switzerland in which sustainability is a very significant component, such as Quantis, Opaline, Pakka, and Loyco, to name but a few, and they are growing very well. At eqlosion, we combine a very robust market approach with a very different understanding of profitability, which includes parameters such as well-being, flexibility, making a positive impact, and, in particular, calculating profitability over a longer term. We are building the future with profitable businesses and a long-term vision.

Your arguments are persuasive, but even so, between ourselves, don't you think that the economic reality of your business model is very idealistic?

Quite the reverse, civil society is undergoing a profound change in which it is finally possible for sustainable projects to be implemented and produce an economic return over time.

The key actors who are bringing about this shift fall into three groups: the multinationals, municipal authorities, and Generations Y and Z. The change in their approach over the last 10 years regarding sustainability is incredible. As an indicator of this change, take the impact analyses and ecological footprint analyses offered by Quantis. Ten years ago, no-one considered these services to be very important. Nowadays, they are carried out as standard before any major development project is discussed! And that's just one example, there are many others.

In fact, our approach is being confirmed by the way eqlosion is growing. We've been in business for two years, and there are now 6 of us. We're receiving a lot of enquiries, and we've got some really interesting projects under way!



Yves Loerincik is passionate about entrepreneurship, innovation, and sustainable development. His fifteen years of experience in these fields includes jointly founding and heading Quantis (2006) and creating the start-up eqlosion (2015). With his team, he offers opportunity analyses and feasibility studies, business launch and development services, and project management services for innovative, sustainable entrepreneurial ventures. His particular niche: transforming ideas into sustainable businesses.

Cleantech start-ups and companies are becoming more and more important as pillars of our economy

How important do you think start-ups are in the energy sector?

Start-ups are important in all sectors, and energy is no exception. With their innovative products, start-ups accelerate Switzerland's process of adapting to the changed realities of global markets. Start-ups are also driving forces in digitalisation, which is still in its early stages in the energy sector. The challenges facing young companies are greater when it comes to energy infrastructures, since these involve long investment cycles. There are some very promising start-ups here too, however, making the networks more intelligent and increasingly processing large quantities of data for new business models. Ultimately, start-ups and other companies in the global growth market of cleantech are becoming ever more important as future pillars of our economy.

What role do you think start-ups have in the overall energy strategy?

It is very likely that start-ups will play an important role in rebalancing the energy market as it tends increasingly towards decentralisation and a new consumption and production dynamic. I think, for example, that it won't be long before systems are in place for the direct exchange of kWh between private individuals. Since the success of the energy transition will depend on the combination and integration of existing infrastructures with new solutions, it is not only start-ups that are important, but also SMEs and large corporations – the latter will be key to the marketing and implementation of innovative solutions in a market that is in the throes of change.

What specific support do you offer to start-ups?

The SFOE provides support for innovative projects from the research to market launch stages.

It is involved with individual support programmes for start-ups – for example, a scheme for the very early phase of a company's life, and an exchange programme for new companies that want to export to the USA. The SFOE is also directly involved in a technology fund that grants loans to start-ups. Most of the SFOE support programmes are available to all companies with innovative energy projects. Often, small and large companies, together with universities, will form consortia to carry out joint research, pilot and demonstration projects with the support of the SFOE.



Benoît Revaz graduated with a Master's degree in law from the University of Fribourg. After working in various capacities in the private sector, on 1 October 2016 he became head of the Swiss Federal Office of Energy (SFOE), in charge of a staff of around 250 people. Reporting directly to Federal Councillor Doris Leuthard, he is responsible for proposing and implementing solutions to ensure that the energy transition remains as consistent as possible with market forces.

Protecting Innovation to protect the Environment

P&TS
INTELLECTUAL PROPERTY



P&TS Fund of Ethical Innovation supports start-ups and SMEs in the cleantech field by awarding grants for their steps in the protection of intellectual property.

More info: <http://www.patentattorneys.ch/industries/innovation-ethique/>



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- 38** **Ensy**
Electricity from the drinking water network
- 39** **aquama®**
Harnessing hydrolysis to protect the environment
- 40** **bNovate Technologies**
Real-time measurement of the bacteria present in water
- 41** **HOOC**
Secure control of technical facilities in buildings
- 42** **Citizenbees**
Urban farming 2.0
- 43** **AquAero**
Water from the air
- 44** **Designergy**
When a solar roof becomes an income generator
- 45** **Climeworks**
CO₂ in the air
- 46** **dhp technology**
Electricity from a sunshade
- 47** **ecoRobotix**
The robot working in the field
- 48** **esave**
Street lights on demand
- 49** **Gjosa**
The shower of the future
- 50** **Smartvolt**
On the roof in no time
- 51** **Green Motion**
Providing charging points for Switzerland's electric vehicles
- 52** **eSMART**
A platform for connected homes
- 53** **Buyeco**
A marketplace for renewable energy
- 54** **GreenWins**
Encouraging recycling
- 55** **Imperix**
Networks that are more intelligent and more reliable

56 Joulia

Reusing the shower's heat

57 Aventor

The racing car of the future is Swiss

58 SEAS

Generating drinking water from ambient air

59 Reech

A test bench for PV innovations

60 Swiss Eco Line

Only 10% of the water without compromising on cleanliness

61 Eternity

Giving the best advice for decentralised energy supplies

62 MoSan

Toilets for all

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The latest in photovoltaic technology

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65 DEPsys

Improving electricity grid stability in the era of renewable energy

66 Smixin

Combining hygiene, sustainability and business

67 Stignergy

Using artificial intelligence to achieve energy efficiency

68 Insolight

When space technology comes back down to earth

69 WaterDiam

Diamond-pure water

70 Enairys Powertech

A Lausanne-based start-up at the heart of the energy transition

71 Swiss Hydrogen

Shaping the future of the "green" car

72 Plus MAT

Making new solar cells out of silicon waste

73 Proxipel

Pellets produced close to their source

74 Bcomp

From skies to the skies

75 TVP Solar

Solar panels that are more than just a lot of hot air



Ensy

Electricity from the drinking water network

Power plants in the Alps convert the high pressure of water at dams into electricity. A family company in the Hinterrhein valley, in the canton of Graubünden, reproduce the major power plants' operations in miniature – the Ensy AG mini-hydroelectric plants using the water pressure in the drinking water networks.

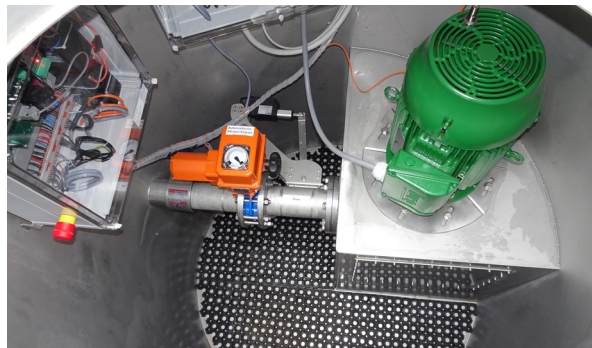
A NICHE PRODUCT WITH POTENTIAL FOR EXPORT

The water network turbine is an invention by Rolf Gloor. A graduate engineer from ETH Zurich, he perfected his invention together with two students almost ten years ago, when he was lecturer of a course on electric motors. "The biggest challenge was to construct a financially viable, compact installation," Rolf Gloor says. Nine water network turbines are now in operation in Graubünden. Where it is possible to feed the electricity into the grid and obtain feed-in tariffs, the investment cost of around CHF 100,000 can be recouped in seven years. Water

Wherever water falls from a height, it generates energy that can be used. This, the principle behind the good old-fashioned water wheel, is also what drives modern hydroelectric power plants. Simon Gloor and his father Rolf, from the little mountain village of Sufers in the Hinterrhein valley, are exploring a new way of harnessing the force of water. The Gloors, proprietors of Ensy AG, have constructed a turbine that uses the natural pressure in a drinking water network. It is customary in mountain villages to collect spring water in reservoirs, which in turn feed the drinking water network. As these reservoirs are located at high altitudes, there is a natural pressure in the water network. This pressure is used by Simon and Rolf Gloor to drive their water network turbine, which is connected to an 18 kW generator producing around 50,000 kWh per annum, sufficient to supply 17 modern four-person households with electricity.

MORE OR LESS PERMANENT OPERATION

"There are around 400 mountain communities in Switzerland where our water network turbine could contribute to a sustainable electricity supply," says Simon Gloor. To ensure that the households' drinking water supply is fully maintained, the turbine only operates



when the reservoir is well filled. This is almost always the case, however, apart from peak consumption times in the mornings and evenings. The water network turbines can therefore generate electricity most of the time. The reservoir water levels are transmitted to a control centre at regular intervals to ensure optimum operation of the turbine. Water network turbines are used exclusively in the drinking water network, which means that the mini-hydroelectric plants have no impact on the watercourse ecosystem and therefore do not need permits.

network turbines are a niche product, only suitable for use in regions where the topography is appropriate, so to date the marketing efforts of Ensy AG have been concentrated on Switzerland. In future, however, the family firm would like to attract customers in Austria and Italy. "I'm learning Italian

at the moment," Simon Gloor says with a smile.

—
"OUR MINI-HYDROELECTRIC PLANT MAKES A MODEST BUT EFFECTIVE CONTRIBUTION TO THE SUSTAINABLE PRODUCTION OF ELECTRICITY."
—

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✉ simon.gloor@ensy.ch
🌐 www.ensy.ch
👤 Simon Gloor, Director



aquama®

Harnessing hydrolysis to protect the environment

Aubonne-based start-up aquama® has developed a solution that enables people to produce environmentally-friendly detergents and disinfectants that contain only salt and water.

An enthusiast for new technologies that combine economy and ecology, Willy Lionel Pomathios discovered the value of hydrolysis about fifteen years ago. Since then, he has carried out research in order to develop a totally biodegradable solution that can replace up to 80% of the detergents and disinfectants that are used, and therefore considerably reduce our impact on the environment. He formed the company aquama® in 2013 and is developing a concept that is commercially viable and can be used by everyone - public bodies, companies and individuals. aquama® sells or leases machines

INTERNATIONAL OUTLETS

"Geneva airport has been a key actor in our success," emphasises Pomathios. "From the beginning, this client was clearly interested in our solutions, testing them in-house and using them in different sectors. The technical development requirements of the airport enabled us to create up to three new machines."

aquama®'s other major clients and partners include Copenhagen Airport, the Renens and Ecublens municipal authorities, Tesla Motors, SSP The Food Travel Experts, QoQa, as well

luxury hotels, before specialising in hotel industry recruitment at Manpower. Several hotels and restaurants now use his technology, as do several transport, health and education companies. What about the next steps in the company's development? "Putting new technologies on the market and obtaining a patent is likely to require a funding

AQUAMA® CLEANING SOLUTIONS ARE TOTALLY BIODEGRADABLE AND CAN REPLACE UP TO 80% OF THE DETERGENTS AND DISINFECTANTS USED.

campaign for around CHF 2 million this year," says Pomathios. "We're also planning further major expansion outside Switzerland."



that enable people to produce biodegradable detergents, disinfectants and combined-action solutions, using just water, salt and electricity. Not only do clients reduce their environmental footprint, they also minimise the logistics associated with the use of multiple cleaning products. In addition, they can resell the solutions that they make, through a smartphone app that connects the machines.

as many other private companies and individuals. The company has also just established a presence in France and is in discussion with new domestic and international actors. It has begun to make contacts among major US distributors.

FUNDING CAMPAIGN IN 2017

Before launching his company, Pomathios trained and pursued a professional career in the hotel and catering industry. He worked in various Swiss

aquama®

🏠 2013 👥 11

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🌐 www.aquama.ch

👤 Willy Lionel Pomathios, CEO



bNovate Technologies

Real-time measurement of the bacteria present in water

Vaud-based start-up bNovate has developed a technique that allows the microbiological quality of drinking water to be monitored continuously.

Most of the analysis techniques used to identify the bacterial strains involved in the pollution of drinking water take several days – in other words, sufficient time for a large number of people to be affected. The principle underlying the solution offered by bNovate Technologies is to make the cells in the water instantly visible by staining them with a DNA marker to make them fluorescent, and then to detect them with a laser beam. “This method, known as flow cytometry, was already used in laboratories,” says Simon Kuenzi, “but we’ve automated it and made it sufficiently robust to be usable industrially.”

With Fabrice Merenda, Sigi Straessler and Peter Ryser, he formed a start-up in 2011 at EPFL's Innovation Park campus. Their first prototype was produced at the end of 2013. The company is targeting all water producers, from small municipal filtration plants to large companies that bottle mineral water.

AUTOMATIC ANALYSES IN SITU

The BactoSense technology automatically analyses the concentration of bacteria in water in situ, in just fifteen minutes, which makes it a revolutionary product for its market. It is also very simple to use: as soon as a bacterium is detected, an alarm is triggered. The machine is made entirely at the EPFL campus and is watertight and self-contained, thanks to its cartridge, which contains all the chemicals it needs to operate. It also collects waste material. The start-up has already made its mark.

It sold ten machines in 2016, and hopes to sell another fifty by the end of 2017. The manufacturing operation will soon



be outsourced to another Swiss company, Sigrist-Photometer, which already handles the distribution. This company will initially focus on Switzerland, and will then market the machine in Germany, Austria and France during 2017, before looking further afield from 2018 onwards.

THE TECHNOLOGY DEVELOPED BY BNOVATE TECHNOLOGIES ANALYSES THE CONCENTRATION OF BACTERIA IN WATER IN JUST FIFTEEN MINUTES, WHICH MAKES IT A REVOLUTIONARY PRODUCT FOR ITS MARKET.

SEVERAL SOURCES OF SUPPORT

During its development, bNovate has received support from several sources, including the Commission for Technology and Innovation (CTI), the Vaud Canton economic development department, and the Basel-based Gebert Rűf Foundation. It was also assisted by Innovaud and Platinn, who provided a coach to help the company draw up a

sound financial plan. In its offices at the EPFL Innovation Park, the bNovate team is already thinking about a new-generation machine, which will be able to identify pathogenic water-borne bacteria, such as E. coli. “We’re still looking for investors to help us achieve this objective,” says Simon Kuenzi. “Another three million francs and we’re there.”

bNovate Technologies

- 🏠 2011 👥 10
- 📍 Chemin de la Dent d’Oche 1A, 1024 Ecublens
- ✉ info@bnovate.com
- 🌐 www.bnovate.com
- 👤 Simon Kuenzi, founder



HOOC

Secure control of technical facilities in buildings

The remote control and monitoring of technical facilities installations in buildings is a hot topic. A cloud solution offered by HOOC AG (Visp) enables control systems and networks to be accessed remotely and securely via the Internet, promoting energy efficiency and preparing the ground for innovative business models based on smart networks.

The technical facilities in today's buildings have complex control systems that guarantee the comfort of the occupants while encouraging them to conserve energy and optimise costs.



Heating, ventilation, air conditioning and other technical facilities in buildings are now increasingly controlled and operated remotely, with growing demand for web-based solutions. This is where HOOC AG comes in – the company, based in Visp, has developed a cloud-based software solution for the secure remote operation and control of technical facilities in buildings and of industrial machinery. Just over two years since its foundation, the start-up has 70 clients using the cloud solution for 600 installations, typically to control the technical facilities in commercial properties such as shopping centres. A particular attraction of the HOOC solution is that in-depth IT skills are not needed to use it.

INTELLIGENT NETWORKING OF ENERGY SYSTEMS

“We consider the use of our system for controlling technical facilities or machinery to be an initial stage,” says Daniel Berchtold, co-founder and sales executive of HOOC AG. “We are currently developing higher-end services that will eventually be a building block for smart cities.” By this, he means that the energy system data collected in the cloud is intelligently interlinked. By way of example, an energy supplier who has secure remote access to a number of heat pumps using the HOOC solution will be in a position to bring them into operation whenever a surplus of solar electricity is produced. Alternatively, the same supplier could control the electrical installations so as to produce

“OUR TECHNOLOGY WILL EVENTUALLY BE A BUILDING BLOCK FOR SMART CITIES.”

the “balancing energy” that is essential for the stabilisation of the energy supply network. “Our solution enables a number of installations to be networked intelligently, creating a framework for new business models,” says Berchtold.

A FACILITY MANAGEMENT APP

HOOC AG is a spin-off of an established HVAC company, where the basic principles of the HOOC technology were developed prior to its inception. The new company enjoyed strong sup-

port from its parent company, as well as assistance from The Ark, the foundation for innovation in Valais. The Ark funded a project carried out together with the HES-SO Valais to develop an application for access to HVAC installations via smartphone – a facility management app. The creation of the young company was a technical challenge, but it was a no less demanding task to launch the marketing campaign, finding the right potential clients and appealing to them in the right way. Berchtold says, “This was a real achievement for a team with a primarily technical background.” At the beginning of 2017, HOOC AG made its first foray abroad, establishing a joint marketing company in Berlin together with a German partner.

HOOC

🏠 2014 👥 5

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🌐 www.hooc.ch

👤 Daniel Berchtold, co-founder



Citizenbees

Urban farming 2.0

Keeping bees on the roof of company premises, with real-time monitoring of their activity: this is the offer from the Neuchâtel-based company Citizenbees.

IN WESTERN SWITZERLAND
AND BEYOND

Citizenbees has developed an innovative system that enables beekeepers to monitor their bee colonies via their smartphones. Problems such as food shortage, swarming, disease, or situations requiring urgent intervention, such as a sudden nectar flow, can be detected remotely. "This saves beekeepers a lot of time, and also a lot of fuel, because they don't travel unless there's a problem," says the company's founder, Audric de Campeau. The other aim is to ensure that the work of Swiss beekeepers continues in the long term. "Nowadays, maybe 50% of the honey consumed in Switzerland is imported, particularly from eastern Europe, and also from China, where, in some regions, people have never even seen bees." Citizenbees is also pursuing another aim, of educating and raising awareness. For this reason, the company offers to provide bee colonies directly for companies or government organisations to host, with the support of a beekeeper who manages these colonies.

before his career brought him to Switzerland in 2011. Seeing his small company grow, he decided to leave his job

EMBEDDED TECHNOLOGIES
ENABLE HIVES TO BE
MONITORED AND THE
LIFE OF BEES FOLLOWED
IN REAL TIME, IN ORDER
TO HELP THE SCIENTISTS,
BEEKEEPERS AND
COMPANIES WHO HOST
THESE COLONIES.

at LVMH to launch a second start-up. Its special feature is the use of embedded technology, which means that the hive can be monitored via several sensors and cameras, and the life of the bees can be followed in real time, in order to help the scientists, beekeepers and companies who host these colonies.

"The idea is not just to produce honey, but to implement a living project with employees and their children, or with clients who want to learn about beekeeping," he explains. In the medium term, he also wants to help the scientific world gain a greater understanding of the disappearance of bees. Thanks to an array of hives that are being monitored in Switzerland, scientists will be able to start compiling some statistical data, and they hope to identify some significant factors.

Citizenbees is now based at Néode, the Neuchâtel Canton's science and technology park. The company operates throughout western Switzerland and in some German-speaking parts of the country, including Bern and Gstaad. It works with various large companies, such as Johnson & Johnson, Migros and Vaudoise Assurances, and also a number of luxury hotels and vineyards. Its funding comes essentially from equity capital and "love money" (family and friends), and a bank loan for research and development, guaranteed by Cautionnement Romand. The company also won the 2015 Prix eco. swisscanto, worth CHF 15,000.



LEARNING MORE ABOUT THE DISAPPEARANCE OF BEES

Originally from Paris, Audric de Campeau had already created his first urban beekeeping venture, Miel de Paris,

Citizenbees

🏠 2013 👤 3

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👤 Audric de Campeau, founder



AquAero

Water from the air

Many of the world's regions suffer from water shortages. In such places, this vital resource could be obtained from the air in future. Researchers at the University of Applied Sciences and Arts Northwestern Switzerland (FHNW) have carried out successful laboratory tests on an innovative process for obtaining water.

Water is a precious resource – those who live in arid regions, without the benefit of easy access to sufficient quantities, are only too well aware of it. Where water is in short supply, solutions may come in the form of wells, supply pipes and desalination plants. Researchers at the FHNW in Windisch have gone down the unconventional route of investigating the air as a source of water. A cubic metre of air contains between 2 and 30 grams of water, depending on the location. "Our system is capable of recovering almost half of the water held in the air, with a reasonable expenditure of energy," Christoph Müller explains. A mechanical engineer, he joined forces with two other FHNW scientists and an electrotechnician from the Paul Scherrer Institute to form AquAero GmbH, a company whose objective is to bring to the market their joint "air well" invention.



pellets are saturated. They are then heated to 100 °C in a special process to release the water. According to estimates by the FHNW scientists based on the data obtained, a system based on a 12 m standard container could produce a daily yield of 5,000 to 10,000 litres of water. This takes an input of 0.2 to 0.3 kWh energy in the form of electricity and heat per litre of water.

SILICA GEL TO BIND WATER MOLECULES

The water contained in the air may be separated out by condensation – that is, by cooling humid air. However, this process requires a high energy consumption, so the young entrepreneurs at AquAero have chosen to do it differently, passing the humid air over a bed of small silica gel beads. Silica gel is similar to glass, but has specific properties that enable it to absorb large quantities of water. After three hours of contact with humid air, the silica gel

A FUNCTIONAL MODEL UNDERGOING FURTHER OPTIMISATION

The FHNW researchers envisage a range of applications for their water extraction system: industrial companies prospecting for ore deposits in remote, arid areas could use it to generate water for their drilling operations. Aid organisations could use it for humanitarian aid in drought situations. Other possible markets include air conditioning and medium-scale industrial drying. Three years of research have resulted in a functional model that successfully produces water in the FHNW laboratory in Windisch (canton of Aargau). The development works have been supported by the Swiss Federal Office for

the Environment and the research fund of the canton of Aargau. "We hope to optimise our system further in 2017, then establish a pilot installation during the following year, for example in a desert region," says Christoph Müller. "We would also consider launching straight into the construction of a prototype together with an industrial partner."

"OUR SYSTEM IS CAPABLE OF RECOVERING HALF OF THE WATER HELD IN THE AIR, WITH A REASONABLE EXPENDITURE OF ENERGY."

AquAero
🏠 2014 👥 4
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👤 Christoph Müller, founder



Designergy

When a solar roof becomes an income generator

Graubünden-based start-up Designergy combines the standard functions of a roof with photovoltaic cells, all in one product.

At San Vittore, in the canton of Graubünden, Daniel Lepori's roofs combine thermal insulation, impermeability to water, and the production of electricity by photovoltaic cells. These functions are all integrated into a single prefabricated unit. A roof of this kind is rapidly installed, durable, and offers high performance as well as economic benefits for the owners of the house. Called TCR, for Triactive Core Roof, the system developed by Designergy consists of a layer of metal combined with a thermal insulation slab beneath it. Photovoltaic panels are fixed to the upper plate in such a way as to provide ventilation. Impermeability to water is guaranteed on two levels via a membrane and some steel plates. In this way, homeowners can fit a new, high-performance roof that provides better protection for the environment while reducing their costs.

DESIGNERGY WON THE WATT D'OR, A PRIZE AWARDED ANNUALLY BY THE SWISS FEDERAL OFFICE OF ENERGY TO REWARD OUTSTANDING ENERGY PROJECTS.

A FRUITFUL COLLABORATION

It was in 2011 that Daniel Lepori had his lightbulb moment. "I was already working in the sector. One day, I wondered why it was more expensive to replace ordinary tiles with photovoltaic tiles than to fit solar panels above the

tiles." He observed that installers of solar panels come up against several problems concerning integration. To provide a practical answer to this, Lepori then founded Designergy. In 2012, he collaborated with Sunage, one of Switzerland's last manufacturers of photovoltaic panels, on a CTI-funded project to produce an initial prototype of his integrated roof.

Production of the first pilot roofs began two years after the first prototype was made. "Very quickly, the prizes rewarding my innovation started coming, as did the investors. It then became possible to start manufacturing and marketing my roofs," recalls Lepori. Since then, Designergy has found investors willing to put up several million francs. Its turnover remains confidential but Lepori admits that it is "in the millions of francs". The start-up, which is based in Graubünden, employs a staff of nine, and operates mainly in Switzerland. "Because it's important to us that our technology is present and recognised in our own country, even though we also look elsewhere for partnerships."

INNOVATION REWARDED

In January 2016, Designergy won the Watt d'Or, a prize awarded annually by the Swiss Federal Office of Energy to reward outstanding energy projects. This was a welcome distinction for Designergy, which is aware of the oppor-

tunities that exist in the field of energy efficiency, and intends to continue to expand, in Switzerland and in other countries.

The electricity production of TCR roofs is equivalent to that of standard photovoltaic systems. As for the cost of these high-tech roofs, that depends on the installation, but it is becoming ever-closer to that of an ordinary roof.



Designergy

🏠 2011

👥 9

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👤 Daniel Lepori, CEO



Climeworks

CO₂ in the air

If sufficient quantities of CO₂ could be removed from the atmosphere, the scale of the current climate problems could be alleviated. With its DAC technology, Climeworks is taking a step in this direction, while producing CO₂ for the food and fuel industries.

Studies carried out worldwide leave no room for doubt: the CO₂ output over the last 150 years is causing serious climate problems for humankind. If we are to put a stop to global warming and its dramatic consequences, the pollution of the atmosphere with greenhouse gases must be drastically reduced. One possible way of alleviating the problem would be to capture atmospheric CO₂ and hold it in a secure storage facility. Climeworks could make a valuable contribution to this with its DAC (Direct Air Capture) technology. "If our technology were to be used on a large scale, we could reduce the CO₂ content of

"IN A NUMBER OF REGIONS WE ARE ALREADY COMPETITIVE WITH OUR CO₂"

the atmosphere and thus curb global warming," says Jan Wurzbacher, co-founder and CEO of this spin-off of ETH Zurich.

CARBON CAPTURE BY CELLULOSE FILTERS

From early summer 2017, a pilot plant in Hinwil (canton of Zurich) will demonstrate how carbon dioxide can be removed from the air. Eighteen Climeworks CO₂ collectors will remove 900 tonnes annually, the equivalent of the emissions from 330 medium-sized cars travelling 15,000 km per annum. Within the modules, the air passes through a filter made of cellulose fibres that chemically binds the CO₂. Once the filter is saturated, a special process is used to draw off the CO₂. Capturing the gas requires

electricity and heat. At Hinwil, the heat is obtained from the refuse incineration plant operated by the inter-municipality organisation Kehr- und Abfallverwertung Zürcher Oberland. The CO₂ recovered at Hinwil is used as a raw material, to promote the growth of the plants in the greenhouses of the nearby market garden, which was previously supplied with "technical CO₂" from the chemical industry.



FOOD AND FUEL PRODUCTION

CO₂ from the air is suitable for a wide range of uses. "In the longer term, carbon capture can contribute to an alleviation of the world's climate problems. In the more immediate future, however, we want to use the carbon dioxide for the food industry and for carbon-neutral fuel production," Jan Wurzbacher says. Possible customers include, for example, the producers of carbonated drinks. Direct Air Capture technology enables CO₂ to be made available in regions where there is currently no source of CO₂. "In these regions we are already competitive with our CO₂," Jan Wurzbacher observes. Climeworks envisages a second potential market in the manufacture of synthetic, climate-neutral fuels. To produce these, hydrogen obtained from renewable electricity is combined with CO₂ to produce natural gas (methane). Such fuels open up the possibility of sustainable motor and air traffic that does not pollute the atmosphere with additional CO₂.

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👤 Jan Wurzbacher, CEO



dhp technology

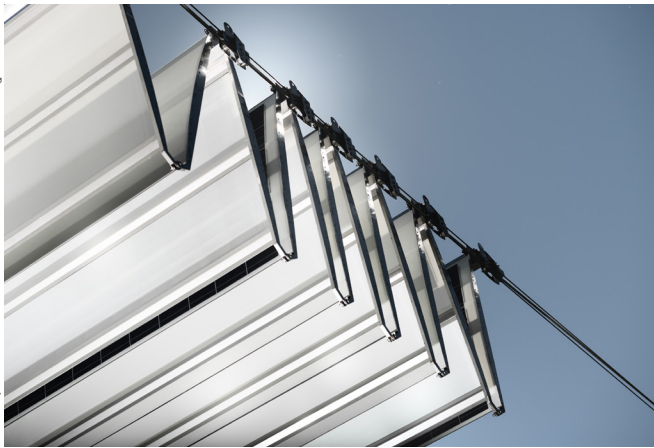
Electricity from a sunshade

Photovoltaic electricity may also be generated in places where there is insufficient space for a fixed installation. DHP Technology, a Graubünden start-up, has developed a folding solar roof that can be opened up like a sunshade whenever the sun is shining.

Photovoltaic systems are usually installed on roofs. However, there are some situations where there may be

large surfaces suitable for the production of solar electricity, but these cannot be permanently covered. This includes, for example, car parks and the logistics facilities of commercial and industrial enterprises, where covering the surface would limit use excessively. "These are the kinds of situations for

which we have developed our folding solar roof," says mechanical engineer Andreas Hügli, who is the co-founder and director of DHP Technology AG of Grüşch in the Prättigau region. "Whenever needed to allow the passage of vehicles or cranes, or for other uses, our roofing system can be folded up mechanically. It also uses half the materials of a fixed roof system," Hügli adds.



operational circumstances require it, or in conditions of wind, hail or snow, the solar roof is retracted and stored

beneath a shelter. Since this means it is never blanketed by snow, it can be used to benefit from the winter sun in areas of heavy snowfall. The installation at the Chur WWTP is an opportunity for the new support structure to be tested on an ongoing basis. The plant's operators also hope that the roof will provide an additional benefit as the shade it provides contributes to reducing algal growth in the clearing tanks.

ELECTRICITY FROM A WASTE WATER TREATMENT PLANT

A DHP Technology photovoltaic roof was recently installed and can be seen in action at the waste water treatment plant (WWTP) in Chur. In December 2016, the company IBC, supplier of water and energy for the town of Chur, installed a 50 x 150 m folding roof with a maximum capacity of 660 kW, which corresponds to the annual consumption of 250 four-person households. When the sun is shining, the photovoltaic modules are spread out over a 5 m high support structure of steel cables. When

DOUBLING UP LAND USE IN AREAS OF HIGH POPULATION DENSITY

The base module of the folding roof system measures 17 x 50 metres. The 50 metre long roof is designed so

"WHENEVER NEEDED FOR THE USE OF THE SITE, OUR ROOFING SYSTEM CAN BE FOLDED UP MECHANICALLY."

it only needs support at the ends and in the middle. According to Hügli, the biggest challenge lay in the industrialisation of the concept. During the development phase it attracted support from the canton of Graubünden's foundation for innovation, as well as from the Basel general utility company, IWB. As well as the Chur installation, three other projects are currently operational in Switzerland, at a WWTP, over a car park and at a company's premises. The solar energy pioneers are already looking outwards from their base in Graubünden beyond the borders of Switzerland. "South Korea is a densely populated country with plenty of opportunities for the dual use of sites and a declared will to make greater use of the potential of solar energy," says Gian Andri Diem, co-founder and director of DHP Technology AG. The first test installation should become operational in 2017, with the support of the export promotion organisation, Switzerland Global Enterprise (S-GE).

dhp technology

🏠 2015 👥 6

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👤 Andreas Hügli, Director



ecoRobotix

The robot working in the field

ecoRobotix is developing a solar-powered robot weeder.

Steve Tanner grew up on a farm in the Orbe valley, and as a child, he used to help his parents weed fields of sugar beet. This is a particularly demanding task and the young man still clearly remembers the crouched position and the repetitive, tiring actions required to pull out the roots. After studying at EPFL and obtaining a PhD in microtechnology, he wondered, "Surely it must be possible to devise a solution that uses robots instead of human beings and weedkillers?"

A POSITIVE PARTNERSHIP

In 2011, Steve Tanner met Aurélien Demaurex, a graduate of the Faculty of Business and Economics of the University of Lausanne, and talked to him about his idea of using a robot without any weedkillers. Aurélien was soon convinced of the merit of such a project. They worked together to develop a concept, at the same time producing a

THE DIGITAL REVOLUTION IN AGRICULTURE IS HAPPENING THROUGH ROBOTS LIKE THAT DEVELOPED BY ECOROBOTIX, WHICH CAN WEED TARGETED AREAS OF LAND WITHOUT USING CHEMICALS.

market study, which confirmed to them that this was a project with commercial potential.

Their company was formed in 2011, with the name ecoRobotix, and the first prototype was completed shortly afterwards. To date, they have designed five, and their robot weeder is due to go on the market early in 2018. Ten robots have already been ordered by Grunderco, a Swiss distributor that specialises in selling agricultural equipment. Each robot costs approximately CHF 25,000.

TARGETED TREATMENT

Unlike competitor products, the ecoRobotix model is very light, weighing barely 130kg. This first version of the robot does not use articulated arms to pull out weeds, but instead sprays a small quantity of weedkiller on an area that has been delimited beforehand. "It uses a twentieth of the quantity of chemicals that a standard sprayer uses. What's more, it doesn't require an electrical connection, because it operates using solar energy," says Aurélien Demaurex, who presented the robot at the most recent Paris International Agricultural Show. Although ecoRobotix did use weedkiller for the first version of its robot, this was simply because only 10% of Swiss farms are organic. "In addition, to get this project going, it was technically

the simplest model to produce," adds Aurélien Demaurex. However, the start-up has not forgotten its initial robot

project and is due to launch another version in 2019, which will destroy weeds without using weedkillers.

DRONES TO ASSIST ROBOTS

ecoRobotix is looking to the future with confidence. In 2016, it raised CHF 3 million in funding to continue its expansion, and it hopes to achieve a turnover of around CHF 100,000 in 2017. Its support comes from various quarters, including the Swiss Confederation, via research programmes, and also the Foundation for Technological Innovation

(FIT) and the Canton of Vaud. Its main aim is to become established in the Swiss market, but Aurélien Demaurex and Steve Tanner plan to extend their



marketing operations to France and Belgium in 2018, and then eventually to Germany.

Next, the start-up intends to improve the connectivity of its robots by using low-flying drones, which would gather information about the area to be weeded. These two young entrepreneurs from Vaud are determined not to miss out on the digital revolution in agriculture.

ecoRobotix

🏠 2011 👥 10

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👤 Aurélien Demaurex, co-founder



esave

Street lights on demand

At the moment, streets are brightly lit even when they are completely empty, which represents a huge potential for savings. It was in response to this potential that Rico Kramer and his company Esave AG in Chur developed a system for intelligent street lighting.

There are some 1,900 km of national highways in Switzerland, together with 18,000 km of cantonal roads and 52,000 km of roads at municipal level. The lighting of this extensive and intricately branching network uses 1.5% of the country's electricity consumption. For this reason, those municipalities that are concerned about their energy management currently opt for energy-efficient LED lighting, enabling them to reduce their electricity consumption by around 25% compared with the classic high-pressure sodium lamps that give off an orange light. Yet this is

UP TO 90% LESS ELECTRICITY CONSUMED

This kind of "intelligent" public street lighting is what Rico Kramer has developed with his company Esave AG. "When there is no traffic on the highway, our LED lights automatically reduce the brightness of their lighting, enabling us to use up to 90% less electricity in comparison with traditional street lighting," he says. The brightness of the lighting also adapts to the weather conditions (cloud cover, rain, snow). Areas where safety is critical, e.g. zebra crossings, are lit more brightly. Each light is fitted with a movement sensor that immediately detects the presence of a road user in its vicinity. The lights communicate with one another by a remote network to ensure that the roads are optimally lit at all times. If requested by the operator, the control data can be collected by a central server and used to monitor the street lighting network.

A REFERENCE PROJECT IN CHUR

Esave is already responsible for the intelligent lighting of the lakeside streets in Lucerne and the main streets of Bern. The town of Chur is currently replacing 2,500 out of its total of 4,100 street lighting units with Esave intelligent lights. Clients abroad are also showing an interest in this innovative solution from Graubünden; one example is a prison in the German state of Brandenburg. Other projects are currently being implemented, in the United Arab Emirates and in Singapore among others. The Chur-based company received financial support for its establishment from the Graubünden Foundation for Innovation

Development and Research. Six years on, it now generates an annual turnover of CHF 1.4 million. "The reference project in Chur, which enabled us to implement our system on a large scale, will be of great assistance to us in tapping new international markets," says Rico Kramer cheerfully.

"WE USE UP TO 90% LESS ELECTRICITY IN COMPARISON WITH TRADITIONAL PUBLIC STREET LIGHTING."



not the only savings potential – even more efficient is the concept of street lights that only shine brightly when they are needed, in other words when pedestrians, cyclists and motorists pass through the area.

esave

🏠 2011 👤 9

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👤 Rico Kramer, CEO



Gjosa

The shower of the future

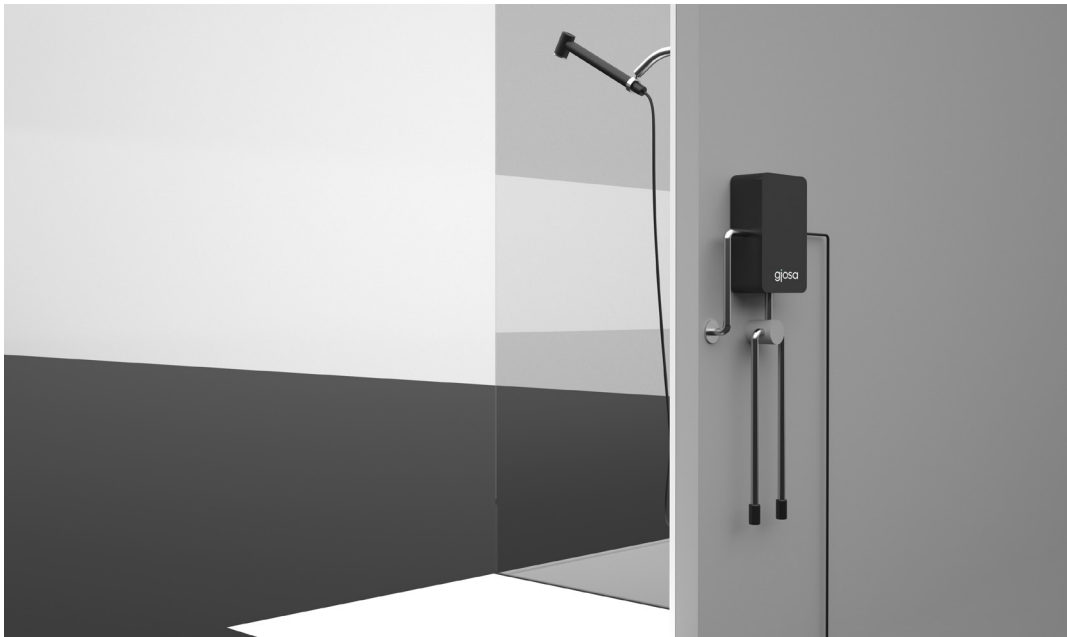
Biel-based Gjosa has developed a showering system that achieves unprecedented levels of economy in its consumption of water and energy.

"We're convinced that it will be essential to use water more economically in the future, but that economies cannot be made unless an equivalent level of comfort is offered," points out Luc Amgwerd, joint founder of the company Gjosa. The technology offered by this Biel-based start-up is inspired by

Switzerland currently uses 11 litres of water per minute, Gjosa's technology makes it possible to have a shower with about 2 litres per minute. In other words, substantially reducing both water and energy consumption, by as much as 80% and 60% respectively. "We offer a new showering experience

and test installations in conjunction with partners in the bathroom fittings industry, in particular PC-Tech of Penthalaz (Vaud), or in relevant market contexts. "We have a key partner in the cosmetics sector, because our solution enables smaller but appropriate quantities of body care or hygiene products to be incorporated," adds Amgwerd. The company is targeting various business markets (hotels, transport, kitchens, hairdressing salons, etc.) which could make significant savings

in water and energy. In addition, it is taking a close interest in the construction of apartment buildings in regions where it is imperative to reduce water consumption, such as Asia and the Middle East, where it has specific operational objectives. A funding campaign and some initial sales are planned for 2018 onwards.



nature, specifically geysers, from which the company takes its name (Gjosa is the Icelandic word for "to gush" or "to erupt"). It was developed over a period of six years by Creaholic and Bosch. Whereas the average shower taken in

that achieves unprecedented savings in both water and energy: a high-speed jet of small drops that feels pleasant and has excellent wetting ability, resulting in a feeling of abundance," explains Amgwerd. "It involves a new approach to body care and different methods of using water."

WHEREAS THE AVERAGE SHOWER TAKEN IN SWITZERLAND CURRENTLY USES 11 LITRES OF WATER PER MINUTE, GJOSA'S TECHNOLOGY MAKES IT POSSIBLE TO HAVE A SHOWER WITH ABOUT 2 LITRES PER MINUTE.

APPEAL FOR ASIA AND THE MIDDLE EAST

The founders of the start-up are all from Switzerland (Creaholic and eqlosion) or Dubai. To date, they have produced various demons-

Gjosa

🏠 2016 👥 5

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👤 Luc Amgwerd, CEO



Smartvolt

On the roof in no time

Installing photovoltaic systems on flat roofs is expensive and time-consuming. Smartvolt AG, a company based at Herzogenbuchsee (canton of Bern), pre-assembles the modules at its industrial premises, saving time and money.

When solar panels are fitted to a pitched roof, they are inclined and thus oriented towards the sun. Ten to fifteen per cent of PV modules are fitted to flat roofs in Switzerland, a more demanding process since metal supports are used to incline the modules towards the sun. It is also necessary to provide the panels with concrete ballast to make them wind-resistant. The installation of a PV solar power system on the flat roof of an apartment building previously represented two to three days' work. Since last year, Smartvolt AG, based in Herzogenbuchsee (canton of Bern), has been offering an alternative. "We can install PV solar power systems in a tenth of the time at a 10 to 12% lower cost," says Stefan Bigler, CEO of Smartvolt AG. Where the cost of installing a system on a flat roof was once more expensive than the modules themselves, now the new system has brought the installation costs down to less than half of the total price.

"WE CAN INSTALL PV SOLAR POWER SYSTEMS IN A TENTH OF THE TIME AT A 10 TO 12% LOWER COST"

PRE-INSTALLATION IN A WORKSHOP

The young Bern company achieves its impressive feat by pre-assembling the modules at its own premises rather than installing them on the roof as individual elements. Two or four PV modules are attached to a support structure with ballast and expertly wired to a unit called a SmartSolarBox. The preassembled solar modules are then lifted by a crane onto the roof, where they can be rapidly installed. This procedure is particularly

advantageous when the weather conditions are bad. Similarly, the mechanical and electrical connections can also be carried out in a clean, dry workshop. The SmartSolarBox is marketed in German- and French-speaking Switzerland by Fankhauser AG of Selzach (canton of Solothurn).

MOVING INTO NORWAY

The company's founder, Stefan Bigler, a qualified mechanical and software engineer, got his inspiration for the SmartSolarBox, which can be folded for transportation, from a folding tent. At the same time as establishing the company, he was working for an EMBA in Business Creation and Innovation Management. "Our main challenge was to secure funding for the development phase, which lasted for two years, and for the introduction to the market, which has been ongoing since 2016," he says. Financial assistance came from the Bern Economic Development Agency and from private investors. Smartvolt sold 1,000 SmartSolarBoxes in 2016, and are looking to sell a further 3,000 in 2017 and 30,000 to 50,000 per annum in future. This year, the Bern company will for the first time try to gain a foothold in a foreign market with its product, which so far has no competitors. "Norway has recently been showing an increased interest in PV solar," Stefan Bigler says. "We are working there with a distribution partner so that we can benefit from the opportunities of this new market."



Smartvolt

🏠 2013 👥 4

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👤 Stefan Bigler, CEO



Green Motion

Providing charging points for Switzerland's electric vehicles

The Lausanne-based SME sells charging points. It aims to finance 1600 public points and sell 1400 private points by 2019.

LICENCE GRANTED TO A CHINESE COMPANY

François Randin answers our questions from among piles of cardboard boxes. Green Motion, the SME that he co-founded, has outgrown its base in Lausanne and is moving to more spacious premises at Le Mont-sur-Lausanne. This is a strategic move to deal with the exponential growth in demand for public charging points in Switzerland that has happened since Green Motion began marketing charging points for electric cars in 2009. "For the third consecutive year, there has been a big increase in the number of electric vehicles registered in Switzerland. Green Motion is set to achieve its objective of providing power to all the electric cars in Switzerland in 2020. That means 200,000 vehicles."

THE CHINESE GOVERNMENT PLANS TO INSTALL BETWEEN 5 AND 10 MILLION CHARGING POINTS THROUGHOUT THE COUNTRY, USING GREEN MOTION'S SOLUTIONS.

This is why Green Motion is growing so quickly. Interestingly, Randin did not begin his career in the cleantech sector. He was previously the head of a company involved in banking software, which he sold so that he could set up Green Motion with his business partner, Christophe Millet, in 2009.

GETTING A STEP AHEAD OF THE CAR MANUFACTURERS

The idea of opening cleantech versions of petrol stations had occurred to the company's co-founders a few months

earlier. They had observed the renaissance of lithium-battery electric cars on the Asian market. "We carried out a market study. The car manufacturers weren't interested in it. So we decided to do something ourselves before other



people did," recalls Randin. Green Motion has grown from three employees in its early days to 21 now, and is recruiting five more so that it can continue its expansion.

Just eighteen months elapsed between having the idea and selling the first charging points. Randin established scientific collaborations with HEIG-VD and EPFL, and the first prototype was presented in spring 2010. In June of the same year, Green Motion started production. At the end of the summer, it delivered its first charging points to Medtronic, Geneva airport and Touring Club Suisse. During this period, the company was given some extra help in the form of cantonal and federal grants (including a CHF 200,000 research and development grant from the Canton of Vaud), and also a grant from the Swiss Climate Foundation. This public support perfectly fulfilled its purpose of pump-priming and conferring credibility, enabling the company to raise a total of CHF 20 million through funding campaigns.

The major boost came from China. In May 2016, Green Motion, whose turnover is not disclosed but is "between 2 and 5 million francs", sold a licence for charging systems to the Chinese multinational Anhui Zhongding, an

automotive parts manufacturer. The Chinese government plans to install between 5 and 10 million charging points throughout the country. Randin decided to invest almost all this money in developing a network of charging points for electric cars, called Evpass (www.evpass.ch).

To date, the network has 294 charging points in 160 towns and villages. "My aim between now and 2019 is to fund the installation of another 1600 public charging points across Switzerland, using a 10-year concession as our business model. In other words, we offer the charging points to municipal authorities in exchange for a percentage based on the amount of electricity sold," says Randin. Given these bright prospects, he can be quietly confident as he packs his boxes.

Green Motion

🏠 2009

👥 21

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👤 François Randin, CEO



eSMART

A platform for connected homes

eSMART is a start-up based at Ecublens in Vaud, which works with property management organisations and private owners to make our homes both connected and sustainable.

Founded in 2011 by Fabrizio Lo Conte and Laurent Fabre, the company has developed modules that can manage the electricity consumption of apartments, houses, or an entire apartment block. The system can control not only the heating but also all the electrical installations in a home, lowering blinds automatically, for example. Instructions can be given from a smartphone, a tablet or a touch screen, which also includes a videophone.

Domestic energy consumption can also be monitored in real time. The system does not require any special wiring and is easily integrated into existing homes.



The modules are connected behind the electrical switches already in place and enable each item of equipment to be controlled from a screen.

HOMES CAN BE ACCESSED REMOTELY

Simply being able to observe and control a household's energy consumption has a direct effect on its electricity bill. Savings of 10% can be achieved. "But electricity represents only a third of the energy used," explains Fabrizio Lo Conte. "Our system provides residents with information and takes action on their behalf."

"eSMART now offers a real platform for sustainable, connected buildings. We use a videophone to manage not just access, but also communications, hot water, and regulation of the heating," continues Lo Conte. In addition, the touch screen enables property management organisations to communicate with their tenants, "more efficiently than by simply using a notice stuck to the stairwell". eSMART also offers these organisations remote diagnostic tools. To date, the company's equipment has been fitted in 650 homes.

AT THE CUTTING EDGE OF INNOVATION

Lo Conte and Fabre were both doctoral students at EPFL, and originally intended to work in the field of home automation and intelligent power sockets. Their company's client list now includes SUVA, UBS, and Credit Suisse as well as a large number of property management organisations. It is involved in projects such as the development of the

Eikenott eco-district in Gland (Vaud), the largest eco-district in western Switzerland.

eSMART has received several distinctions and prestigious awards, including the 2011 Prix Entreprendre Région Lausanne (PERL), the 2014 Swisscom Innovation Award, and the 2015 Prix Strategis, awarded by the organisation HEC Espace Entreprise. At the end of 2016, the start-up finalised its first round of financing, with the aim of boosting its development in the German-speaking areas of Switzerland. Its turnover is now close to CHF 2 million.

ESMART HAS DEVELOPED MODULES THAT CAN REMOTELY MANAGE A HOUSEHOLD'S ELECTRICITY CONSUMPTION, AND CONTROL NOT ONLY THE HEATING BUT ALSO ALL THE ELECTRICAL INSTALLATIONS.

eSMART

🏠 2011

👥 15

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👤 Fabrizio Lo Conte, co-founder



Buyeco

A marketplace for renewable energy

The Valais-based start-up aims to enable consumers to choose exactly which solar panel or hydraulic dam will provide them with electricity.

At a fruit and vegetable market, the origin of the produce is stated. Where electricity is concerned, it is harder for end customers to choose what they use, because its origin is only rarely specified. Are their washing machines running on German wind power or solar electricity from panels in the Fribourg canton? Buyeco, a start-up based at Sion in the canton of Valais, was founded jointly by Julia Beyer, Antoine Martignelli, Richard Pfister and Luc Jodet, and

“BY MAKING IT EASIER FOR CONSUMERS TO CHOOSE THE SOURCE OF THEIR ELECTRICITY, WE INTEND TO CREATE A NEW EXPERIENCE THAT WILL INCREASE THE DEMAND FOR ENERGY FROM RENEWABLE SOURCES.”

was launched in autumn 2014 with the specific aim of improving the traceability of energy.

GREATER TRANSPARENCY CONCERNING THE ORIGIN OF ELECTRICITY

Buyeco is developing a platform that enables end customers to choose from several electricity production facilities connected to their electricity grid, which may include, for example, a farmer with solar panels, or an SME with its own small hydroelectric power plant. “There is a lack of transparency in the renewable energy market,” explains Luc Jodet. “Our project gives consumers access to more information, such as the exact location of the production faci-

lity, photos of it, the annual production figures, opportunities to visit it, and so on. This helps to create a real energy experience.”

This platform is currently being tested by large consumers, including Raiffeisen Bank. Initially, it will be available only to SMEs, before being opened up gradually to domestic users. As Switzerland's energy market has not yet been liberalised for small consumers, this service will be offered in conjunction with the electricity distribution companies that supply clients using less than 100,000 kWh annually.

FOCUSING ON THE SWISS MARKET

In parallel, Buyeco has already set up a website for buying and selling renewable energy, intended solely for businesses. With over 80 million kilowatt-hours traded on this platform, this part of the project is already showing a profit, enabling the start-up to fund future developments itself, despite its youth. Buyeco has been assisted in its growth by a large number of Swiss actors, including The Ark Foundation, in Sion, and SuisseEnergie. The company has also won several awards, including one from the Swiss Climate Foundation, which enabled it to fund the equivalent of three full-time jobs.

For the time being, Buyeco is focusing on the Swiss market. It does not rule out the idea of expanding into France or Germany in the future. Luc Jodet hopes this will happen: “By emphasising the human aspect of renewable sources of energy and by making it easier for people to choose the source of their

electricity, we intend to create a new experience that will increase demand. Interest on the part of consumers is a key factor in the energy transition, but the complexity of the system doesn't make it easy. That might change!”



Buyeco

🏠 2014

👥 4

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👤 Luc Jodet, co-founder



GreenWins

Encouraging recycling

Bernese company GreenWins has developed interactive terminals that offer rewards to people who recycle their waste.

The company, based at Reconvilier, develops interactive recycling terminals. A touch screen is used to combine the collection of waste with a marketing concept that rewards users, provides information, and offers gifts or loyalty points. Launched in 2008 under the name Recycleclean, the project was reactivated in 2017 by Pascal Reichen and is now called GreenWins. "It took five years' work to develop these terminals," explains Reichen, a trained engineer.

TERMINALS THAT ADAPT TO THEIR ENVIRONMENT

The GreenWins terminals can be adapted to all recyclable products: used batteries, coffee capsules, paper, aluminium cans and even medication. "A touch screen makes it possible to show advertisements and make contact with the person using the terminal, giving them the chance to win a prize or obtain a discount," explains Reichen.

As the designer of these interactive terminals, he can see endless possibilities: "In each situation, or for each type of product to be recycled, we can adapt our offer to the requirements of the host organisation and the advertisers who want to get a message across, although the number of actors involved in each installation sometimes makes implementation of the project complicated." Initially, he envisages that they will be rolled out in train stations and supermarkets.

CALL TO INVESTORS

"People want to recycle their waste, we should help them by giving them an additional motivation." In Switzerland, only about 53% of waste is recycled and 47% is incinerated. "We've

carried out a survey of 1000 people, which showed that 40% of them actually recycle their waste. With our terminals, we can almost double that proportion. So it would be possible to recycle 75% of waste, without changing anything in the packaging. We can do it!", enthuses Reichen, whose concept has received support from the canton of Bern.



After several pilot terminals, the first full-scale tests started, at locations that included a McDonald's restaurant in Biel. "The reactions from users are very encouraging," Reichen says.

GreenWins is now looking for further finance so that it can step up a gear, and a crowdfunding campaign is planned.

"PEOPLE WANT TO RECYCLE THEIR WASTE, WE SHOULD HELP THEM BY GIVING THEM AN ADDITIONAL MOTIVATION."

GreenWins

🏠 2008 👥 1

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👤 Pascal Reichen, founder



Imperix

Networks that are more intelligent and more reliable

A Swiss company working in the field of power electronics has created a minor revolution by devising a technology that can control and coordinate complex systems.

In recent years, the massive advance made by renewable forms of energy has greatly increased the need for and interest in power electronics systems, known as converters or inverters. These systems are particularly necessary to integrate these new forms of energy into the grid, or to transmit large amounts of electrical energy over long distances. Converters are complex devices, at the boundary between IT and electrical engineering, requiring manufacturers to incur substantial research and development costs before such products reach the market. Similarly, because converters are essential to the electricity grids of the future, they generate particular interest among academics, especially when the study of these devices is combined with the subject of smart grids. Imperix supplies laboratory equipment to engineers involved in designing prototype converters, in both industrial

clients time during development, and means that new actors who don't have the full range of expertise or technical resources can nevertheless develop the converters of the future," says CEO Simon Delalay.

REDUCING DEVELOPMENT COSTS AND TIME-TO-MARKET

The company works closely with EPFL and Swiss engineering faculties, and its developments include the BoomBox, a prototyping platform for converters. In practical terms, this is an industrial computer that is designed to make it easier for clients to develop control software for power electronics systems. It also makes it easier for actors involved in smart grids to test and validate the control strategies of the future on realistic converters.

This is a minor revolution in power electronics, with potential for a host of further developments in future. Imperix is already making this technology widely available by allowing manufacturers to integrate it into their products directly, thus reducing their development costs and the time-to-market. In the short term, this could involve all devices that transform electrical energy, such as those involved in the production of renewable energy, its storage, or electric traction. In the longer term, Imperix's objective is to make its technology increasingly scalable. Thanks to increased modularity and by building in redundancy systems, it will



and academic settings. Until recently, the development of each converter was very specific, with few reusable components, but Imperix now offers universal building blocks (power modules, control unit, sensors) that can be assembled and used quickly. "Our approach saves

be possible to make the control of very large installations, such as wind or solar farms, more flexible, more reliable, and less expensive.

—
"OUR APPROACH MEANS THAT NEW ACTORS WHO DON'T HAVE THE FULL RANGE OF EXPERTISE OR TECHNICAL RESOURCES CAN NEVERTHELESS DEVELOP THE CONVERTERS OF THE FUTURE."
—

Imperix
 🏠 2013 👥 4
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 👤 Simon Delalay, CEO



Joulia

Reusing the shower's heat

A hot shower is a real pleasure. When the water disappears down the plughole, however, it still contains valuable energy. Joulia SA, based in Biel, has developed a system that enables the heat from waste water to be used a second time.

solar heating installations to offer package solutions: "It will benefit us as a newcomer to enter the market together with well-known manufacturers."

A leisurely shower consumes the same amount of energy as that used by a man to climb the Eiffel tower on foot 55 times. This comparison is used by Joulia SA to illustrate how worthwhile it is to be economical with hot water from the shower. But being economical need not mean going without. Joulia SA, a start-up from Biel, has developed a heat exchanger that is integrated into the shower outflow, where it recovers the thermal energy from the waste water. This heat is used to preheat the cold water before it reaches the mixer tap;

exchanger. A second product, Joulia-Inline, appeared in 2015. This time, the design of the heat exchanger was so compact that it could be fitted into the narrow pipe of a shower outflow. Reto Schmid, architect and industrial designer, is especially proud of the compact size, the simplicity of installation and the ease of cleaning. "With Joulia-Inline, we are offering a simple, economical system that has been really well-received in the bathroom plumbing sector, and one which other bathroom suite manufacturers can integrate into their own showers."



COOPERATION WITH ESTABLISHED BRANDS

Building up a new company in the sanitation industry requires patience; major projects usually have development periods of two to three years. The Biel Foundation for Technological Innovation

it is then combined with the hot water and recirculated to the shower. "Depending on the size of your shower head, you will save between 30 and 40% of the energy used; the cost savings mean that our system pays for itself by the end of three years," says Reto Schmid, co-founder and CEO of Joulia SA.

SUCCESS THE SECOND TIME AROUND

The first foundation stone of the Biel company was laid nine years ago, when mechanical engineer Christoph Rusch – now technical director of Joulia SA – developed the basic heat recovery system at the Biel innovation centre Creaholic SA, with an initial design that involved fitting the whole shower tray with a heat

(STI), the economic promotion department of the Canton of Bern and the Swiss Climate Foundation all provided support for the creation of the start-up. There are now several versions of Joulia's heat recovery system, suitable for both new buildings and renovations. Unlike other heat exchangers used in waste water, the Joulia system can be extended, and it is equipped with an integrated leak detection system. The company has a firm foothold in German-speaking Switzerland, and is currently building up its sales in the French-speaking cantons. Joulia SA is also active in the UK and the Netherlands. According to Reto Schmid, Joulia SA will in future concentrate on working together with the manufacturers of shower taps, instant water heaters and

“WITH THE JOULIA SYSTEM YOU CAN SAVE 30 TO 40% OF THE ENERGY USED FOR SHOWERING.”

Joulia

🏠 2010 👥 7

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👤 Reto Schmid, CEO



Aventor

The racing car of the future is Swiss

Based at La Neuveville (Bern), Aventor SA develops electric racing cars that are used as a test bed for the commercial development of a mass-market electric car designed by its Fribourg-based sister company, Softcar SA.

“Our aim is to prove that even a racing car can have a small environmental footprint,” explains Jean-Luc Thuliez, director of Aventor and of Softcar. “We’ve designed these single-seaters to be completely recyclable.”

One of the main challenges that the constructor of the Aventor vehicle faced was the need to make the chassis from

“SINCE LAST YEAR, THE ACCELERATION PERFORMANCE OF ELECTRIC VEHICLES HAS SURPASSED THAT OF INTERNAL COMBUSTION VEHICLES. ELECTRIC MOTORS ARE BECOMING BETTER THAN PETROL ENGINES.”

a material other than carbon, which is ultra-light but very expensive, involves a toxic manufacturing process, and cannot be recycled. As with the Softcar, the electric car developed in Fribourg by Aventor’s sister company, advanced composite materials (recyclable polymers) were therefore given priority.

ELECTRIC PROPULSION IS POWERING AHEAD

Internal combustion or electric: the two methods of propulsion are now in equal competition. However, in 2016 electric propulsion gained a small lead. “Since last year, the acceleration performance of electric vehicles has surpassed that of internal combustion vehicles. Electric motors are becoming better than petrol engines,” enthuses Jean-Luc Thuliez.

Even the famous Ferrari 488 GTB, and the supercars from Ferrari, Bugatti, Koenigsegg and Pagani, with their turbocharged engines that produce crazy levels of power output – in excess of 1000bhp – have been caught up by production models of electrically-propelled vehicles. Combustion-engine vehicles with the swiftest acceleration are finding their position under threat. “Some electric vehicles are already breaking this record, with 1000bhp motors that are minuscule in size relative to their power,” says the CEO of Aventor.



SUCCESS IN A HILL-CLIMB EVENT

In August 2016, the Aventor took part for the first time in the Saint-Ursanne–Les Rangiers hill climb, one of the classic competitions of this kind in Switzerland. With former Swiss champion rally driver Nicolas Althaus at the wheel, the electric car proved itself easily at that event. Buoyed by this success, Jean-Luc Thuliez is no longer in any doubt that electric vehicles will take the lead on motor-racing circuits in the near future. However, there is still one difficulty left: the presence of very high-voltage batteries means that race

officials cannot safely approach a car that has had an accident. This obstacle has to a large extent been removed with the Aventor: its polymer chassis is much safer than a traditional carbon chassis.

A NICHE TECHNOLOGY

The Aventor remains a niche technological product that is perfect for Switzerland. Sprint races are due to be allowed in the country once again, provided that the vehicles are electrically propelled, offering new prospects for Aventor. The three-wheeler model, which is in the same vehicle category as motorcycles, is designed for the Californian trike market and is therefore in high demand in the United States. The fact that these

motors are silent also makes it possible to envisage races being held, which opens up some great possibilities for this gem of Swiss technology.

Aventor

🏠 2014

👥 12

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👤 Jean-Luc Thuliez, CEO



SEAS

Generating drinking water from ambient air

Innovative modular solutions developed by Ticino-based SEAS enable water to be extracted from air.

“Our mission is to produce clean, high-quality drinking water from ambient air, using as little energy as possible and without polluting the environment,” says Rinaldo Bravo, CEO of the Ticino-based company SEAS.

SEAS MACHINES USE A COMPLEX SYSTEM FOR FILTERING, CONDENSING, STERILISING AND MINERALISING TO GENERATE BETWEEN 2500 AND 10,000 LITRES OF WATER PER DAY.

SEAS (for Société de l’Eau Aérienne Suisse) wants to solve the problem of water shortage via its Air-to-Water technology, which enables air to be turned into water, quickly and wherever necessary. For this reason, the company has offices in countries that suffer from a shortage of water, such as the United Arab Emirates, Mexico and Peru, although its base is in Riva San Vitale, near Mendrisio.



now employs 16 people, and also has a presence in the United States. Its capital is provided by its joint founders and by external investors. “Even now, the same investors continue to support our company so we can develop new markets and new products,” Rinaldo Bravo points out.

A complex system that filters and condenses ambient air, then sterilises and mineralises the water thus produced, enables SEAS machines to generate between 2500 and 10,000 litres per day. The treatment of the water can be configured to adapt to different applications and qualities (pure water, irrigation water for greenhouses or farms, etc.). For example, different types of mineralisation and treatment can be used to enhance the quality of drinking water.

developed in association with its main partner, Watershed, a Cambodia-based NGO.

SEAS is currently participating in different projects in the United Arab Emirates, in particular Dubai and Abu Dhabi, which involve the development of greenhouses and decentralised water production systems. “We’re also working with hospitals in Mexico and the Caribbean, and with schools and hospitals in Namibia,” adds Bravo.

CUSTOMISED WATER TREATMENT

The company was founded in 2013 by four entrepreneurs: Flavio and Graziano Giacomini, Italian brothers who were working in the valve industry in Switzerland and Italy; Marco Honegger, a Swiss economist and marketing expert; and Lawrence Graev, an American lawyer and fund manager. It

INTERNATIONAL DEVELOPMENT PROJECTS

The machines developed by SEAS can be powered by gas generators, and also by solar or wind power or other forms of renewable energy. In addition, the company offers an integrated bottling system. The company presented its latest product, the Awa Modula 25, in March 2017, in Monaco. This was

SEAS

🏠 2013

👥 16

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👤 Rinaldo Bravo, CEO



Reech

A test bench for PV innovations

Innovation is an ongoing process in the PV industry. The Reech GmbH private testing and development centre in Oberurnen (canton of Glarus) makes an original contribution to the development of top-class products.

The Linth valley between Ziegelbrücke and Glarus is in a mountainous setting. It seems as though the sun rises late and sets early, but appearances can be deceptive – solar energy can achieve good yields even here in the canton of Glarus. The town of Oberurnen near Ziegelbrücke is home to a unique establishment: Switzerland's only private test and development centre for photovoltaics (PV). This centre has all the necessary expertise, test equipment and procedures for activities ranging from the measurement of the output of PV modules through to the detection of internal and external defects and tests for wind and snow loads. Users of the facility include PV module and system providers, installers, building owners, energy suppliers and insurance companies. Here in Oberurnen they can all test their modules and installation systems or put samples through quality control procedures.

indispensable link in the value creation chain of the solar industry. The test centre is run by Reech GmbH, which has its headquarters in the Rhine valley in Graubünden. The engineer-



ring company plans and builds solar installations, and also offers a full range of services connected with PV solar energy, including maintenance and repair of PV systems, repowering and yield optimisation.

from the Graubünden Foundation for Innovation, Development and Research. Tamás Szacsavay, who studied physics at the ETH Zurich, specialising in photovoltaics, joined the company as a second managing partner in 2016. Before moving to Zizers, near Landquart, at the beginning of 2017, the start-up spent five years at the INNOZET innovation centre in Grüşch, in the Prättigau valley. INNOZET is a place where established companies and young enterprises operate side by side, exchanging experience and ideas. "We are proud to have been part of an initiative whose aim is to create innovative jobs in the region's technology sector," says Andreas Hügli.

A CONTRIBUTION TO PRODUCT DEVELOPMENT

While the test centre is not an accredited test institute, the evaluations and preliminary tests carried out here make an important contribution to innovation in the solar energy sector. Its users also include industrial clients, for example those who have developed a new installation system and want to know if it satisfies the official requirements, or manufacturers who want to optimise the cost of new components. The test and development centre thus serves as an "extended test bench" for industrial clients, and in this capacity it forms an

"WE ARE PROUD TO HAVE BEEN PART OF AN INITIATIVE WHOSE AIM IS TO CREATE INNOVATIVE JOBS IN THE REGION'S TECHNOLOGY SECTOR."

START-UPS AND ESTABLISHED COMPANIES LEARN FROM ONE ANOTHER

Andreas Hügli studied mechanical engineering and held various positions in PV, semiconductor and microsystems companies before founding Reech GmbH in 2012. His company received financial support for its establishment

Reech

🏠 2012 👥 2

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👤 Andreas Hügli, managing partner



Swiss Eco Line

Only 10% of the water without compromising on cleanliness

The Swiss Eco Line AG start-up has reinvented the tap – with its innovative spray technology, the Swiss Eco Tap only uses a tenth of the water consumed by a classic tap, and requires no hot water at all.

Contact with foreign cultures is an enriching experience, as Rolf Senti discovered for himself. When he was travelling in Dubai, the owner of bathroom fittings supplier Bagno Sasso observed how the Muslims washed before their five daily prayer sessions. However, water is not always available in sufficient

THE SEARCH FOR INVESTORS

One of the places where this innovative product was introduced was right where Rolf Senti had been inspired a few years previously – the prototype of his water-saving tap was installed in a mosque in Dubai. The Swiss Eco Tap is also used in Switzerland, in particular in high-altitude skiing areas where drinking water is scarce and expensive to supply. Rolf Senti also hopes to establish the Swiss Eco Line taps in the attractive markets of the United States, Canada, and the Middle East where they are currently being evaluated for sports stadiums. This is a promising outlet, since the major stadiums will need at least 1,000 taps. "These large orders are of crucial significance for us, enabling us to gain a foothold in the marketplace – without orders of this magnitude, investors are generally reluctant to invest in a product such as ours," says Rolf Senti.



quantities in the desert zones of the Gulf States. This experience gave Rolf Senti the idea of developing a tap that distributes the water economically but nevertheless ensures that the hands are thoroughly washed. He was supported in this project by Werner Egli, owner of former Swiss tap manufacturer Arwa AG (Wallisellen). The Swiss Eco Tap was ready to be marketed by the end of 2015.

NO NEED FOR HOT WATER

The Swiss Eco Tap has been especially designed for the sanitary facilities in public buildings and offices, where a lot of people wash their hands. Not only does its innovative spray technology, based on the use of kinetic energy, offer a substantial reduction in water consumption, but its extremely fine spray also reduces the sensation of cold on the skin. This enables the Swiss Eco Tap to

be used entirely with cold water, thus making further savings as heating costs are eliminated. Despite these advantages, the start-up from Chur faces a long haul to establish itself on the market, as it could take several years for the company to receive an order to supply a substantial building development project. Entrepreneur Rolf Senti will have the chance to put into practice the skills he has gained as a former professional cyclist – as a top-level sportsman he has learned how to pace himself to cover long distances.

“THESE LARGE ORDERS ARE OF CRUCIAL SIGNIFICANCE FOR US, ENABLING US TO GAIN A FOOHOLD IN THE MARKETPLACE.”

Swiss Eco Line

🏠 2016 👥 3

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👤 Rolf Senti, CEO



Eternity

Giving the best advice for decentralised energy supplies

The deployment of photovoltaic installations and other decentralised energy supply systems with a wide geographical coverage requires efficient consultancy and sales processes. Eternity AG (Chur) has developed the LEA platform for precisely this purpose.

Having graduated as an electrical engineer from the ETH Zurich, Matthias Wiget first worked in the construction of hydroelectric plants. Inspired by the potential of renewable energies, he then became involved in marketing and installing solar power systems. "That was when I realised that the promotion of renewable energies requires not only good technology, but also efficient advice and sales processes. These are essential to ensure that solar power systems provide adequate value for money and are able to achieve a broad take-up," Wiget says. The young Graubünden entrepreneur took on Peter Novotny, an experienced software developer, as CTO of Eternity. Together, they developed the LEA (Live Energy Analysis) advice and sales platform, a software solution with the objective of accelerating and optimising the efficiency of the sales processes for photovoltaic systems and other decentralised energy systems such as heat pumps or charging stations for electric cars.

TABLET-ENABLED PLANNING TOOLS

LEA uses satellite images of roof surfaces, which it integrates seamlessly into its own dimensioning and simulation algorithms for energy systems. When a sales representative visits a potential customer with the tool, a system can be designed and an offer presented on the spot. Sales representatives and installers are not the only ones who use the LEA platform – end customers can also benefit from its solar calculator, such as the one installed by Eternity for

the Centralschweizerische Kraftwerke AG power plant operator. Basic data such as the roof type and orientation are fed into the solar calculator, and in minutes it provides a rough calculation for a possible installation together with an outline price quote. 18,000 private individuals have already used Eternity solar calculators like this one to plan their installations. The third customer

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"DECENTRALISED ENERGY SYSTEMS NEED TO BE EASIER TO SELL IF THEY ARE TO ACHIEVE A BROAD TAKE-UP."
—

base for the LEA platform is that of system manufacturers, such as suppliers of battery storage systems or heat pumps. The tool enables them to speed up the planning and design processes for their products, making them more attractive for installers.



CLOSE TO THE BREAK-EVEN THRESHOLD

Eternity now has some 30 commercial customers in German-speaking Switzerland and is currently expanding its territory to include French-speaking Swit-

zerland and Germany. The Chur-based start-up received financial support for its establishment from the Graubünden Foundation for Innovation, Development and Research. Finding a source of funding was just one of the challenges to be overcome in order to achieve the full potential of the business model. "When we founded the company, we were motivated by the idea of using our new platform to help the market for solar power and renewable energies to move forward," says Matthias Wiget. "But first we had to learn how to adapt what we offer to our customers' requirements." The company is currently on the verge of passing its break-even threshold.

Eternity

🏠 2012

👥 8

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👤 Matthias Wiget, CEO



MoSan

Toilets for all

It may sound banal, but to millions of people a first step out of poverty would be to have their own toilet. Industrial designer Mona Mijthab refused to ignore this worldwide problem, and set about redesigning the toilet.

At the age of 21, while studying industrial design at the Magdeburg-Stendal University of Applied Sciences, Mona Mijthab undertook a period of work experience with the German development agency GIZ, which took her to Bangladesh. "I was shocked to see how people lived in the slums, without clean water or sanitary facilities. Their situation was extremely difficult, especially for the women," says the young entrepreneur, now 29. After gaining her Master's degree at the Zurich University of the Arts, Mijthab developed a system of ecological toilets that operate on a closed-circuit system, which she called MoSan (mobile sanitation). The central element is a simple yet visually appealing



toilet that functions without water or chemicals and is easy to transport in crisis zones. Since the summer of 2016, Mona Mijthab has been selling the MoSan system through a start-up of the same name.

FOCUS ON CENTRAL AMERICA

The dry toilets have been tested over the last few years in the slums of Kenya and in a refugee camp, and the design has been refined on the basis of suggestions by the local people. They consist of five plastic elements that can be assembled in a few seconds. Urine and faeces are collected separately and can thus be treated or disposed of separately. The MoSan system enables solid waste to be composted to produce fertiliser or to generate biogas. In 2017, the toilets are to be introduced to urban areas of Jamaica affected by poverty, under the auspices of a Mexican NGO, and it is hoped that the treatment and composting cycle will be further improved. "A strategic analysis has shown that Central America is a key target area for our product," says Mijthab.

ACTING AS A SOCIAL ENTREPRENEUR

MoSan GmbH is based in Willisau (canton of Lucerne), at the International Centre for Water Management Services (CEWAS), a training and coaching association for start-ups in the water sector. As a social entrepreneur, the start-up faces specific challenges when it comes to funding; MoSan funds its research and development activities mainly from prizes and awards (Climate-KIC, Bestform Award 2013, Hans-Sauer Social Design Award 2015, Award for Social Entrepreneurship SEIF). "Now that our sanitary system is ready for the market, we will live off the orders we receive from multilateral organisations, NGOs and government departments," Mijthab explains. "They

will pay for the toilets and the work involved in distributing them, setting them up and operating them." In future, there will be an association that supports the projects with information and education campaigns on hygiene. "The long-term aim is that the MoSan toilets will become a status symbol and offer a sustainable contribution to improving the lives of the people concerned," Mijthab says.

"WE ARE NOT SIMPLY OFFERING A DRY TOILET SYSTEM, BUT A COMPLETE SANITARY SOLUTION."

MoSan

🏠 2016

👥 4

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👤 Mona Mijthab, CEO



INDEOtec

The latest in photovoltaic technology

As a designer of machines that make solar panels, this Neuchâtel-based company is involved in a rapidly-expanding field.

Formed in 2007, INDEOtec began life as a spin-off from the photovoltaic laboratory at the Institute of Microtechnology, belonging to the Swiss Center for Electronics and Microtechnology (CSEM) in Neuchâtel. It has successfully completed the difficult transition from start-up to SME, and is now expanding rapidly, having developed a revolutionary technique for manufacturing solar panels and flat screens. Its Octopus machines deposit ultra-thin layers of silicon on both faces of a substrate in a single operation, something that competitor technologies cannot achieve.

“INDEOTEC HAS DEVELOPED A REVOLUTIONARY TECHNIQUE FOR THE MANUFACTURE OF SOLAR PANELS: ITS MACHINES DEPOSIT ULTRA-THIN LAYERS OF SILICON ON BOTH SIDES OF A SUPPORT IN A SINGLE PASS.”

A PROMISING TECHNOLOGY

“We started with traditional methods first of all, before developing this new approach,” explains the CEO and main shareholder, Omid Shojaei. “We developed this technology ourselves and all the patents belong to us.” A physics graduate from EPFL, Omid Shojaei knows the sector particularly well, having started his career at Oerlikon, part of the photovoltaics division of a British company, the Edwards Group. “We launched without raising any money,” says Omid Shojaei. “We managed to keep going, but it has been very

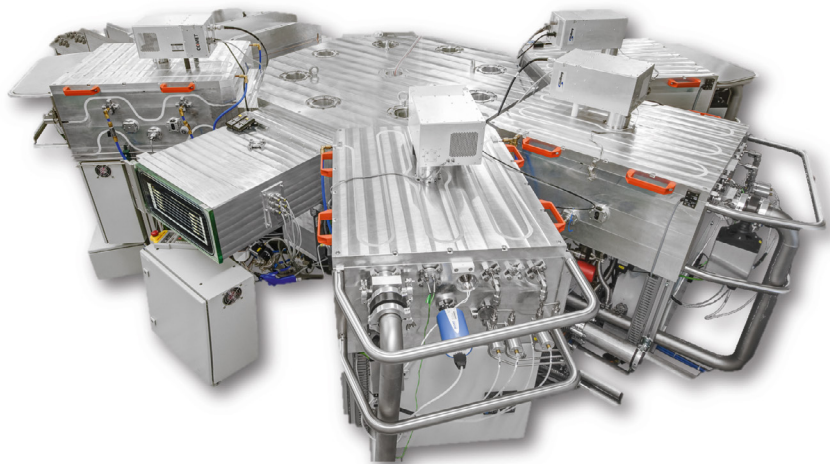
difficult. We had to tighten our belts to ensure that our gamble paid off.” The first sales of the second generation of Octopus machines to the CSEM and to research institutes in France and the United States breathed new life into the company from 2015 onwards. In January of that year, the company was able to start using a new 600m² clean room in Neuchâtel.

FROM LABORATORY TO PRODUCTION LINE

By the end of 2016, INDEOtec's turnover had risen to CHF 2 million, and the company had won some new clients in Saudi Arabia and the Middle East. With the imminent launch of the third generation of Octopus machines, INDEOtec will reach a new stage that will move its technology out of the research laboratories and into the world of manufacturing, to produce highly efficient photovoltaic cells.

Its sales are set to more than double in 2017, to reach CHF 5 million “The potential market is enormous,” says a delighted Omid Shojaei. “Our techno-

logy enables a 50% reduction in costs to be achieved across all our clients' production lines.”



INDEOtec

🏠 2008 👥 12

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👤 Omid Shojaei, CEO



Softcar

Reinventing the electric car

The Fribourg-based company intends to take advantage of the imminent disruption of the car market to promote an innovative concept in the manufacture of electric vehicles.

A quarter of a century after the idea for the Swatchmobile came to Nicolas Hayek, a lightweight and economical electric car may at last see the light of day in Switzerland. The implementation of this incredible project is in the hands of Softcar, a Fribourg-based company headed by Jean-Luc Thuliez, himself a former member of the Swatchmobile team, and Marc Frehner, who is responsible for the design.

Jean-Luc Thuliez believes that his electric vehicle provides a lighter and more accessible alternative to the electric cars currently available on the market. "Current models are designed in the same way as petrol vehicles. They're heavy and they cost too much. On top of that, the available battery technologies don't give them a sufficiently attractive range." Even the electric Smart weighs almost a tonne. A long way from Nicolas Hayek's visionary dream!

recovery of the vehicles. "This is a much more modern business model that enables us to provide solutions far more quickly than the model used in manufacturing traditional cars," Thuliez adds. "We're going against the whole of the automotive industry, which increasingly tends to produce complex, expensive electronics."

A NEW INDUSTRIAL MODEL

Marketing of the Softcar is due to begin in Switzerland and Austria in 2018. But the real horizon for the project is much further away: the key market for the electric car is China, with its 80 megacities, each with more than 10 million

SOFTCAR OFFERS A CAR THAT IS THE ANTITHESIS OF THE TYPICAL ELECTRIC VEHICLE, AND A MANUFACTURING CONCEPT BASED ON THE DECENTRALISED "CLOUD FACTORY" MODEL.

AN ECONOMICAL AND ENVIRONMENTALLY-FRIENDLY VEHICLE

A traditional car has almost 40,000 components and weighs 1.3 tonnes. The Softcar, on the other hand, has only 1800 parts and weighs 480 kilos. The car body can be changed in 30 minutes and, unlike present-day cars, whose worn-out parts have to be destroyed or burned, all the mechanical parts can be reused. The Softcar's batteries give it a range of between 240 and 400 kilometres, depending on the model. According to Jean-Luc Thuliez, replacing 100,000 petrol vehicles with electric models would reduce CO₂ emissions by 300,000 tonnes annually. However, the issue for Softcar is not merely one of replacing petrol cars.



inhabitants. The Softcar company will not make the cars itself, but will develop the technologies needed to produce these vehicles and will sell manufacturing licences to third parties. "We're selling a recipe and the ingredients needed to build clean cars," explains Jean-Luc Thuliez. This decentralised model, known as the "cloud factory", will use assembly plants close to the megacities. These same plants will also be responsible for the end-of-life

Softcar

🏠 2011

👥 12

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👤 François Vuille, Chairman



DEPsyst

Improving electricity grid stability in the era of renewable energy

The Vaud-based start-up has developed a scalable real-time control platform for managing a low-voltage electricity distribution network. This modular solution uses smart sensors and actuators spread across the network.

This is the story of three friends who dreamed of becoming major entrepreneurs. Joël Jaton, Guillaume Besson and Michael De Vivo, who are now in their thirties, have been friends since they were students at the School of Engineering and Management Vaud (HEIG-VD) in Yverdon-les-Bains. All

crease in the supply of solar renewable energy from decentralised sources and the advent of electric vehicles, the electrical stability of networks is no longer guaranteed. In addition to this, the networks were designed for centralised production and vertical distribution to users. DEPsyst provides a solution to this with its platform.

The year 2014 marked a turning-point in the start-up's development, with the grant of a loan of CHF 100,000 by the Foundation for Technological Innovation (FIT) for the development of its prototypes. However, it was a major strategic commission from Romande Energie, a major network operator,

that enabled DEPsyst to integrate its second-generation GridEye solutions into the day-to-day management of a low-voltage electricity distribution network. Romande Energie tested GridEye for two years before incorporating it into its strategic roadmap, and is now planning to roll out the solution across its entire network.

“THERE IS HUGE POTENTIAL FOR SMART GRID SOLUTIONS, BOTH WITHIN AND OUTSIDE SWITZERLAND. IN THE COMING YEARS, ALL OPERATORS ARE GOING TO HAVE TO DEAL WITH THE PROBLEMS THAT RENEWABLE SOURCES OF ENERGY CAUSE FOR THE DISTRIBUTION NETWORK.”

three specialised in smart grids. In 2012, they formed DEPsyst, a start-up that initially operated from the Swiss Technopole at Yverdon-les-Bains, but which recently moved to Puidoux (Vaud).

NETWORKS UNDER CONTROL

To meet the needs of distribution network operators, the three electrical systems engineers developed a scalable real-time control platform for managing a low-voltage electricity distribution network, which was named GridEye. This modular solution incorporates smart sensors and actuators, which are spread across the electricity network. It can perform measurements and calculations, and communicate the information (alerts, faults, damage, statistics) collected in the field. With the in-

outside Switzerland, DEPsyst raised CHF 3 million in June 2016 from three major risk-capital investors, one of whom, Statkraft, is Europe's biggest supplier of renewable energy. Since last autumn, this Vaud-based start-up has had a presence throughout the whole of western Europe.



“There is huge potential for smart grid solutions, both within and outside Switzerland,” emphasises Marc Schreiber, DEPsyst's marketing director. “In the coming years, all operators are going to have to deal with the problems that renewable sources of energy cause for the distribution network.” The advantage of the DEPsyst solution is that it is easily fitted to existing equipment. “Our platform helps operators to control these changing environments and improve the utilisation of the low-voltage network, while keeping costs under control,” summarises Marc Schreiber.

A PROMISING MARKET

Since then, DEPsyst has conducted around ten pilot projects throughout Switzerland. The fourth generation of GridEye is now entering its industrial production phase. DEPsyst now has an opportunity to move beyond the confines of Switzerland and become established in the western European market. In order to prepare for the certification and marketing of its solutions

DEPsyst

🏠 2012 👥 13

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👤 Marc Schreiber, marketing director



Smixin

Combining hygiene, sustainability and business

This Biel-based start-up has developed a cutting-edge handwashing system that is environmentally-friendly and economical with water, dispensing just 100ml per use.

It's something we do several times a day, without thinking about it. Our forebears washed their hands too, probably in the same way, with lots of soap and water, and the method hasn't changed very much since. It's true that liquid soaps and automated dispensers introduced something new into the practice, in public toilets at least. But otherwise, the ritual is very much the same. Start-up company Smixin recently entered the market with a new product that reduces the amount of water used for handwashing, while cleaning them equally effectively. At a time when governments are emphasising the importance of handwashing as a matter of public health, this invention is bound to be appealing.

with an integrated paper dispenser, which has to be connected to the main water system in order to work. Each time someone washes their hands, it dispenses just 100ml of water. The most complete version of this installation costs CHF 2500 (retail price), excluding the cost of consumables such

IT'S A "TAP FOR THE 21ST CENTURY". IT DISPENSES JUST 100ML OF WATER, AND THE 1.5 LITRE SOAP POUCH CAN BE USED FOR APPROXIMATELY 3000 HANDWASH CYCLES.

as the 1.5 litre soap pouch, which can be used for approximately 3000 hand-wash cycles i.e. for up to a month, depending on use. "Smixin has designed a tap for the 21st century," is the summary given by Jean-Michel Deckers, who became CEO of this specialist company in March 2016. Smixin is targeting its products at Switzerland and Germany, but above all Asia, given that the continent has to rationalise its water consumption.

Deckers now spends half his time in Hong Kong, Taiwan and China. Back in Biel, the team of around fifteen staff is preparing for the imminent launch of a new compact version, intended to appeal to both commercial and non-commercial organisations.

LOOKING FOR NEW INVESTORS

The results are already promising: in 2016, the company's turnover was CHF 250,000 and the profit figure for the first

quarter of 2017 is likely to be equally encouraging. From the beginning, Smixin has been able to rely on some active shareholders, as well as on support from the Biel municipal authority and the canton of Bern. "We launched a funding campaign a few months ago, and to date, we've achieved over 70% of our target," says Jean-Michel Deckers. "But we're still looking for new investors."

At this rate, the start-up looks set to reach its break-even point in 2018, while at the same time continuing to improve its offer: its most recent creation consists of connecting its products to internet applications, so that the entire soap management process can be optimised.



NO MORE THAN 100ML OF WATER

Smixin was formed in Biel at the end of 2009. The technology was originally developed for Nestlé by Creaholic, the innovation incubator founded by Elmar Mock. Nestlé retained the agrifood application and authorised Creaholic to reproduce the concept in another area of application, which resulted in the launch of Smixin. In practical terms, it is a sensor device

Smixin

🏠 2009 👥 15

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👤 Jean-Michel Deckers, CEO



Stignergy

Using artificial intelligence to achieve energy efficiency

The Yverdon-based start-up offers an energy management system based on an artificial intelligence technology inspired by the natural world.

How can organisations reduce their electricity costs and also the load that a site places on the grid? Stignergy has developed a system for managing electricity consumption, known as SEMS (for Smart Energy Management System). This technology controls consumption and distributes electricity dynamically within a single entity, such as a factory, to avoid peaks in the load and eliminate unnecessary consumption, thus reducing electricity costs.

OPTIMISING ENERGY DEMAND

The solution, which has received support from the Swiss Federal Office of Energy, relies on a collective intelligence technology inspired by the natural world. It proved its worth at the end of 2015, at the Usines Métallurgiques de Vallorbe (UMV) site, as part of a partnership that also included Romande Energie. This full-scale test went on for six months.



Practically, this meant that each energy-consuming device in the factory was fitted with a SEMS module, known as a "SEMS terminal", which analysed the energy consumption of the device in real time, and shared the information with all the modules installed at the same site. Working out all the requirements in this way, the SEMS modules can optimise overall demand by distri-

buting energy requirements dynamically throughout the day, without disrupting the output of the devices concerned. This limits peaks in electricity consumption, which adversely affect the grid. At the end of the test period at UMV, "the reduction in energy costs attributable to installation of the system was 15%," points out Sami Najjar, the founder and CEO of Stignergy. What's more, electricity distributor Romande Energie now includes the SEMS modules in its offer to major consumers.

EMBEDDED INTELLIGENCE

Sami Najjar sees in these successes the practical implementation of an idea that he had in 2009. At the time, this entrepreneur was an R&D engineer in machine-to-machine systems at the School of Engineering and Management Vaud (HEIG-VD). In 2012, he formed Stignergy SA, which was involved in the industrial production of the SEMS system. "Smart meters didn't have any embedded intelligence," he recalls. "They measured energy consumption, but they weren't sufficiently intelligent to take decisions aimed at reducing it." So Stignergy developed terminals that can communicate with other terminals. The SEMS project obtained CHF 1.8 million in development funding from research funds and from the Commission for Technology and Innovation, as part of the support given to a CTI project. Stignergy also received support from the Foundation for Technological Innovation (FIT), in the form of a loan of CHF 100,000. The start-up now has a recorded turnover of CHF 400,000 and is making preparations for its first funding campaign in summer 2017 (CHF 1.5 million). The SEMS modules have

already been successfully installed at industrial sites and in hotels, and Stignergy is also fitting them in schools, universities and hospitals.

THE SEMS MODULES CAN OPTIMISE OVERALL DEMAND BY DISTRIBUTING ENERGY REQUIREMENTS DYNAMICALLY THROUGHOUT THE DAY, WITHOUT DISRUPTING THE OUTPUT OF THE DEVICES CONCERNED.

Stignergy

🏠 2012 👥 4

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👤 Sami Najjar, CEO



Insolight

When space technology comes back down to earth

Vaud-based start-up Insolight has developed a concentrated solar panel that is twice as efficient as a standard panel.

The space industry has been using high-efficiency solar cells for decades, in order to boost the energy supply to satellites. Now, thanks to the impetus provided by Insolight, this technology is coming back down to earth. This Vaud-based start-up, formed in 2015 at the EPFL Innovation Park, has designed a flat photovoltaic panel equipped with cells used in the space industry. It offers an efficiency level of around 36%, twice as high as that of the solar panels currently on the market. However, ultra-efficient solar cells cost 200 times as much as standard cells.

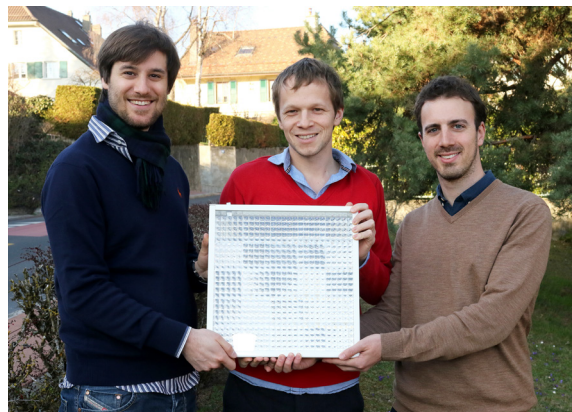
“WE DECIDED TO FOCUS ON THE EFFICIENCY OF THE INSTALLATIONS TO MAKE OUR SOLUTIONS AFFORDABLE.”

To overcome this commercial obstacle, Insolight uses a concentrator, which means that the cells occupy only 0.5% of the surface area. The infrastructure is accompanied by a solar tracking system, which ensures that the light is permanently focused on the cells. The panel therefore follows the path of the sun, and does so without having to pivot.

MAKING THE TECHNOLOGY ACCESSIBLE

The brains behind Insolight are three microtechnology graduates who are only just in their thirties. “After our studies at EPFL, we all decided to go into industry,” explains Laurent Coulot, the company's CEO. “This ‘real-life’ experience enabled us to investigate diffe-

rent manufacturing problems, and avoid certain mistakes.” The trio returned to the EPFL campus and were awarded the highest level of funding (CHF 100,000) in EPFL's Innogrant scheme, to incubate their project. Insolight was formed in September 2015. The essence of the challenge was to make this technology accessible. “For



residential or small-scale installations, producing solar electricity in Switzerland is still too expensive,” says Coulot. “So we decided to focus on efficiency to make our solutions affordable. Because the greater the efficiency, the more quickly the installation costs are paid off.” The simulations that have been carried out indicate that each kilowatt-hour produced could cost a third less with Insolight's system.

TARGETING RETAIL AND INDUSTRIAL SITES

Insolight has received support from the canton of Vaud and the European Space Agency, and now employs six people, two of whom are trainees. In summer 2017, the start-up is going to launch a first pilot project with 10m² of panels on the roof of EPFL, and it may extend this area, with other partners,

over the next few months. The three founders are aiming for marketing to begin at the end of 2018. The company is making preparations for a first funding campaign to raise CHF 2 million, to add to the CHF 600,000 already raised through awards and competitions. The company's turnover for 2016 was CHF 50,000 and its current objective is to work on the certification procedures and increase its patent portfolio. “Our strategy is to focus mainly on retail

and industrial premises,” explains Coulot. “Our other aim is to sell a licence to manufacture and distribute our solutions. They are particularly attractive in sunny areas where labour costs are high and installation space is limited.” Several installers throughout the world have already expressed an interest.

Insolight

🏠 2015

👥 6

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👤 Laurent Coulot, CEO



WaterDiam

Diamond-pure water

WaterDiam has developed an innovative chemical-free water treatment system, whose many different applications range from private swimming pools to agriculture.

WaterDiam is an appropriate name for the company founded by Laurent Pupunat, which uses the purity of diamonds to treat water without adding chemicals. Based in Delémont, it designs and produces environmentally-friendly water treatment systems, largely based on boron-doped diamond electrodes.

THE TECHNOLOGY DEVELOPED BY WATERDIAM ALLOWS THE CREATION OF RADICAL HYDROXYLS, WHICH ARE SUPER-POWERFUL CLEANERS THAT CAN DISSOLVE SUBSTANCES PRESENT IN THE WATER AND ELIMINATE ITS IMPURITIES.

The technology at the heart of the project was originally developed by the Swiss Center for Electronics and Microtechnology (CSEM) in Neuchâtel. In 2001, the laboratory was trying to produce artificial diamonds on a silicon surface. Collaborative work with EPFL had shown that this substance allowed the creation of hydroxyl radicals – super-powerful cleaners that can dissolve substances present in the water and eliminate its impurities.

AVOIDING THE UNPLEASANT ASPECTS OF CHLORINE ON THE SKIN

Adamant Technologies was the first company to be founded on the basis of this idea. The objective was to provide purification systems for private swimming pools and waste water treatment plants. Developing this nascent technology required a great deal of work, and when the contracts were slow in

coming, the first investors threw in the towel and the company eventually went bankrupt. Laurent Pupunat, who had been involved in the venture from the beginning, recovered the assets of a part of this technology, with which he was completely familiar. In 2012, he relaunched the project under the name WaterDiam, relying this time on being self-financing, when income began coming in from the company's first sales.



In the swimming pool treatment sector, the leading selling point of WaterDiam is the absence of chemicals, and particularly the unpleasant aspects of chlorine. “Our solution is more expensive than a chemical treatment,” explains Pupunat. “We're targeting a client group that is susceptible to the adverse effects caused by chlorine.” Thanks to this system, it is no longer necessary to soothe the skin by taking a shower after emerging from the pool or jacuzzi. What's more, the use of diamonds gives the water qualities that help to regenerate the epidermis.

FOR FRUIT AND CATTLE TOO

But WaterDiam doesn't intend to stop there. Its purification technology covers a broad range of applications, particularly within industry and agriculture. Laurent Pupunat has therefore deve-

loped and patented a variant of his system that is suitable for cleaning fruit after it has been picked, which once again reduces the use of chemicals. The company has also entered into an agreement with a partner in France, who uses the WaterDiam technology to purify the water given to cattle. “This has some very valuable effects on animal health, reducing infections and the use of antibiotics,” says Pupunat. WaterDiam has installed about fifteen systems of this kind in France and is planning further installations in Jura. The company intends to increase its

capital in future by approximately 1.5 million francs.

WaterDiam
🏠 2012 👤 1
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👤 Laurent Pupunat, founder

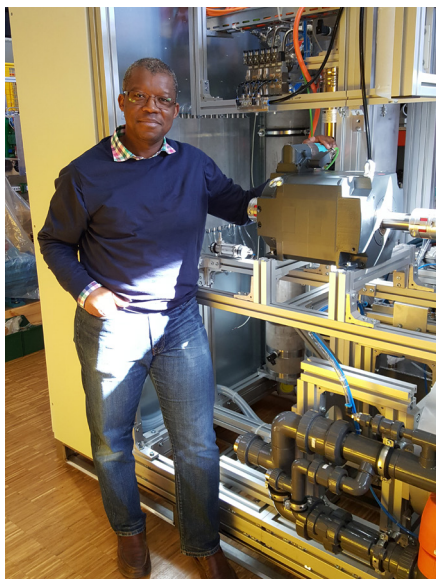


Enairys Powertech

A Lausanne-based start-up at the heart of the energy transition

Lausanne-based start-up Enairys Powertech is developing a system that uses compressed air to store electricity.

How can energy from renewable sources be stored efficiently so that, amongst other benefits, isolated populations in developing countries can be given easier access to electricity? This is the question that was asked by Sylvain Lemofouet, a 47-year-old engineer from Cameroon who founded Enairys Powertech jointly with Alfred Rufer. Based at the EPFL Innovation Park, this start-up has been working since 2008 on a method of storing electricity that uses compressed air.



RENEWABLE ENERGY ON DEMAND

Energy storage technologies, whether mechanical, electrochemical or thermal, are at the heart of the energy transition, because their common objective is to provide renewable energy on demand. This is also the objective of Enairys Powertech, which wants to provide a means of storing energy, based on compressed air, that is environmentally-friendly, economical and durable. The company's ambitious project aims to

use solar or wind energy to compress air in a cylinder. When the air stored in this way is released, it operates a generator when there is no longer any sun or wind. "This idea is more than a century old, but there hasn't been any machinery capable of turning it into a reality," says Lemofouet.

TRANSFORMING ELECTRICITY INTO COMPRESSED AIR

Sylvain Lemofouet prepared the ground for his concept in 2006, while working on his thesis at EPFL, and the start-up was formed a couple of years later. The solution designed by Enairys Powertech uses a system for energy management and hydropneumatic storage of energy to transform electricity into compressed air and vice versa, with an electricity cycle efficiency of at least 60%. The installation consists of a storage unit, a power conversion and management unit, and a water conditioning unit. "This technique requires the development of new machinery," emphasises Lemofouet, who is working with the Laboratory for Applied Mechanical Design at EPFL and the Laboratory of Thermal Processes at HEIG VD.

A MARKET WITH TREMENDOUS POTENTIAL

Enairys Powertech joined forces with the Bernese energy company BKW to set up a pilot project that was due to start in 2012. "But we had underestimated the technical and financial difficulties," Lemofouet admits. The company benefited from a support programme offered by the canton of Vaud (CHF 1.8 million)

to develop the first pilot system. A further CHF 1.5 million came from private funding. "We're hoping to raise 5 million francs by the end of the year so that we can go ahead with industrial production and start marketing our first products." Sylvain Lemofouet is targeting the market for storage of renewable energy from intermittent sources (solar PV, wind, etc.), for which the worldwide potential is estimated to be 19 billion dollars in 2017. "This market is mainly outside Switzerland," he says. "Several developing countries indicated their interest." Enairys Powertech hopes to complete its first pilot installation before the end of 2017 and to start industrial production in 2018. It is aiming to sell 2000 units over the next five years.

THE WORLDWIDE POTENTIAL OF THE MARKET FOR STORAGE OF RENEWABLE ENERGY FROM INTERMITTENT SOURCES (SOLAR PV, WIND, ETC.) IS ESTIMATED TO BE 19 BILLION DOLLARS IN 2017.

Enairys Powertech

🏠 2008

👥 2

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👤 Sylvain Lemofouet, CEO



Swiss Hydrogen

Shaping the future of the “green” car

The Fribourg-based start-up is developing hydrogen fuel cells, a technology that is revolutionary in the motor vehicle industry.

For three years, Alexandre Closset has been driving a Fiat 500 that is unlike any other. It is a hybrid car with a 200kg battery and a fuel cell. This system converts hydrogen and oxygen into electricity, which recharges the battery. Closset, a 45-year-old engineer, is very proud of this little car, because it showcases the knowhow of Swiss Hydrogen SA. The company develops hydrogen fuel cells and was formed by Closset, its CEO, in 2015. It is based in what used to be the administration building at the former Cardinal Brewery site in Fribourg, now renamed BlueFactory.

intended for use in vehicles, although it can also be used to generate electricity for the home. PEM cells are supplied with hydrogen and operate at approximately 80°C.

Switzerland and Europe. Its turnover for 2016 amounted to CHF 1.2 million. The company is targeting new markets, in particular a contract with a major motor vehicle manufacturer. Closset is also thinking of developing dual-purpose batteries that could be used in the car or the home.

“THE BATTERIES ARE IDEAL FOR THE FIRST 100 KILOMETRES AND THE FUEL CELL IS PERFECT FOR RECHARGING THE BATTERIES OVER LONGER DISTANCES.”

A 400-KILOMETRE RANGE

Alexandre Closset's Fiat 500 has a range of 400 kilometres. Half of this is provided by the fuel cell, which is no bigger than a couple of shoeboxes and is housed in the engine compartment. The hydrogen tank occupies part of the trunk. “The batteries are ideal for the first 100 kilometres and the fuel cell is perfect for recharging the batteries over longer distances,” he explains. The fuel cell developed by the company is of a type known as “PEM”, for “Proton Exchange Membrane” or “Polymer Electrolyte Membrane”, which uses polymer (plastic) components and is mainly

FROM CAR TO HOME

The Swiss Hydrogen venture goes back to 2007 and has its roots in the Swatch Group. At the time, its CEO, Nicolas G. Hayek, was becoming involved in environmentally-friendly energy, with the idea of installing solar panels on private homes and using the surplus electricity to produce hydrogen and fuel clean cars. He created Belenos Clean Power and recruited Alexandre Closset, who became its director in 2010. But in July 2015, Swatch Group changed its strategy. It sold Belenos' fuel cell development business to Swiss Hydrogen, whose share capital is held by private investor Marco Simeoni (56%), former

Belenos shareholder Groupe E (40%) and Banque Cantonale de Fribourg (4%). Closset now heads Swiss Hydrogen, a start-up that employs around fifteen people and which relies largely on its capital endowment and research contracts made in



Swiss Hydrogen

🏠 2008

👥 15

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👤 Alexandre Closset, CEO



Plus MAT

Making new solar cells out of silicon waste

Silicon plays a key role in manufacturing solar cells. In order to make efficient use of this precious resource, the physicist Yun Luo and her company Plus MAT AG have commercialised a method for recycling silicon waste that was originally developed at the Swiss Federal Institute of Technology in Lausanne (EPFL).

Nowadays, most solar cells are made of silicon. Silicon blocks are sawn into extremely thin slices known as wafers. The sawing process generates waste in the form of silicon dust, which mixes with liquid to produce a mud-like sludge. "Around half the silicon is lost during sawing. That is the biggest loss in the whole production process," according to Yun Luo, CEO of Plus MAT AG. "Our method allows us to reclaim 80 to 90% of the silicon waste so that it can be

reused for wafer production." The recycling also makes financial sense: the reclaimed silicon costs significantly less than extracting new silicon from sand. Using the recycled material reduces production costs for PV modules by "several percentage points" according to Yun Luo.

Previously, an expensive and energy-intensive melting process had been used to purify the metallic waste. In 2011, Yun Luo launched the start-up Plus MAT AG to commercialise Patrik Hoffmann's method. She had formerly worked in technology management at Meyer Burger (Thun, Switzerland), a company that manufactures sawing machines for wafer production.



reused for wafer production." The recycling also makes financial sense: the reclaimed silicon costs significantly less than extracting new silicon from sand. Using the recycled material reduces production costs for PV modules by "several percentage points" according to Yun Luo.

A NEW PROCESS DEVELOPED IN THE EPFL LABORATORY

Yun Luo comes from Shanghai in China. She studied physics at Fudan University

in Shanghai and École Polytechnique in Paris, and then completed a PhD at the Max Planck Institute of Microstructure Physics in Halle, Germany. From 2005 to 2008, she worked as a scientist at EPFL, where Prof. Patrik Hoffmann had developed a method allowing silicon waste from wafer production to be recycled at room temperature, normal pressure and relatively low cost.

BUILDING A PILOT SYSTEM

Plus MAT AG is based in Schüpfen (situated between Bern and Biel), the town where Yun Luo lives. The laboratory facilities are located in Thun, near Meyer Burger and Empa (Swiss Federal Laboratories for Materials Science and Technology), which are both partners of the fledgling company. Since 2015, Plus MAT has been collaborating with

a European PV module manufacturer. The aim is to build a pilot system for recycling the silicon waste generated by wafer production. Plus MAT has received funding from STI Biel (Foundation for technological innovation), the Commission for Technology and Innovation (Bern) and the Bern Economic Development Agency. The company is now looking for customers for its silicon recycling equipment. "At the same time, we are also talking to investors so we can expand our business," reports Yun Luo.

"OUR METHOD ALLOWS US TO RECLAIM 80 TO 90% OF THE SILICON WASTE."

Plus MAT

🏠 2011

👥 6

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👤 Yun Luo, CEO



Proxipel

Pellets produced close to their source

The Vaud-based Proxipel has designed a mobile pellet production unit that processes biomass in the place where it is produced.

Branches, vine shoots, straw, hay, grape pomace and even manure – Proxipel swallows everything. The machine developed by Richard Pfister and his team can produce pellets from almost any type of fibrous biomass. The major advantage of this 30-tonne unit is that it is mobile and can be towed to a site and used there. Transporting the biomass, which is an expensive and not very "green" operation, becomes unnecessary.

Proxipel is the only machine of its kind. Its distinctive features are its ability to grind up large pieces of waste material – up to 40cm in diameter – and to dry moist biomass. These enable it to turn

THIS MACHINE IS THE ONLY ONE OF ITS KIND, BECAUSE IT CAN GRIND UP LARGE PIECES OF WASTE MATERIAL ON-SITE AND DRY MOIST BIOMASS.

many different types of material into pellets. Using the unit avoids the statutory and financial constraints related to facilities for new pellet-production buildings, and means that material can be recycled in situ.

IN THE FIELD IN MAY 2017

The idea for the Proxipel mobile unit took root in the mind of André Corthay, former manager of the non-profit organisation Energie-bois Suisse. He then suggested to Richard Pfister, co-founder of renewable energy consultancy firm Praxis Energia SA, that he join him in developing it.

After the project was launched in 2013, it received support from the Federal Office for the Environment (FOEN), the

economic development department of the canton of Vaud, Services Industriels de Genève, the Swiss Climate Foundation, Alternative Bank Switzerland, InnovARC, the Foundation for Technological Innovation, and also several private

waste disposal, composting and biogas production. "We've conducted a survey of the use of biomass in Europe, and the prospects for the future are tremendous," says Pfister, before going on to emphasise a significant advantage: "We've got very little competition, at least for the moment."



investors. A third round of funding was finalised in November 2016 and, after four years of development, the first Proxipel mobile units went on sale in May 2017. "Our project has generated a lot of interest," says a delighted Richard Pfister. "We have eight clients who are just waiting to take delivery of the first machines."

A MARKET TO CONQUER

Potential clients include farmers, SMEs or multinationals involved in waste management, and logging companies, as well as public bodies, and centres for

Proxipel

🏠 2013 👥 2

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🌐 www.proxipel.com

👤 Richard Pfister, CEO



Bcomp

From skis to the skies

Created by four skiing enthusiasts, this Fribourg-based start-up specialises in developing composite materials based on natural fibres. Its products are already used in sports equipment and motor vehicles, and this young company now has its eye on the aviation industry.

Lightness at any price. This could easily be the motto of Bcomp, which creates natural fibre-based materials that are used in applications ranging from motor vehicles to sports equipment. Formed in 2011, the company has made its home in the BlueFactory technology district of Fribourg. Bcomp's use of natural materials was attractive to the sports industry from the very beginning. Now, the aviation and automotive industries are also showing a keen interest in these technologies.

BASED ON FLAX

Christian Fischer, 39, is one of the four joint founders of Bcomp. This Franco-Swiss engineer grew up in the German-speaking part of Switzerland. After studying materials science at EPFL and writing a thesis on composite materials, he began his career in industry, working for the Canadian aluminium manufacturer Alcan. He put this experience to



good use later on when he and three associates formed Bcomp. The year is 2011, the place is a garage in Fribourg. Julien Rion, Cyrille Boinay, Christian Fischer and Andreas Brühlhart are beginning to produce a material that

will revolutionise the ski industry, by making it possible to manufacture skis that are lighter than the traditional models. This is achieved by using technologies developed and patented by Bcomp

“THE CENTRAL ADVANTAGE OF OUR TECHNOLOGY IS LIGHTNESS,” EMPHASISES CHRISTIAN FISCHER. “IT HAS ALREADY PROVEN ITSELF, NOT ONLY IN SKIS, BUT ALSO IN THE AUTOMOTIVE INDUSTRY.”

that incorporate flax grown in northern France and Belgium. The result: a ski whose structure is improved in terms of weight, rigidity, and damping/absorption of shocks.

MAJOR BRANDS ATTRACTED

The first product was a balsa-flax composite. This material soon attracted the interest of major Swiss and international ski brands (K2, Nordica, Stöckli). In the first year, Bcomp was funded by a loan from Seed Capital Fribourg, the funding body of the Fribourg Development Agency. After winning a few awards for its innovation, Bcomp raised a first round of funding in March 2012. It broke even in 2015.

The company does not give details of its finances but is currently preparing to raise a second round of funding to attack new markets.

THE AUTOMOTIVE INDUSTRY, AVIATION, AND SOON THE SPACE INDUSTRY

“The central advantage of our technology is lightness,” emphasises Christian Fischer. “It has already proven itself, not only in skis, but also in the automotive industry.” In the latter case, there is a weight saving of 40% in comparison with standard automotive parts. “We are now aiming to enter a number of transport markets.” These include aviation – Bcomp has just entered into a partnership

with Lufthansa Technik – and even the space industry, which is already showing clear signs of interest.

Bcomp
 🏠 2011 👥 10
 Passage du Cardinal 1, 1700 Fribourg
 ✉ christian@bcomp.ch
 🌐 www.bcomp.ch
 👤 Christian Fischer, CEO



TVP Solar

Solar panels that are more than just a lot of hot air

The Geneva-based company has developed a unique technology for vacuum flat plate solar thermal collectors, which generate high temperatures. The solution is creating as much interest in the Gulf States as in Scandinavian countries.

The solar panels designed by TVP Solar, a company founded in Geneva in 2008, are suitable for cooling processes as well as heating. "Our technology helps to replace the use of fuels with sunlight," explains Jonathan Koifman, the company's technical pre-sales consultant. The applications range from industrial process heat to desalination, and even include air conditioning. TVP has also developed a specialist knowledge of the petroleum industry.

THE GROWING MARKET FOR DISTRICT HEATING

"We started the marketing phase in 2015," says Koifman. The plant at Avellino, in southern Italy, can produce



"IN EUROPE, THE MAIN APPLICATION IS IN DISTRICT HEATING SYSTEMS, WHERE SOLAR THERMAL PANELS PROVIDE HEAT FOR HEATING AIR OR DOMESTIC HOT WATER."

TEN PATENT APPLICATIONS FILED

Between 2008 and 2010, TVP Solar was in a phase in which it refined its technology, says Koifman. This process resulted in ten patent applications being filed. The implementation and test phases followed, from 2010 to 2014, which included testing by utility company Services Industriels de Genève. Initial production began at the end of 2015, with a slight delay. "The highly specialised nature of the machines used to manufacture the panels meant that an adjustment period was required," he explains. The company says that it made use of this experience to improve its processes.

122,000m² of solar panels per year and TVP Solar now employs 38 people. "We will be carrying out our first commercial installation this year, the client is a Kuwaiti logistics company." Indeed, the Gulf countries are a very attractive market for TVP Solar, especially for its air-conditioning systems for shopping centres. "In Europe, the main application is in district heating systems, where solar thermal panels provide heat for heating air or domestic hot water," continues Koifman, giving an example: "In Denmark, where district heating is very common, the plants use a lot of biofuels, such as wood. However, Denmark is actually preparing to increase its use of solar power." Since TVP Solar was formed, it has raised more than CHF 22 million from private investors, via three successive funding campaigns.

TVP Solar

🏠 2008

👥 38

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✉ koifman@tvpsolar.com

🌐 www.tvpsolar.com

👤 Jonathan Koifman, Marketing Manager



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de l'industrie

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A list of 207 innovative or technological cleantech start-ups with high growth potential created since 2006.

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ABCD TECHNOLOGY Production of equipment for deposition of 3D-patterned multifunctional thin films using the CBE (Chemical Beam Epitaxy) process. www.abcd-technology.com	 AQUAERO Equipment that produces drinking water from air. www.aquaero-water.com	 BCOMP LTD. Supplier of robust, high-performance materials for the sport and leisure industry, developing lightweight solutions based on renewable materials. www.bcomp.ch	 BOXTANGO System facilitating the transfer of containers from road to rail. boxtango.com
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AMPARD System for intelligent management of the production and storage of solar energy aggregated to a virtual power plant for grid balancing. www.ampard.com	 AVENTOR Ultra-light electric racing cars that combine advanced composites and biopolymers to achieve greater energy efficiency and total recyclability. www.aventor.ch	 BLUEWATT ENGINEERING Modelling software for optimising the operation and energy consumption of waste water treatment plants. www.bluewatt-eng.com	 CATECAR Hybrid city-car with a solar roof, using new plant-based materials and removes pollution from the ambient air. www.catecar.ch
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


























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www.stemys.io


STIGNERGY 
SEMS, a solution for the control and optimisation of the power consumption of companies' machines and equipment to avoid peak periods, based on bio-inspired artificial intelligence technology.
www.stignergy.ch


SUN-D 
Luminous panels that work by collecting daylight or artificial light and redirecting it in a controlled manner.
www.sun-d.ch


SWISS BLUE ENERGY 
Thermomagnetic motor enabling electricity to be produced from residual heat at low temperatures.
www.swiss-blue-energy.ch


SWISS ECO LINE 
Water diffusion technology that uses 90% less water than is needed by a conventional diffuser.
www.swissecoline.com


SWISS FRESH WATER 
Decentralised water treatment system with telemetry-assisted maintenance.
www.swissfreshwater.ch

SWISS HYDROGEN 
Personalised turnkey solutions based on hydrogen-related technologies.
<http://swisshydrogen.ch>


SWISS NEWATER GROUP 
Hydroclean, cleaning and disinfection technology based on a non-toxic biocide obtained by the electrolysis of water using diamond electrodes.
www.swiss-newater.com


SWISS-9 
Transparent, hydrophobic and antireflective surface coatings that reduce the quantity of reflected light.
<http://swiss-9.com>

SWISSINSO 
Surface treatment for the production of coloured thermal and photovoltaic solar panels.
www.swissinso.com

SYSTEM-ALPENLUFT 
An integrated system with low ecological impact for waste collection, treatment and recycling by local authorities.
www.system-alpenluft.ch


TALBOT NEW ENERGY 
Production of electricity from low-pressure vapour.
www.talbotnewenergy.com


TECHSEP 
Equipment for the collection and treatment of water from road drainage.
www.techsep.ch

TENTSO 
Flexible mobile structures (tents, etc.) clad in photovoltaic panels.
<http://tentso.com>

TREATECH 
Waste water treatment technology enabling inorganic salts to be separated out and organic waste to be reused.
www.trea-tech.com

TREMOLA 
Three-wheeler electric vehicles for urban use.
www.tremola.ch

TRICOPIAN 
A system of exchangeable recharging modules for mobile appliances, for use in airports, rail stations, city centres, etc.
www.fuel-rod.com


TRUNZ WATER SYSTEMS 
Self-sufficient systems for water treatment and purification powered by renewable sources (solar power, wind power).
www.trunzwatersystems.com


TVP SOLAR 
Flat solar thermal panels based on high-vacuum tubes, for air conditioning and heating.
<http://tvpsolar.com>


TWINGTEC 
Technology for the conversion of high-altitude wind energy to electricity using tethered wings.
<http://twingtec.ch>


TYRE RECYCLING SOLUTIONS 
Technology for recycling tyres with recovery of the rubber and metal.
www.trs-ch.com


URBANFARMERS 
Installation and management of rooftop farms on urban buildings for the supply of local, organic produce.
<https://urbanfarmers.com>

VARIONIX 
Air treatment solutions, odour neutralisation, pollution breakdown and sterilisation by ionisation.
www.varionix.ch

VATOREX 
System for the ecological treatment of Varroa (bee parasite) by hyperthermia.
www.vatorex.ch

VELA SOLARIS 
Simulation software for the design of solar thermal, photovoltaic, heat pump and combined energy systems.
<http://velasolaris.com>

VELOHUB 
Development and marketing of bicycle light systems of the future.
www.blinkers.io

VIR2SENSE 
System for the continuous monitoring of engine emissions based on virtual sensor technology.
www.vir2sense.com

VIRVE SAGL 
Software solution and human-machine interface for assisting drivers and optimising the driving of electric vehicles.
www.virve.ch

VOLTITUDE



Design and production of folding electric bicycles.

www.voltitude.com

VSBOAT



Electric motors for boats and a multiple-use energy storage solution.

www.vsboat.ch

WASTE ALLOCATION SYSTEMS



Manual waste compactor for individuals and SMEs.

www.was-e.com

WATERDIAM



Diamonds in the service of water. Water treatment systems without chemical additives based on boron doped diamond electrodes.

www.waterdiam.com

WAYRAY



Navion, the transport of tomorrow – a hologram-based augmented reality system to assist and inform the drivers and passengers of vehicles in real time.

www.wayray.com

YOUMO



Development and marketing of electric bicycles with unrivalled comfort.

<http://youmo.ch/>

YOUNERGY



Leasing solution for the installation and management of photovoltaic solar systems.

<http://younergy.ch>

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Founded in 2015, eqlosion turns ideas into products, activities or companies. The young company was created by entrepreneurs focused on the theme of sustainability. It develops its own ideas, supports sustainable innovation in companies and promotes innovation from research centres by bringing new products and activities to market. Its founders and employees have many years of experience and a very large network; including investors, partners, companies, academics and public authorities. With a very strong market orientation, they share the risks of new developments and have a passion for the transition to a more sustainable economy.

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