Are more innovations the key to a transition into a more sustainable future?

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Are we innovating quickly enough to solve the environmental challenges, for example reach the 2050 Swiss climate objectives, and stay within the planetary boundaries? If not, where are the gaps and how could we accelerate the deployment of existing technologies to reach our objectives? These are the questions we are addressing in this article.

Interviews with nine experts, survey responses from startups, and a literature review show that we already have many cleantech technologies available to succeed in reaching carbon neutrality, also known as net-zero. Mature and currently available technologies could solve 50% to 70% of the currently identified environmental issues. Most of the remainder could be addressed with technologies that exist, are demonstrated, but need to be introduced to the market.

The current challenges are therefore, by order of importance: 1. Massive scaling of the available technologies, 2. Bringing to market demonstrated, but not fully mature, technologies and 3. Further innovation to fill the remaining gap. However, the latter two are very likely to follow if the first is achieved. In other words, massively scaling the available technologies will induce a big pull for new technologies and innovation and will drive a lot of investment and interest.

Addressing the massive scaling challenge of those technologies requires decision makers at different levels to change practices and the way decisions are taken. As highlighted in the interviews, it is a mix of various actions and decisions that can, together, play a role to see a sudden change of the dynamic in the adoption of specific technologies.

Six limiting factors to a massive scaling

1. The legal framework does not favor environmentally friendly technologies;
2. While there is a lot of public money in R&D, very little goes to the deployment of innovations;
3. A lack of information on the urgency of the sustainable transition, which could lead to more pressure from stakeholders;
4. Public and private organizations do not spend enough resources on prospective work, which would favor anticipating risks and opportunities and adoption of new technologies;
5. Uptake of technology suffers from lack of skills in some professions;
6. Not all technologies have found a working business model and some lack financial competitiveness.

The objective of this article is to investigate what is the status and potential of cleantech technologies that are on the market and whether we are innovating quickly enough to solve the environmental challenges. In the COP26 meeting in November 2021, the Paris agreement was further confirmed, and many regulations were promised. But we are still very far from being carbon neutral. There are three important measures to reach the goal: sufficiency, where we reduce our demand by downsizing; carbon capture & storage, where we try to compensate for most of our emissions; and the massive deployment of new sustainable and renewable technologies. We will certainly need a mixture of all three, but the last two are very attractive, because they promise further prosperity, growth and job security. Little is known in the general public and among politicians about how much of the necessary technologies are already existing, tested or even deployed. Can we reach 20%, 50%, or 90% carbon neutrality with the current technologies?

- Do we invest enough in innovation to enable the transformation of our society and our economy and to become truly sustainable?
- Are there gaps and environmental issues for which the rate of innovation is not sufficient?
- What is the potential of all innovations that are already on the market?
- What are the key limiting factors preventing the deployment of the full potential of these technologies?
- What are the key challenges to overcome in order to accelerate their adoption and what should be our focus to make it happen?

This article first investigates where we stand in terms of available technologies to overcome key environmental challenges by asking experts and startups and performing a literature review. It then assesses what are the fields in which we need innovations and in which we expect innovations and startups to explode in the coming years. Finally, interviews with experts and startups help to understand what the key challenges for the massive deployment of existing solutions are (full interview at the end of the article) and where it is possible to act.

What do Swiss startups say?

In a survey sent in May 20201, we asked cleantech and sustainability startups in Switzerland about the need for more innovation and the deployment of existing technologies. Results representing the point of view of 120 startups are presented in Figure 1.

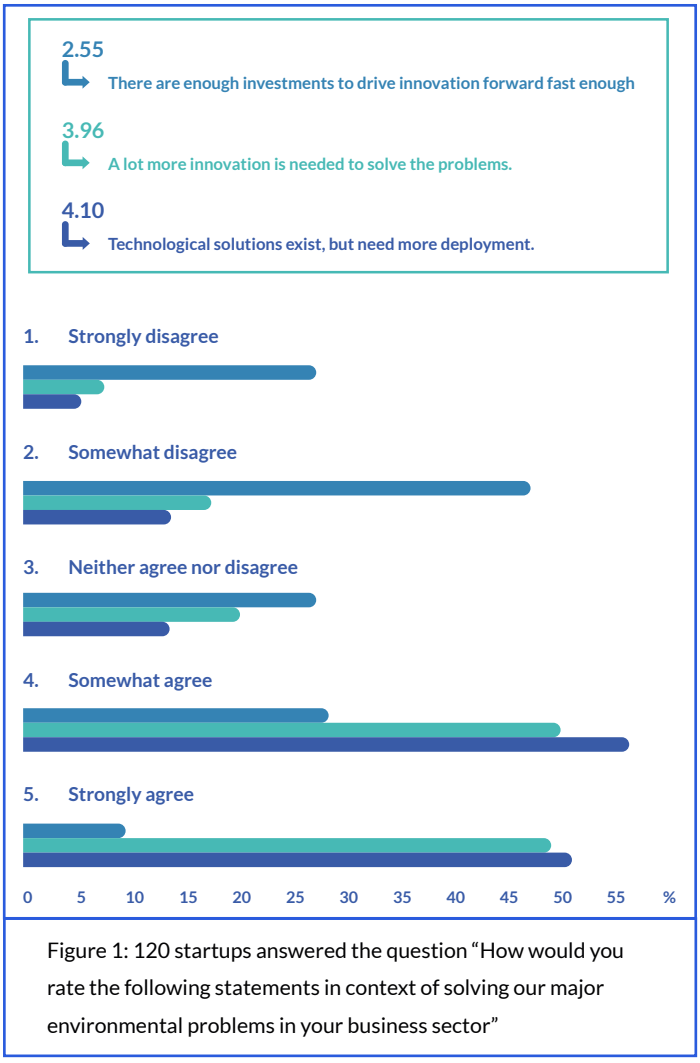

Figure 1: 120 startups answered the question "How would you rate the following statements in context of solving our major environmental problems in your business sector"

The responding startups generally agree that a lot more innovation is needed and that technological solutions exist and need more deployment. There are no major differences between startups from different sectors.

What can we learn from the literature?

McKinsey, a management consultancy, suggests in a report on Europe's net-zero pathway that "climate technologies that are already mature could, if deployed widely, deliver about 60 percent of the emissions abatement that will be needed to stabilize the climate by 2050. The challenge is that further abatement must come from climate technologies that aren't quite ready, including 25 to 30 percent from technologies that are demonstrated but not yet mature and another 10 to 15 percent from those still in R&D." Christoph Schweizer, CEO of Boston Consulting Group, is aligned and "says his firm's analysis shows the world can get 70% of the way using existing technologies. But 30% of the needed technology is yet to be invented."

https://fortune.com/2021/12/09/net-zero-technology-needed-ceo-daily/

In its report Seizing the EU's Man On The Moon, Cleantech for Europe explains, citing the International Energy Agency, that "50% of the emissions reductions needed to get on a path to net zero by 2050 may come from technologies that are not on the market yet.". However, "These technologies are already demonstrated at a small scale but need to be scaled up now to have a material impact by 2030. They include long-duration energy storage, green hydrogen production and storage, the use of hydrogen in heavy industry, low-carbon fuels for transport, and carbon capture."

What do Swiss experts say?

A set of experts were interviewed to get their point of view on that same questions and the innovation one should focus on. They have been chosen for their know-how of the cleantech and innovation ecosystem in Switzerland, as well as their understanding of key sectors such as food, energy and building. They are:

Thomas Dübendorfer
President at Swiss ICT Investor Club (SICTIC)

Richard Mesple
CEO of Local energy (interview at the end of the article)

Marc Muller
CEO Impact living

Maël Perret
CEO of e-nno (interview at the end of the article)

Myke Naef
co-founder and managing partner at Übermorgen Ventures

Eric Plan,
COO at CleantechAlps

Kurt Schaller
CEO of Agolin (interview at the end of the article)

Karin Söderström
energy research and cleantech specialist, SFOE

Daniel Zürcher
head of section innovation, FOEN

The experts interviewed were asked the following question: "What percentage of environmental issues could be solved by technologies that are already available?". Although answers are very diverse and go from "We need a lot more." to "We have more or less all of them.", there is a trend among the interviewed experts that we have most of the technologies available, which is in line with our literature research. Experts also indicated levers of the transformation and factors limiting scaling, that are mentioned later in this article.

Scaling is a key priority

To make it short, we summarize the point of view of experts, startups and data from the literature in the following way: technologies on the market have the capacity to support at least 50% and up to 70% of the climate transition. The remaining gap could, according to statements above, mostly be filled by technologies that are already demonstrated at small scale (30% to 40%). A remaining 10% to 20% still need to be invented.

As highlighted by Marc Muller: "The interesting question is which technologies are needed for which lifestyle? If the goal is to fly 20,000 km per person around the world, we certainly need a lot more! If the goal is to live well, to change our habits a little and to consume in a reasonable way, then we don't need anything more than what exists!"

The Solar Impulse Foundation identified more than 1322 solutions currently available in 2022 that, if all deployed, could have tremendous environmental and economic benefits. The foundation labels solutions that are efficient, clean and cost-effective. However, as underlined by Bertrand Piccard: "there is an immense laziness and fear of change and a legal framework today that allows pollution to continue "[3].

In the interview at the end of this article, Richard Mesple explains in detail the evolution of PV technology and its acceptance and deployment in Switzerland. He underlines that we need to put the effort into deployment: "Universities and startups are feeding feeding industry with new ideas. This is good, it makes solar more competitive, but it doesn't always help with deployment".

In some hard-to abate sectors, more innovation is needed

Myke Naef, co-founder and managing partner at Übermorgen Ventures underlines that "In some fields, some fundamental innovations are needed, and in others, where we already have a lot of options on the market, there's still room for improvement".

The following fields have been described by Swiss experts as those in which more innovation is definitely needed:

- Robotisation of agriculture
- Regenerative agriculture, including alternative plant based protein
- Digitalisation and the use of data and IA for the transition (e.g. grid management)
- Green hydrogen and alternative fuels

[2] https://solarimpulse.com/foundation
[3] Broadcast: 52 minutes on 16 October 2021

- Carbon capture, utilization and storage (CCUS)
- More efficient industrial processes (steel, concrete and aluminum production)
- Specific recycling activities (precious metals, rare earth, etc)
- Underground infrastructure (like the Cargo Sous terrain project)
- Protection of infrastructure from natural disaster

In Switzerland, the R&D phase and early stages development are very well covered by public money, top universities, and the work done by organizations like Innosuisse. As explained by Daniel Zürcher, head of innovation at FOEN (see Figure 2): "We very well support technologies up to the door of the research lab. For the following phase, pilot and demonstrators in real conditions, some support mechanisms exist, although financial resources are too scarce. But for the next phase of the scale-up, having the possibility to have the first clients, there's almost nothing in terms of public funding. This is however also one of the most challenging phases for startups". The objective is not to distort the market thus public support should be reduced when approaching marketability.
However, and especially as we need to accelerate the deployment of some sustainable technologies, more support for pilots and demonstrations and acquiring the first clients could be an efficient temporary measure to accelerate the shift towards the adoption of new technologies.

Is scaling happening at the right speed?

It is absolutely clear, from the discussion with experts and startups, that scaling is not happening at the right speed to reach the environmental and climate objectives.

If we manage to increase the speed of the scaling, it is very likely that further innovation will follow to "close the gap" and meet the full climate and environmental challenges. The R&D ecosystem is very efficient in Switzerland and will provide the necessary new innovation.

What are the factors limiting scaling?

Six factors limiting scaling have been identified during the interviews with experts:

- The legal framework does not favor these technologies;
- There is a lot of public money in R&D, but very little in the deployment;
- Key decision makers do not put enough pressure on their suppliers and partners to adopt these technologies;
- Public and private organizations do not spend enough resources on prospective work, which would favor anticipating risks and opportunities and the adoption of new technologies;
- Technology adoption suffers from lack of skills within certain professions and a lack of general information on the urgency of the transition;
- Not all technology owners have found the right business models and some technologies lack financial competitiveness;

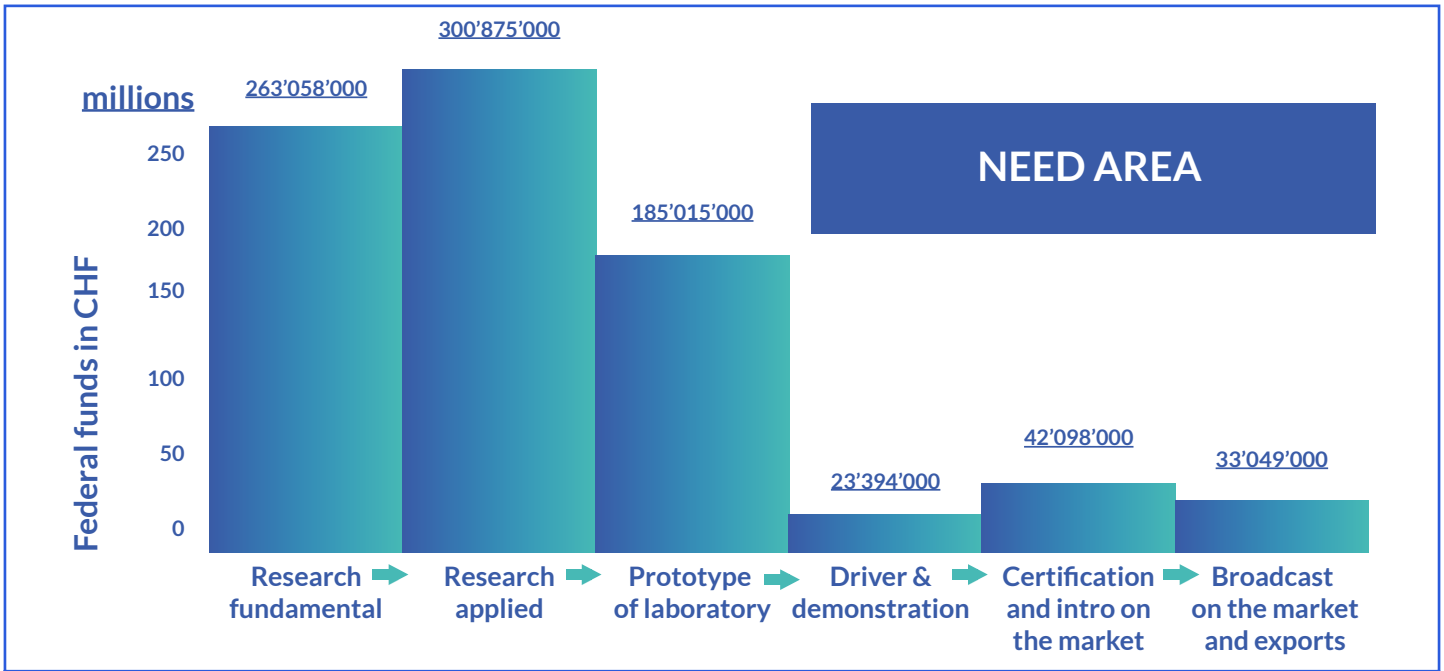

Figure 2 : Aggregated amounts (in CHF) of the public support via support programmes in the field of environment and energy per phase of R&D to market (data for the year 2019). Source: Federal Office for the Environment, 2021, Révision de l'ordonnance sur la réduction des émissions de gaz à effet de serre (ordonnance sur le CO2), Rapport explicatif

Innovating to net zero: an executive's guide to climate technology

In a recent guide, published in October 2021, McKinsey assessed five technology areas with considerable potential, the so-called next-generation technologies. These could attract $1.5 - $2 trillion of capital investment per year by 2025. These next-generation technologies are:

- electrifying transportation, buildings, and industry
- launching the next green revolution in agriculture
- remaking the power grid to supply clean electricity
- delivering on the promise of hydrogen
- expanding carbon capture, use, and storage

There is a clear overlap between the McKinsey study and the areas identified during the interviews with experts. Some of the groups of technologies identified by McKinsey are however larger than the fields identified by the Swiss experts. On the other hand, the latter have also identified some other sectors that might attract less investment, but are also considered as important.

TECHNOLOGIES TO WATCH	ANNUAL INVESTMENT BY 2025, $ BILLION	CO2 ABATED PER YEAR IN 2050, GIGATON (1.5°C PATHWAY)
Electrification • Electric-vehicle batteries • Battery-control software • Efficient building systems • Industrial electrification	700-1.000	~5.0
Agriculture • Zero-emissions farm equipment • Meat alternatives • Methane inhibitors • Anaerobic manure processing • Bioengineering	400-600	~10
Power grid • Long-duration storage • Advanced controls • Software and communications • Vehicle-to-grid integration • Building-to-grid integration • Next-generation nuclear • High-efficiency materials	200-250	~5.0
Hydrogen • Low-cost production • Road-transport fuel • Ammonia production • Steel production • Aviation fuel	100-150	~2.5
Carbon capture • Pre-and postcombustion capture technologies • Direct air capture and storage • Biochar • CO^2-enrichied concrete	10-50	~3.0

https://www.mckinsey.com/business-functions/sustainability/our-insights/innovating-to-net-zero-an-executives-guide-to-climate-technology

Figure 3 : illustrates these factors with three examples of mature technologies that could play a significant role in the transition and are ready to be scaled: photovoltaics, additives for livestock (e.g. Agolin) and optimisation of energy use in buildings (e.g. e-nno). See interviews from experts and startup CEOs below for more information.

Where to act?

It is absolutely sure that accelerating the massive scaling and adoption of climate and sustainability-friendly technologies is not the responsibility of a single stakeholder and that there are a lot of sticking points to act on. Figure 4 shows the kind of decisions and actions that key stakeholders can take to act on the six key limiting factors.

How can startups contribute?

Startups cannot act on many of the levers that have been described in this article. They need to work with the existing rules and framework and have few resources to influence the economic environment. There are however some levers on which they can work to prepare their entry to the market and speed up acceptance:

1. Focus on building trust with future clients: as described in Kurt Schaller's and Mael Perret's interviews, building trust with future clients takes time and is not only linked to the fact that a product works and that the technology is proven. It is also linked to showing the reliability over time. That requires the early set up of experiments, with strong testing and measurement protocols and external certifications. This work should not be underestimated as it is complex and needs to be well prepared and managed. This is also cost intensive and a must to convince potential clients about the reliability of the product.

2. Building value for all stakeholders: when designing the product, making sure to understand the full value chain, with all the stakeholders and to build the product and the business model to bring value to all of them. This could have a huge impact on the product as well as the business model and should be considered as early as possible in the process.

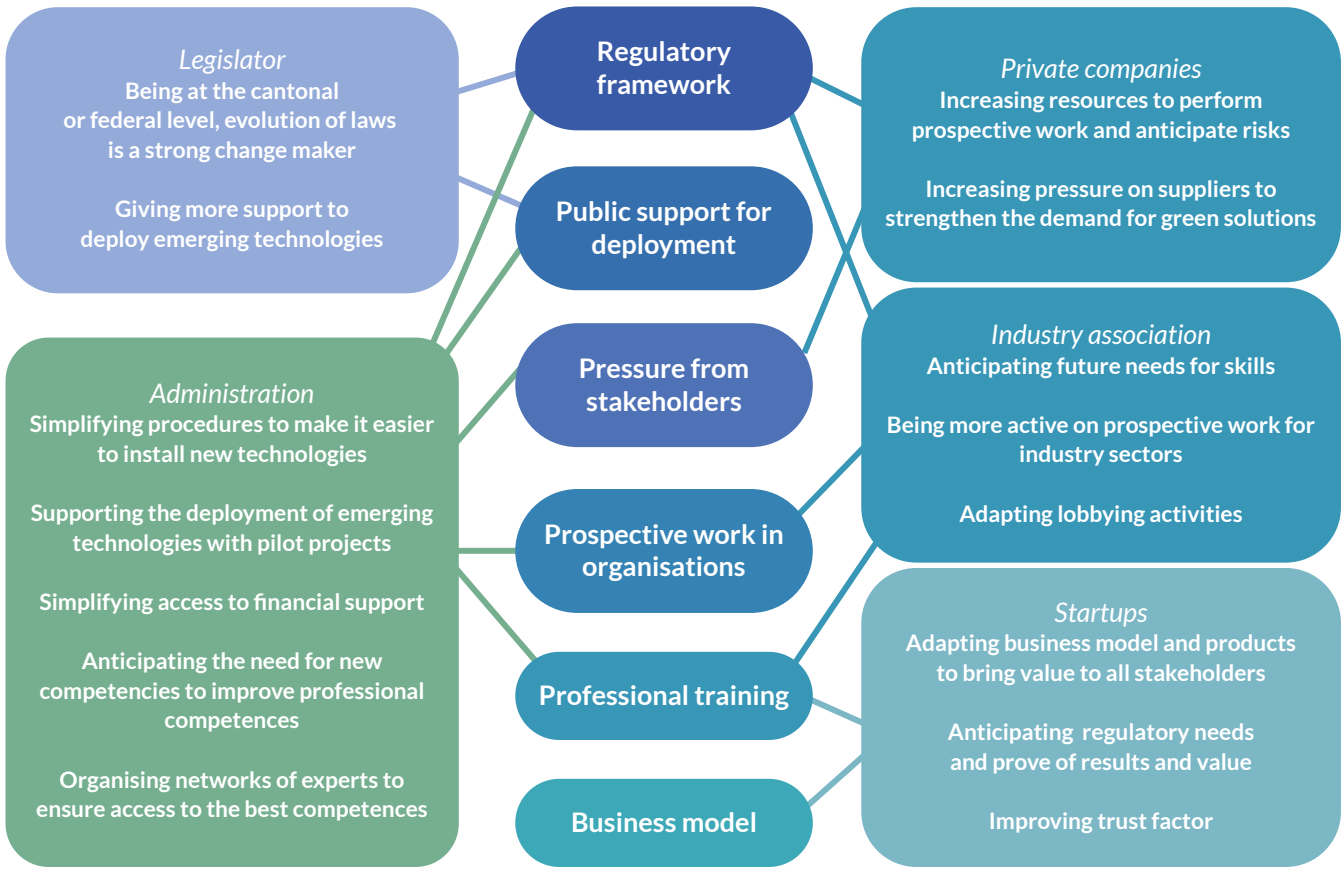

Figure 4: Decisions and actions of key stakeholders to act on the 6 key limiting factors.

Conclusion

It is how we will adapt the framework and conditions to massively accelerate the diffusion of these technologies that should be our key focus. This acceleration will also be a big pull that will drive more innovation to the challenges that will remain.

The innovation ecosystem is ready and efficient enough to tackle that challenge. We need to work collectively on understanding how scaling existing technologies could happen. Which decision-makers need to take what decisions? Being aware of the situation is a first step, understanding more in detail the obstacles and barriers in each sector and for specific technologies is the second. This is yet not clearly known, sufficiently analyzed and communicated, except in some specific fields. Only then will we be able to work on breaking the lock. Learning from the past (like the example of PV) and learning from experience in other countries might be a way to follow.

https://swisscleantechreport.ch/
Perspectives Energétiques 2050 - OFEN:
https://www.bfe.admin.ch/bfe/fr/home/politique/perspectives-energetiques-2050-plus.html
Fintech News
https://fintechnews.ch/partner-content/swiss-green-fintech-network-launches-the-first-action-plan/43927/

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TCFD : Task Force on climate-related Financial Disclosures
https://www.energynews.pro/cleantech-for-europe-souligne-les-investissements-de-lue/
Quelle pourrait être l'importance des émissions négatives de CO2 pour les futures politiques climatiques de la Suisse ?
Rapport du Conseil fédéral en réponse au postulat 18.4211 Thorens Goumaz du 12 décembre 2018

Interview with Kurt Schaller from Agolin

Agolin is active in the field of animal feed, especially for cattle. Agolin markets a mixture of natural plant extracts (based on coriander and clove seeds) in the form of microbeads that are mixed with the feed. The mixture increases cattle performance by 4% and also reduces methane emissions by about 10%.

Can you tell us more about the sales development of the product in recent years?

KS: We started working in this field in the 1990s (essential oils for ruminants (e.g. cattle, sheep, etc. livestock)). Today 70% to 80% of sales are in ruminants and we have invested more in this area to meet the demand. In terms of sales, we have tripled our turnover since 2016.

Were there any triggers that allowed you to make leaps in terms of deployment? Start sales? If so, which ones?

KS: The first thing that was very important for us was to have a good scientific basis. And trials in ruminants are time consuming and expensive (each trial costs 100,000 euros).
To date, we have a meta-analysis that includes the results of 23 trials. This meta-analysis shows a reduction in methane emissions of 10% and an increase in performance of 4%. These scientific trials have allowed us to get a Carbon Trust certification, which has helped us a lot. It also allows us to bring value to all the actors in the chain, the producers (performance) and their customers (GHG reduction).

We have noticed that large companies have been much more active over the last 1-2 years. Before, we had interest, now there are decisions. The GHG argument is becoming more and more important. Behind all these steps, there is one key element that stands out, which is credibility. We sometimes tend to forget the basics, giving confidence.

What are the 3 key factors that would enable massive deployment of your technology?

KS: One factor is competition. We work with natural products, and some competitors work with chemicals, or with algae. We also have competitors who are very large companies, who have lobbying capabilities, for example, that are very important. Regulation plays an important role through approvals. If our product could be approved as an environmental additive, this would enable us to increase sales even more. To date, no additives have been approved as 'environmental' in Europe.

What decisions/actions, and on the part of which players, could be important levers?

KS: A strong development of the voluntary carbon market and the approval of «environmental» additives in Europe.

In the event of very rapid growth, what are the main challenges you anticipate?

KS: We think we will be able to keep up with production. We can set up new production lines and organize storage space. Of course, we will have to ensure growth, i.e. find qualified personnel, adapt the structure of the organisation, or ensure liquidity. But it is easy to find money when you are successful.

Interview with Richard Mesple, Director of local energy

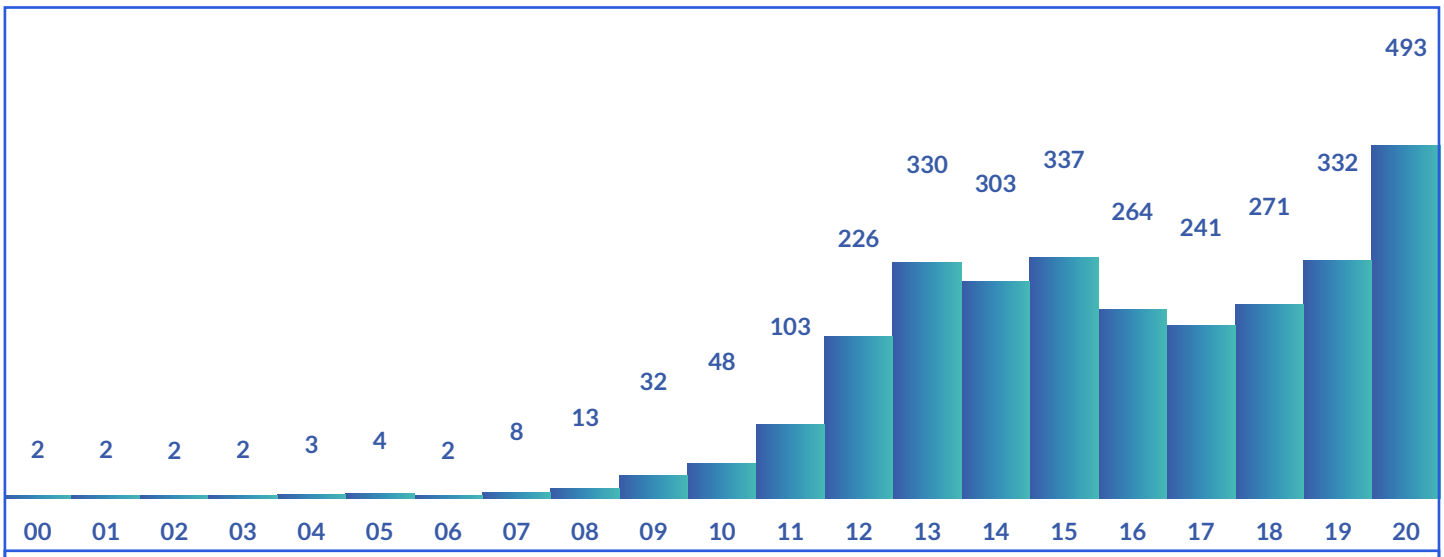
We talked about photovoltaic panels, which allow solar radiation to be transformed into electricity, their development and the associated challenges.

Can you remind us of the history of the development of photovoltaic solar energy, particularly in Switzerland? The evolution of panel sales is shown in the table below. If we analyse the graph, we see a clear increase in the sale of PV power around 2011 - 2012, a dip from 2014 and a further increase in 2019 and 2020. How can this be explained?

RM: It's a good idea to look back at what has happened, analyse it to understand the dynamics, and take inspiration from what has worked and possibly apply it to other technologies

2011 - 2012: The increase is linked to the introduction of the Feed in Tarif (FiT), a very interesting mechanism, which has generated excitement.

2013 - 2014: The transition from FiT to UC (Unique contribution) generated a very clear slowdown. The UC has a huge flaw, it forces the producer to deal with self-consumption and the buy-back price of the surplus by the DSO (Distribution System Operator) to work on the return on investment.



Evolution of annual power sales over the last 20 years (in MW) - source: Swiss Federal Office of Energy, Solar Energy Statistics, Reference year 2020

2019 - 2020: This new increase is linked to an awareness and a change in behavior. It is probably a combination of a whole series of trends, decisions and realities that are leading to a change in perception. Are we perhaps a little more aware of the climate crisis we are entering?

To sum up, it is first of all the changes in the framework conditions, which have had an effect on profitability. And secondly, it is the accumulation of several trends that is driving action.

Note on the evolution of price: In a report published in 2021, the IRENA (International Renewable energy Agency) explains that the price of electricity has fallen by 85% between 2010 and 2020. The increased competitiveness of photovoltaic electricity is certainly another factor that explains the strong increase in recent years.

What are the 3 key factors that would enable the massive deployment of this technology?

RM: The first one for me is clearly the simplification of administrative processes. Everything is too complicated.

The second one is the fact that you open a box of 1000 questions when you ask about PV panels. Renovating the roof? Changing the heating? Then it's complicated to solve everything at once. The third is the people who are qualified in the field. Companies that do not do quality work offer lower prices on the market and compete with «serious» companies.

What decisions/actions, and on the part of which actors, could be important levers? Do you have concrete examples from other countries?

RM: Putting the effort into deployment. Universities and start-ups are feeding industry with new ideas. This is good, it makes solar more competitive, but it doesn't

always help with deployment. A clear decision by the Confederation to favour solar energy. We must not forget that, although everyone is in favour of solar energy, not everyone has the same vision as to where solar energy should go and how fast it should develop.

In the event of hyper-rapid growth, what are the main challenges you anticipate?

RM: A lack of skilled people. There will be a shortage of qualified companies. I don't think there will be a shortage of materials, a panel is easy to produce, and the technology is very advanced.

Any other comments?

RM: In the car industry, historical players were well established. It took a new player coming from California, who is rethinking the whole production of a car, to get this technology off the ground. They started from scratch and questioned the whole chain.

Interview with Maël Perret, CEO of e-nno

e-nno has developed a solution for the energy optimisation of buildings. The technology exchanges data with technical installations in order to learn more about the thermal behaviour of the building and to identify potential energy savings. Optimisation algorithms can then be used to modulate heat production and achieve savings of 10% to 30%. The technology can be adapted to all heating systems and all types of building, which is particularly relevant given the heterogeneity of the Swiss building stock.

How did you get started?

MP: We couldn't find any technology that could optimise the consumption of existing buildings in the way we wanted to do. So we developed it. The most difficult part was to find the first 5 buildings to equip to run a trial. Our technology is actually quite new, it was put on the market in 2019. Today, we have more than half a million m2 equipped and the equivalent in the planning of installations, we hope to continue this trend in 2022.

Have there been any triggers that have allowed you to make leaps in terms of deployment? Start sales? If so, which ones?

MP: Our strategy has been to target several markets and see how they responded. Interestingly, the real estate funds have responded best. Our technology allows them to show their

investors that they are active and that they care about the «health» of their portfolio. They are not looking for short term financial savings and are convinced of the need to transform their stock to ensure long term value.

The «we've always done it this way, why should we change» logic is persistent. In order to convince all stakeholders, we have been working to develop the product to bring value to everyone.

What are the 3 key factors that would allow your technology to be deployed on a massive scale?

MP: It is mainly at the level of the public authorities, whether it is the administration or the legislator, that we must be able to act and show political courage.

-In terms of the legal framework, an increase in the price of energy or a CO2 tax is one factor;

-Another problem is the tenancy law, which has been discussed for years;

-The public authorities are not playing their role as an example. They could show that optimisation works, to encourage other owners to do the same.

Finally, training plays an important role. Heating engineers are still learning how to size an oil burner and are not talking about new technologies.

In the event of hyper-rapid growth, what are the main challenges you anticipate?

MP: Our challenges will be :
- securing the IT infrastructure and data processing.
- the shortage of electronic components.
- managing growth.

Any other comments?

MP: In general, we must rely on technological developments to accompany the transition. New innovations can do a lot of things. But we can't do it with technology alone.

Better support for the deployment of solutions also means encouraging the emergence of new solutions.
Finally, there is clearly too much administrative work to access funds. If the process for accessing it were simpler, there might be more projects.