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Key Swiss Circular Economy Features

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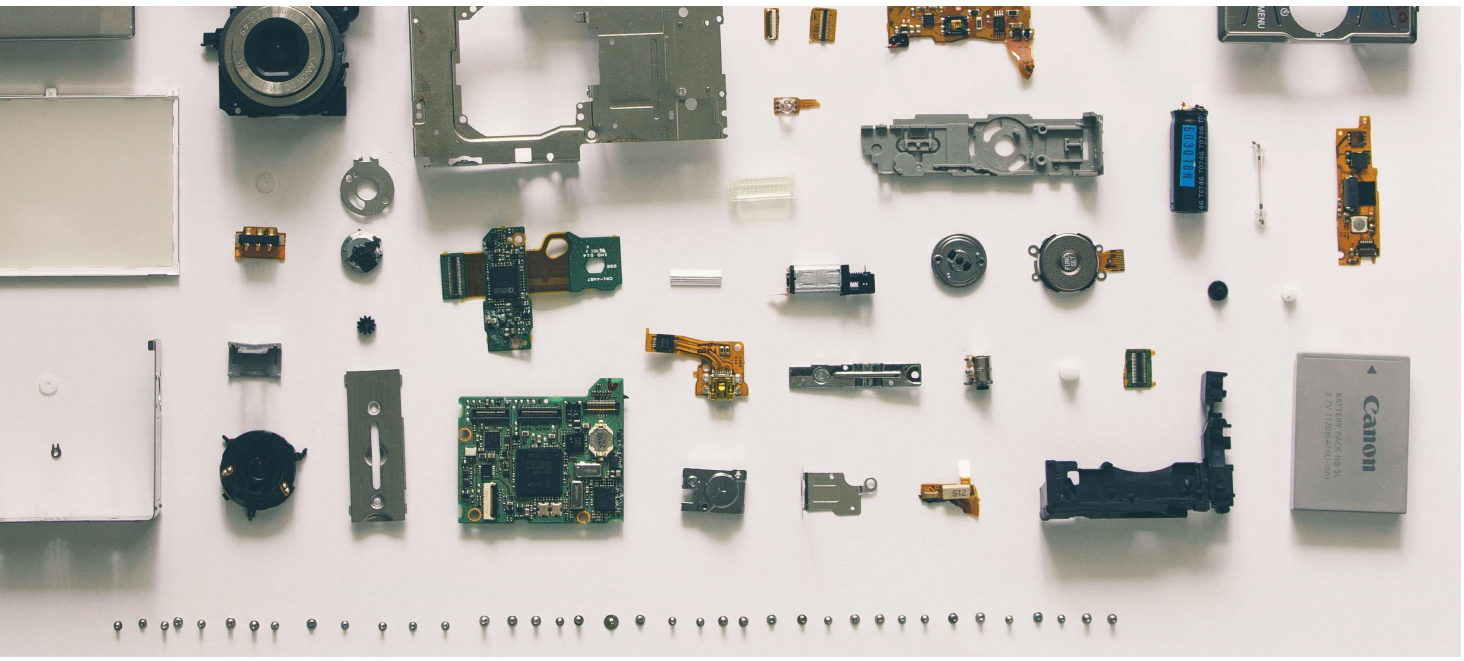

Image source: https://www.relaio.de/wissen/upcycling/, © Vadim Sherbakov

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1 Introduction to Circular Economy

11 Limitations of the linear economic model

In our current linear economic model the principle of "take-make-waste" dominates. This implies that raw materials are mined (take) to make products (make), which we sell, consume and finally throw away (waste). Consequently, the pressure on ecosystems and natural resources increases. The linear economic model leads to resource scarcity, waste and ultimately, to environmental crises such as climate change and biodiversity loss. Humanity is crossing planetary boundaries, which increases the risk of generating large-scale abrupt or irreversible environmental changes. To stay within planetary boundaries, industrialised countries would have to reduce their current resource consumption by up to two thirds.

12 Circular economy – the paradigm of the future

Circular economy implies a transformation of the linear economic model to achieve an economy with which humanity can continue to develop and thrive for generations to come. The goal is a system of closed loops in which resources are used as efficiently and for as long as possible. This results in a regenerative system that minimizes both the demand for primary materials as well as the production of emissions and waste.

Circular economy is thus much more than recycling and considers all stages of the value chain – from raw material extraction, production and product design, distribution and trade, consumption and use to take-back systems, recycling and waste management.

The transition to a circular economy does not solely consist of adjustments that reduce the negative impacts of the linear economy. Rather, it is a systemic change that conserves resources, makes the economy more resilient, creates business and economic opportunities, and creates environmental and societal benefits.

13 Basic principles of circular economy

The Ellen MacArthur Foundation, one of the leading think tanks in the field of circular economy, maps the basic principles of a circular economy in a systems diagram (see figure 1). This diagram illustrates the continuous flow of technical and biological materials through the value chain. An important basic requirement of a sustainable circular economy is that all processes use primarily energy from renewable sources. Various strategies are used to slow down, reduce and close cycles in order to maximize both cycle time and the value of products, resources and materials.

On the left-hand side, the systems diagram displays the biological cycle, which consists of renewable resources such as food, natural fiber or wood. This cycle is characterized by a close interrelation with the biosphere. Bio-based materials are extracted from the biosphere –

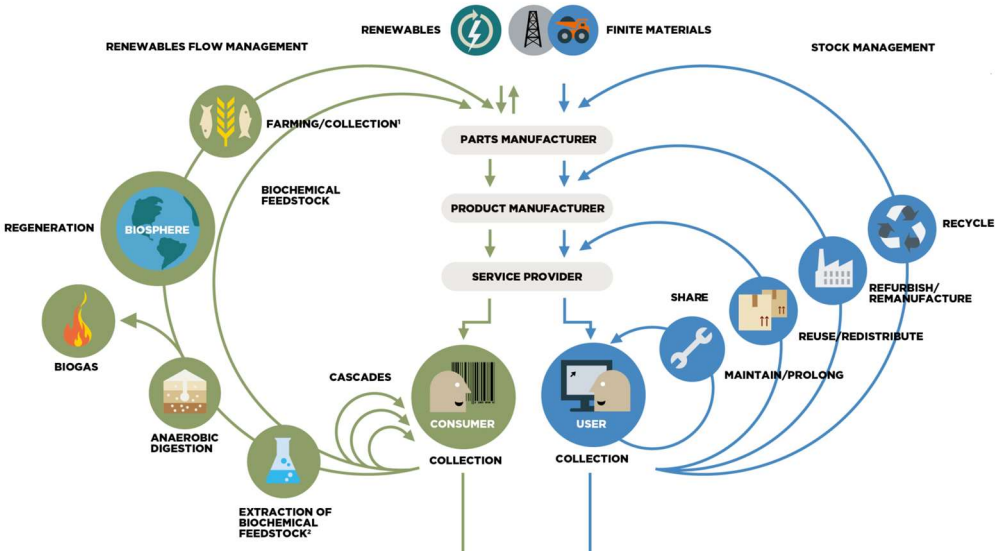

Figure 1: Circular economy systems diagram. Source: Ellen MacArthur Foundation (2019), www.ellenmacarthurfoundation.org

Cradle to Cradle (C2C)

for example through agriculture or forestry – and subsequently used by consumers. With biomass cascading, that is an in series-connection of (multiple) material and energetic utilization of the same bio-based material, resource efficiency can be maximized. After use the components are returned to the biosphere with microorganisms taking over the processing and decomposition through natural biological processes. For the biological cycle to function sustainably, it is essential that non-toxic materials are used and that the regeneration rate of natural systems is not exceeded. The ultimate goal is not to exploit ecosystems, but to contribute to their regeneration and enhancement while using their resources efficiently.

On the right-hand side, the technical cycle with non-renewable raw materials (e.g. plastics, metals and synthetic chemicals) is illustrated. These materials cannot be returned to the biosphere without value loss and environmental impacts. This is why their value should be preserved in a closed system for as long as possible. In the technical cycle, various strategies of

so-called "cascade use" are applied for a lifespan extension: reuse, redistribution, repair, refurbishment, remanufacturing, repurposing and recycling. Strategies with low energy and resource demand are prioritized to more resource intensive processes such as recycling.

The system diagram highlights that circular economy requires a systemic approach in the whole value chain, considering the different characteristics of biological and technical cycles. Furthermore, these eight key elements of circular economy, based on an in-depth literature review of the NGO Circle Economy[1], serve well as guiding principles:

- **Prioritise regenerative resources:** Ensure renewable, reusable, non-toxic resources are utilised as materials and for energy in an efficient way.
- **Stretch the lifetime:** While resources are in-use, maintain, repair and upgrade them to maximise their lifetime and give them a second life through take back strategies where applicable.
- **Use waste as a resource:** Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.
- **Rethink the business model:** Consider opportunities to create greater value and align incentives through business models based on the interaction between products and services.
- **Team up to create joint value:** Work together throughout the value chain, internally within organisations and with the public sector to increase transparency and create joint value.
- **Design for the future:** Account for the systems-perspective during the design process, to use the right materials, to design for appropriate lifetime and to design for extended future use.
- **Incorporate digital technology:** Track and optimise resource use and strengthen connections between value chain actors through digital, online platforms and technologies that provide insights.
- **Strengthen & advance knowledge:** Develop research, structure knowledge, encourage innovation networks and disseminate findings with integrity.

14 How can businesses benefit from circular economy?

Circular economy brings huge business opportunities and is a way to make companies successful in the long term, as part of resilient societies and flourishing ecosystems:

- Increased resilience and risk mitigation, e.g. due to long-term supplier relationships, stakeholder management, relocalisation of supply chains, hedging against fluctuating commodity prices by keeping materials in cycles.
- Stronger customer retention through circular economy business models.

[1] See: https://www.circle-economy.com/circular-economy/key-elements

- Stimulation of innovations by tackling the "circularity" of products, combining circular design and circular business models with digital technology.
- Savings in energy, production, material and warranty costs through increased resource efficiency and product quality.
- Proactive handling of environmental protection and climate protection regulations, experience lead in tightening legislation.
- Response to rising consumer awareness and the growing trend of healthy and sustainable lifestyles.
- Improvement of reputation, credibility and employer attractiveness by assuming responsibility towards the environment and increased product and service quality.
- Creation of synergies with innovation and cost reduction potential throughout the value chain.
- Tapping new sources of valuable raw materials, such as urban mining of metals.
- Contribution to the mitigation of climate change and reduction of the risk of future systemic crises.
- Contribution to the strengthening of local economic sectors, local businesses and jobs on a local level.

2 Framework Conditions for Circular Economy in Switzerland

21 Switzerland at a crossroad

Switzerland has long been recognized as one of the most advanced countries in terms of environmental and waste management policies. Thanks to a strong framework for the collection, valorization and elimination of waste, established in the 1980-90s, the country is known as the world's recycling champion. Yet, Switzerland also has a high level of raw material consumption and is among the first OECD countries when it comes to the production of municipal waste per capita[2]. While this can easily be explained by its high per capita income and the associated high level of consumption, the country is now facing the challenge of developing a coherent set of policies to establish more sustainable patterns of production and consumption aligned with its climatic goals and taking full advantages of all circular economy strategies.

[2] See: "Environment Switzerland 2018 – Report of the Federal Council" (2018), Bern. https://www.bafu.admin.ch/bafu/en/home/state/publications-on-the-state-of-the-environment/environment-switzerland-2018.html

22 From waste management to circular economy

Compared to neighboring countries the concept of circular economy (CE) emerged rather late on the Swiss political agenda. Still dominantly understood as a recycling agenda, CE strategies such as "slowing" material and energy flows, i.e. aimed at using products, components and materials longer (e.g. repair, reuse…), are still poorly addressed. Nevertheless, respective initiatives and proposals have been flourishing at all levels – from local, to regional and national – and from all sectors of society for some years.

23 Current developments in Swiss politics, economy and civil society

On a political level for instance, the Federal Parliament is now strongly pushing for CE through numerous interventions covering most of the dimensions of CE: from traditional strategies of closing resource loops (material and thermic valorization), to issues related to specific materials (sustainable management of plastics, an action plan against food waste, etc.), to provisions on slowing material flows (availability of spare parts, a repairability index, etc.), as well as broad CE strategies dealing with drivers and barriers for the transition towards circularity. While many of these interventions are still at the beginning of a long decision-making process, some initial results can already be noted. For example, a parliamentary initiative, titled "Reinforcing the circular economy in Switzerland", should result in a legislative revision aiming at increasing the efficiency of resource use, supporting material valorization and promoting sustainable consumption and CE[3].

Interestingly, this supporting trend for CE is stemming from a broad coalition of political groups that see a potential to link environmental and sustainability issues with both an economic and innovation agenda, and a way to reinforce the strengths of the Swiss economy (e.g. strong research and innovation, a manufacturing sector centered on high-quality products, etc.). This trend is also endorsed and even pushed by the economy, with companies from SMEs to big multinational corporations moving towards circular business models and influential economic associations emphasizing the economic opportunities offered. Many civil society organizations are also supporting the trend, as underpinned by the creation of the Swiss-wide Circular Economy Switzerland[4] movement that connects numerous organizations engaged in the transition towards CE.

[3] See: https://www.parlament.ch/de/ratsbetrieb/suche-curia-vista/geschaeft?AffairId=20200433

[4] See: https://circular-economy-switzerland.ch/?lang=en

24 Future perspective

As a country with a small domestic market and an export-oriented economy, it is in Switzerland's best interest to develop sound CE framework conditions in alignment with the European Union's CE action plans (2015 and 2020)[5] and regulations (e.g. on single-use plastics). Whereas many success factors are already present in the country, the transition depends on the political decision-makers' ability to move beyond the existing end-of-pipe and waste management perspective in order to establish a new generation of environmental policies centered around products and materials entire life-cycle, while achieving climatic and biodiversity goals and ensuring producers' responsibility. This, however, can only be achieved through a dialogue and cooperative interfaces for all relevant stakeholder groups involved in the transition, i.e. public authorities, economic, scientific and civil society actors. Clear CE framework conditions would in any case establish a new playing field and strengthen the competitive advantage of Switzerland and the well-established reputation of Swiss companies for quality and innovation. At the same time, these conditions would contribute to building a sustainable and thriving economy within the planetary boundaries.

3 Good Practice Examples

Transitioning towards a circular economy is based on pioneering work by courageous entrepreneurs and researchers who are rethinking product design and economic models. Below you will find outstanding projects made in Switzerland that incorporate central principles of a circular economy through groundbreaking innovations, e.g. by improving electric vehicle batteries, developing cleantech that filters carbon dioxide from the atmosphere, developing biodegradable plastics, or even training an AI technology in managing photovoltaic plant maintenance. While we still have a long way to go, these practical examples aim to honor the transformative efforts made so far on the path towards a circular economy in Switzerland, and inspire and motivate anyone wanting to join these efforts to make our economy more resilient and sustainable.

31 **Batteries2020**: Consortium to increase the lifetime of lithium-ion batteries used by electric vehicles (chemical industry)

Batteries 2020 is teaming up to create joint value, advance knowledge and help design for the future: The battery manufacturer Leclanché SA from French-speaking Switzerland has joined collaboratively with eight other companies from Spain, Denmark, Italy, Belgium and Germany

[5] See: https://ec.europa.eu/environment/circular-economy/

with aims to improve performance, lifetime and total cost of ownership of lithium-ion batteries for electric vehicles by the development of high-performing and durable cells. Simultaneously, the consortium conducts research on reliable lifetime prediction, understanding ageing phenomena and assessment of second life in renewable energy applications. The project is co-funded by the Eco-innovation initiative of the European Union.

This project follows the idea of a circular economy by improving the cost-efficiency, usability and better energy-efficiency of lithium-ion batteries, reducing resource consumption throughout production and usage of electric vehicles, as well as prolonging their overall lifetime. Furthermore, increasing the residual value means that electric vehicle batteries can be re-used in the future, for example in grid-connected applications and photovoltaics, after their capacity has diminished below the necessary threshold for efficient electric driving.

For more information: http://www.batteries2020.eu/
https://www.leclanche.com/

32 **Bloom Biorenewables:** Biofuel from biomass (chemical industry)

Bloom's mission is to provide the solutions that will drive the transition from linear, fossil-based resources to circular, plant-based alternatives: Created in 2019 as a spin-off from the École Polytechnique Fédérale de Lausanne (EPFL), the company has developed a technology to valorize all fractions of widely available biomass, like wood or agricultural waste. This allows for the sustainable and cost-competitive production of components like fine and bulk chemicals, polyester and composites, fibers, fuels and fuel additives. By large-scale production, the company aims to de-risk its technology and expand its petroleum-like products to industries that heavily rely on fossil fuels today, e.g. plastics, cosmetics, freight transport and medicine, which were previously lacking viable bio-based alternatives. Bloom's bio-based heavy fuels can furthermore help decarbonizing fuel-intensive industries like shipping and aviation. The multi-award company is supported by numerous organizations as well as research institutes and has also recently established an international partnership with the Japanese Yokogawa Electric Corporation.

Through its groundbreaking technology, Bloom Biorenewables Ltd creates value from waste, by valorizing biomass into bio-based alternatives to petrol-derived products, contributing to responsible production, reducing the consumption of non-renewable resources, and providing a clean energy source in line with the circular-economy-approach.

For more information: https://bloombiorenewables.com/

33 **Clariant**: Sustainable plastics lubricants made from rice production waste (chemical industry)

The Swiss specialty chemical company Clariant has developed bio-based wax solutions made from the waste stream of rice bran oil production: Licocare® RBW Vita is an innovative range of wax additives derived from crude rice bran wax, a non-food-competing by-product of the rice oil production. Clariant refines this raw material both chemically and physically, resulting in high-performance waxes for a wide range of plastics. Typical application areas include engineering thermoplastics, biopolymers and epoxy resins. By improving the flow of the polymer melt and facilitating de-molding, the wax product leads to higher throughput, more complex design possibilities, and a smoother surface, especially desired in e.g. the automotive, electrical and electronic industries. Beyond this, the products are used in coatings, agriculture and consumer applications.

Clariant's Licocare® RBW Vita products are safe for reintroduction into the environment and contribute to more efficient and energy-saving production and plastics recycling in a circular economy. Furthermore, these products fulfill the requirements of the rigorous circular economy principles: the cradle-to-cradle approach, where linear material flows are transformed into circular ones. By modifying and transforming the product along its life cycle, Clariant is maintaining the value of all involved materials over time and makes full use of all components of rice as a renewable resource. For this, the company represents beacon for circular economy in the chemicals industry.[6]

Thanks to their leading performance, the Licocare RBW range has been awarded Clariant's EcoTain® label for sustainability excellence.

For more information: https://www.clariant.com/en/Business-Units/Additives/Waxes/Licocare-RBW

34 **Climeworks:** Direct air capture technology (cleatech)

Climeworks empowers everyone to be climate positive by removing carbon dioxide (CO2) from the air in a safe and permanent way. The spin-off from the Swiss Federal Institute of Technology in Zürich (ETH) was founded in 2009 - ten years later, it's the world's leading direct air

[6] See: https://www.chemicalmarket.net/Articles/Detail/Clariants_Licocare%C2%AE_RBW_Vita_bio-based_additives_for_plastics_receives_award_for_sustainability_excellence

capture company. Their newest facility for CO2 collection and storage (currently under construction) is the world's biggest climate-positive facility to date, capturing 4'000 tons of CO2 per year.

The modular collectors work by capturing CO2 on the surface of a highly selective filter material. After the filter is saturated, the collector is closed. Raising the temperature about 100 °C subsequently releases the CO2 in a collectable, high-purity and high-concentration form. This product can then be used as a raw material, e.g. for the carbonation of drinks or the production of renewable synthetic fuels. Such fuels can directly substitute conventional fuels and therefore will be crucial for transforming the mobility sector towards carbon-neutrality. Climeworks focuses in particular on carbon removal by offering the permanent removal of CO2 from the air as a service to companies and private individuals. In this case, the air-captured CO2 is stored underground through the process of rapid underground mineralization provided by Carbfix, which turns it into solid rock in a few years' time. If the CO2 is stored, it is permanently removed from the air, which counteracts climate change by helping to restore a healthy balance of CO2 in the atmosphere. Climeworks' direct air capture machines are powered solely by renewable energy or energy-from-waste. Grey emissions are below 10%, which means that out of 100 tons of CO2 captured from the air, at least 90 tons are permanently removed.

Apart from the ability to fight climate change in a measurable and scalable manner, what makes the Climeworks technology unique is that it has the smallest land and water usage of all carbon dioxide removal approaches, and creates value from one of the main greenhouse gases, mitigating climate change at the same time.

For more information: https://climeworks.com/

35. **DePoly SA**: Closing the loop on PET plastic recycling (chemical industry)

Recycling is one of the ultimate stages in a circular economy, decomposing products like PET plastic bottles into their material components and remanufacturing them into new products. The main challenge of current PET plastics recycling methods is that they cannot effectively or efficiently recycle PET plastics if they are dirty, mixed in color, or are already processed into e.g. fibers or textiles. DePoly SA's innovative low-cost low-energy process produces terephthalic acid (TPA) and mono ethylene glycol (MEG) from low-value post-consumer PET plastic waste including mixed color, multi-layer and polyester fibers. They do so without additional heat or pressure, and only involve sustainable and environmentally friendly chemicals in their technology. What makes this process unique is that it even allows for the selective treatment of PET plastic in the presence of other plastics like polypropylene. The result are 100% recycled PET resins that can then be sold back to the industry to make new virgin PET plastic without the need of oil, and allowing for a sustainable source of TPA and MEG on the market. Per ton

of recycled plastic, the equivalent of the greenhouse gas emissions from the burning of 18 barrels of oil is saved.

Through its innovative technology, DePoly not only manages to make the recycling process more energy-saving and widely applicable for a range of mixed-plastics products, but also allow the industry to use their own waste – millions of tons of plastics polluting our environment – as a resource. This is reducing our dependency on oil-based products, and ultimately helps closing the material loop on PET production.

For more information: https://www.depoly.ch/

36 **Embion**: Upcycling of industrial biomass to bioactive compound for diverse use (biotech)

With food waste and world population on the rise, the food and nutrition industry has been trying to create value from industrial lignocellulosic biomass for a century. Moreover, the global bioactive ingredients market is confronted with long development phases, inconsistent results, and hidden operational costs. Embion, which originates from the EPFL Innovation Park, provides a solution for this: Through its groundbreaking catalyst technology, the company extracts bioavailable oligomers from industrial biomass waste for human and animal nutrition. Their patented catalyst is fully recoverable for subsequent reuse, their method is simple, cost efficient and fast to implement, and the resulting soluble bioactive compounds have a high functionality. Moreover, Embion provides a technology platform where industries can innovate in a rapid prototyping process their specific extraction product in the field of fibers and prebiotics, flavours and pigments or plant-derived bioactives to promote growth in animal farming. Embion has recently teamed up with the Japanese company Asahi and its subsidiary R&D company, in order to create new products from brewing by-products of the Asahi Group.

Through this, Embion is not only promoting the upcycling of industrial biomass in the biological cycle of the circular economy, but also creating disruptive innovation in nutrition through their R&D team, essentially strengthening & advancing knowledge around the extraction of bioactive ingredients, accounting for tomorrow's growing demands.

For more information: https://embiontech.com/

37 **FluidSolids**: Home Compostable Biocomposites from organic waste (chemical industry)

FluidSolids is a Swiss technology that produces biodegradable Biocomposites from biological waste and residual materials. Waste from the food, furniture and fashion industries that cannot otherwise be recycled – like nut shells, wood fibres, corn cobs, cardboard, hemp fibres or paper – is turned into the FluidSolids biocomposite, a cost-effective substitute for countless products that have traditionally been produced from petroleum-based plastics and bioplastics, which is

even compostable at home. Its high fiber content gives the material a high flexural strength, and component wall thickness and weights can be highly optimized and made more efficiently. Furthermore, the biocomposite is suitable for industrial mass production processes through existing machinery and the FluidSolids technology provides a platform that can be integrated in existing manufacturing processes. This allows for a production tailored to a client's specific need on-site, and results in products that look and feel exactly like their creators intended them to.

The circular economy idea of using waste as a resource was central in the development of the company from the beginning: FluidSolids technologies make it possible to utilize a company's own waste streams as a source to produce biocomposite materials, since production of the biocomposite can be done on-site, furthermore reducing the costs of transport, waste-management, energy and procurement. This is also improving the overall environmental balance of any company, reducing its environmental impact during production, processing, recycling and disposing.

For more information: https://www.fluidsolids.com/en/homepage/

38 **SmartHelio Sarl:** AI-based advanced analytics for solar plant diagnostics (IT industry)

Despite an enormous potential for growth in the photovoltaic industry as a renewable energy source – mainly in emerging markets – solar-plant maintenance, diagnosis and root-cause analysis are highly manual and reactive, and current monitoring solutions only provide data acquisition and visualization. The Swiss company SmartHelio Sarl has developed a smart way to maintain current and future solar assets: an AI-based cloud platform that automatically diagnoses and localizes faults such as shading, connector faults, or wire rust, with limited human intervention, analyzes historical and current data to predict system's behavior, and prescribes actionable steps to maximize production, leading to an up to 20% output improvement. The automated reports and intelligent business insights further help to improve productivity and increase revenue. The SmartHelio technology works for solar plants of any size, from rooftop to utility-scale, and the cloud solution can seamlessly connect with any 3rd party monitoring system. SmartHelio has valuable R&D partnerships with the École Polytechnique Fédérale de Lausanne (EPFL) as well as the University of Lucerne and already has numerous international clients from Switzerland, India and the USA.

Not only the production and efficient management of clean energy is a prerequisite for a circular economy, but SmartHelio's solution is furthermore incorporating digital technology, tracing and optimising resource use through digital, online platforms and technologies that provide insights and help improving renewable energy systems altogether.

For more information: https://www.smarthelio.com/

4 Why Switzerland? Swiss CE investment advantages

This chapter focuses on the question "why Switzerland?", carving out specific locational circumstances and advantages of Switzerland regarding CE. This shall serve as arguments for Japanese companies searching for environment-related investment and cooperation opportunities abroad to consider Switzerland as destination for CE investment.

1. Switzerland is world leader in innovation, and innovation is needed for a CE transition. The disruptive technologies of the 4th industrial revolution are important levers for more circularity in supply chains. For example, with the help of Artificial Intelligence and the Internet of Things, resource and material flows can be tracked and traced, accounted for, and made transparent in order to use resources, materials, and products to the best societal and environmental benefit. Likewise, flows of multimodal mobility, that is, the combination of several means of transport, can be facilitated. 3D printing and robotics create new opportunities for material sorting and recovery, enabling new business models e.g. via an effective integration of remanufacturing schemes in 'product as a service' business models. Furthermore, smart grids efficiently provide sustainable energy.[7] It is therefore fortunate that Switzerland can demonstrate strong expertise particularly in these areas. It is home to world-renowned universities and research institutes in the field of AI and it is an international leader in the field of robotics and drones, which is why it is often referred to as the "Silicon Valley of robotics"[8].

2. Switzerland is a frontrunner in terms of waste processing and recycling. High technology processes, elaborated financing mechanisms, and a high commitment of the population ensure that materials such as glass, metals, textiles, PET or chemicals are effectively recycled and value loss is prevented as much as possible. Swiss recycling rates are among the highest of the world: 94% of glass, 92% of tin cans, 86% of steel, 83% of PET bottles and 67% of batteries are recycled. At the same time, around 122'800 tons of electronic appliances and 53'690 tons of textiles and shoes per year enter reuse and recycling processes.[9] Overall, 53% of waste from

[7] Cleantech Alps (2020): The circular economy: An economic and environmental opportunity for Switzerland? https://www.cleantech-alps.com/de/etudes/details/the-circular-economy-an-economic-and-environmental-opportunity-for-switzerland-0-1932, p. 46.

[8] See e.g. Andrew Cave (2017): How Switzerland became the Silicon Valley of robotics. Forbes, September 26, 2017, https://www.roboticstomorrow.com/story/2017/09/how-switzerland-became-the-silicon-valley-of-robotics/10761/; and PAC blog (2018): How Switzerland is becoming a hub for artificial intelligence, July 13, 2018, https://www.sitsi.com/wie-sich-die-schweiz-zu-einem-zentrum-f-r-k-nstliche-intelligenz-entwickelt.

[9] https://www.eda.admin.ch/aboutswitzerland/en/home/umwelt/natur/recycling.html

households and small businesses has been recycled in 2019.[10] Constant research and development ensure that more and more materials can be recycled in increasingly efficient ways. For example, technologies for the recovery of special high-grade zinc from waste-to-energy plant flue gas treatment residues[11], phosphorus from wastewater, sewage sludge, or ash[12] are currently being established. Therefore, Japanese companies could benefit a lot from Swiss knowhow about waste processing and recycling, and may experience positive spillover and branding effects from the Swiss reputation (see as well argument 6). However, this leading position of Switzerland is challenged when it comes to its amount of waste and the environmental footprint per capita. This contradictory situation exemplifies the inherent importance of recycling in a circular economy approach. At the same time, it confirms the need for a broader CE understanding to prevent waste at the source.

3. Switzerland has a flourishing CE ecosystem supported by vast funding programs. In Switzerland, there is a strong ecosystem and startup culture evolving around CE, creating a fertile and dynamic environment for companies that are interested in circular product and service innovations. Switzerland is a country of short distances and close links between stakeholders. This situation favors the testing and prototyping of CE solutions that can then be replicated by other countries throughout the world.

3.1 Swiss CE catalysts

Incubators like **Impact Hub Switzerland** or **the ark** offer support programs specifically tailored to CE or energy and environment related startups and research projects.[13] The coordination and exchange platform **Circular Economy Switzerland** acts as a catalyst for a new Swiss-wide circular economy movement with various projects and events. Furthermore, it creates visibility for CE pioneers and good practice examples from established companies as well

[10] https://www.bafu.admin.ch/bafu/en/home/topics/waste/state/data.html

[11] https://swisszinc.ch/index.html

[12] https://www.bafu.admin.ch/bafu/de/home/themen/abfall/dossiers/phosphor-recycling.html

[13] https://www.cetransition.ch/en/home

https://www.theark.ch/en/page/energy-a-major-area-for-economic-development-in-the-valais-1738

as startups.[14] Similarly, networking event series or platforms like the **World Resources Forum**[15], **SHIFT Switzerland**[16], **Circular Innovation Ecosystems**[17] and **circular economy entrepreneurs**[18] aim at fostering exchange between CE actors to enable peer-to-peer learning. The **MAVA Foundation** has made a name for itself as a driving force of many of these CE initiatives, allocating a budget of 1'250'000 Swiss francs annually to its CE action plan.[19]

CE and sustainability industry networks and associations furthermore push CE on the political agenda and develop CE solutions in a collaborative, trans-sectoral way - e.g. **swisscleantech**[20], **öbu**[21], **CleantechAlps**[22], **Swiss Sustainable Finance**[23], **PRISMA**[24], or **Drehscheibe Kreislaufwirtschaft**[25].

3.2 Swiss CE research and development promotion

Impressive research programs around the topics of CE, sustainability, and renewable energies pave the way for CE innovations and often result in successful spin-offs. From 2013 to 2020, more than 1'300 researchers have been working at eight **Swiss Competence Centers for Energy Research (SCCERs)** in order to develop and implement solutions for the energy transition, supported by 194.5 million Swiss francs, resulting, among others, in 41 spin-offs. The integration of private and public implementation partners has been found to be a decisive success factor.[26] For the upcoming decades, the funding program **SWEET – SWiss Energy research for the Energy Transition** will ensure the continuation of successful Swiss research

[14] https://circular-economy-switzerland.ch/?lang=en

[15] https://www.wrforum.org/

[16] https://shiftswitzerland.ch/en/

[17] https://www.sanudurabilitas.ch/fr/projets/circular-innovation-ecosystems/

[18] https://www.ce2.ch/

[19] https://mava-foundation.org/oaps/advancing-a-resource-efficient-and-circular-economy/

[20] https://www.swisscleantech.ch/

[21] https://www.oebu.ch/de/home-5.html

[22] https://www.cleantech-alps.com/en//

[23] https://www.sustainablefinance.ch/

[24] https://www.prisma-innovation.ch/

[25] https://www.circular-economy.swiss/

[26] https://www.innosuisse.ch/inno/en/home/about-us/newsroom/nsb-news_list.msg-id-81640.html

on the energy transition.[27] Moreover, the **National Research Program NRP 73**, funded with 20 million Swiss francs, focuses on expanding existing knowledge about the use and dependence of Switzerland on resources, specifically targeting the topic of CE.[28]

Several funding programs enable knowledge transfer and innovation, and they aim at bringing together research and industry partners: The Innosuisse **NTN Innovation Booster Applied Circular Economy[29],** the **Pilot and Demonstration program** of the Swiss Federal Office of Energy (SFOE)[30], and the **environmental technology promotion** of the Federal Office of the Environment[31]. In general, Swiss public funding benefits companies only indirectly, as it is mainly addressed at research institutions and industrial partners have to contribute their own share of funding. In addition, the territorial principle applies, i.e. industrial partners must show a registered office in Switzerland and the project work must be carried out mainly in Switzerland. Only in exceptional cases foreign partners or international project consortia are funded. For Japan, this is the case in programs like the Strategic **Japanese-Swiss Science and Technology Programme (SJSSTP)**[32] and the **Call for Innovation Partnership Grants with China, Japan, South Korea and the ASEAN region** of the ETH Zurich[33], where funding is accessible to Japanese researchers and companies, underlining the strong research collaboration tradition between Japan and Switzerland. However, both programs are open for any research area and not restricted to CE or sustainability topics.

4. Swiss financial sector is an emerging and increasingly important enabler of the CE transition. The financial industry is among Switzerland's most prominent sectors, and CE is in

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[27] https://www.bfe.admin.ch/bfe/en/home/research-and-cleantech/funding-program-sweet/sweet-overview.html

[28] http://www.nfp73.ch/en/the-nrp

[29] https://innobooster.org/servlet/hype/IMT?documentTableId=6557338881090173102&userAction=Browse&templateName=&documentId=fa5a5eae236b7b4dc5cc64f44bd15bf6

[30] https://www.bfe.admin.ch/bfe/en/home/research-and-cleantech/pilot-and-demonstration-programme.html

[31] https://www.bafu.admin.ch/bafu/en/home/topics/education/innovation/umwelttechnologiefoerderung.html

[32] http://www.snf.ch/en/funding/programmes/bilateral-programmes/japan/Pages/default.aspx

[33] https://ethz.ch/en/the-eth-zurich/global/global-research-platforms/swiss-bilateral-programme/Innovation.html

need for innovative financial solutions. In the last few years, financial service offers with relation to CE have steeply increased, with 4 out of 17 public equity funds with a CE focus issued by Swiss financial institutes[34]. One of them, DECALIA, holds a notable number of investments into Japanese CE companies.[35] However, challenges around the perception and assessment of risks of CE activities still need to be overcome in order to broaden these financing opportunities, internationally as well as in Switzerland.[36]

5. Swiss environmental protection reputation could spill over to Japanese companies investing in Switzerland around CE. Switzerland is known for excellent quality and high environmental protection standards, as well as for the widespread efforts of Swiss companies to tackle sustainability challenges and to improve resource efficiency.[37] This is evident from the fact that Switzerland ranks 3rd in the **Environmental Performance Index (EPI) 2020**[38] and 10th in the **Global Cleantech Innovation Index 2017**[39]. In addition, Switzerland has been the first European country to enact an environmental protection law, back in 1983, and is known for its pioneering role with regard to renewable energies and resource efficiency technologies.[40] Japanese companies investing in Switzerland could benefit from a strengthening of their environmental protection reputation, as the excellent reputation of Swiss environmental protection could be transferred to their own companies and products.

6. The absence of industry policy in Switzerland creates a level playing field for foreign companies. Unlike other countries, Switzerland has no industry politics. There are no direct

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[34] ELLEN MACARTHUR FOUNDATION (2020): Financing the circular economy: Captirung the opportunity. https://www.ellenmacarthurfoundation.org/assets/downloads/Financing-the-circular-economy.pdf, p. 33. The four Swiss CE funds are issued by Credit Suisse, DECALIA and RobecoSAM.

[35] https://www.decaliagroup.com/wp/wp-content/uploads/2018/06/2018.06.26-CdP-Lancement-fonds-Economie-circulaire-ENG.pdf

[36] PwC, WWF (2021): Circularity as the new normal. https://www.pwc.ch/en/insights/sustainability/circular-economy.html, p. 28.

[37] Federal Council (2018): Environment Switzerland 2018. https://www.bafu.admin.ch/bafu/en/home/state/publications-on-the-state-of-the-environment/environment-switzerland-2018.html, p. 9.

[38] https://epi.yale.edu/downloads/epi2020report20210112.pdf, p. 3.

[39] Cleantech Group, WWF (2017): The Global Cleantech Innovation Index 2017. http://info.cleantech.com/WWF-Index-2017_WWF-Index-2017-Submit.html, p. 13.

[40] Swiss Confederation: Swiss Cleantech Report, 3rd edition. https://swisscleantechreport.ch/order-your-copy-3rd-edition/, p. 11.

incentives in form of financial contributions for specific (green) industries as for example in the EU, where the new **European industrial strategy** represents an ambitious recovery program after the COVID-19 crisis, which aims at directing enormous funds into green sectors, companies and projects[41], or in China, where cleantech companies get massive financial support under the country's **thirteenth Five Year Plan**[42]. However, industry politics are not meant to serve foreign companies but aim at strengthening the competitivity of local industries and lowering the dependence on foreign countries at the expense of foreign industries. For instance, the planned EU carbon border adjustment mechanism will put foreign industries under pressure to reduce carbon emissions if they want to export to the EU.[43] By not having an industrial policy, Switzerland does not put foreign companies in such a disadvantaged position.

7. The Swiss legislative framework for CE under development is a possibility to shape the legislative process. Strong environmental and climate policies enable CE innovations and create a competitive advantage for CE products and services. The legislative requirements regarding circular economy and sustainability are not yet as high in Switzerland as in the EU, but Switzerland is closing up (see chapter 2). In that sense, the current legislative situation bears advantages and at the same time disadvantages, compared to the EU. On the one hand, CE products and services are currently getting a stronger tailwind in the EU than in Switzerland due to regulations such as the **EU Ecodesign Directive** for environmentally sound product design[44]. On the other hand, companies that invest in CE in Switzerland still are able to influence the political discourse as well as the upcoming legal changes and Swiss adaptations to EU law. In Switzerland, it is easier for interest groups to receive attention. In consultations, a structured lobbying process, individual companies are asked to contribute their points of view. There is still a lot of freedom to create a position and to shape the legislative process.

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41 https://www.consilium.europa.eu/en/policies/eu-industrial-policy/

https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en

42 PwC (2017): Chinese Cleantech Market Opportunities. https://www.pwccn.com/en/energy-utilities-mining/chinese-cleantech-market-opportunities-2017.pdf, p. 2.

43 https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12228-EU-Green-Deal-carbon-border-adjustment-mechanism-_en

44 https://www.bmwi.de/Redaktion/EN/Artikel/Energy/energy-efficiency-labelling-of-products-02-ecodesign-directive.html

8. Swiss talent is looking for meaningful jobs, and CE creates a strong sense of purpose. Switzerland is well-known for its excellent education system, attracting talents from all over the world. At the same time, young people are said to be part of "Generation Purpose," looking for jobs with a purpose and refraining from working for companies that lack sustainability ambitions[45]. The proportion of people with a pronounced environmental awareness is particularly high in Switzerland[46]. Therefore, for foreign companies with CE ambitions, the recruitment conditions in Switzerland are particularly attractive, with talented as well as committed workforce readily available.

9. Similarities between Japan and Switzerland help to facilitate collaboration. Beyond similar values such as precision, punctuality, reliability and a high ambition for excellent quality, Japan and Switzerland both lack natural resources and space. These unavoidable framework conditions have long encouraged the efficient use of resources and a strong reliance on the brainpower of people for economic development. Moreover, Japan and Switzerland occupy a very similar position in the Circularity Gap Report 2020, which evaluates the gap of each country until reaching a circular economy. Japan and Switzerland have a similar high score in the Human Development Index and ecological footprints nearly of the same (large and unsustainable) size, so both countries are estimated to have a somewhat medium to big circularity gap[47]. Since Japan and Switzerland face similar challenges for sustainable development and have reached a similar level, it makes sense for Japanese companies to consider cooperation with Switzerland, specifically.

Side note on hydropower

Large and small-scale hydropower is contributing around 56% to the Swiss electricity production and accounts for 96% of its renewable energy electricity production.[48] Therefore, hydropower research, development, and industry clearly is among the Swiss core competencies. Since the potential for hydropower in Switzerland has largely been tapped, there is a strong willingness to export knowledge and technology.

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[45] https://www.forbes.com/sites/afdhelaziz/2020/03/07/the-power-of-purpose-the-business-case-for-purpose-all-the-data-you-were-looking-for-pt-2/?sh=2336b3143cf7

[46] Franzen (2003): Environmental Attitudes in International Comparison: An Analysis of the ISSP Surveys 1993 and 2000. https://doi.org/10.1111/1540-6237.8402005

[47] Circle Economy (2021): Circularity Gap Report 2021. https://www.circularity-gap.world/2021#downloads

[48] https://www.swv.ch/fachinformationen/wasserkraft-schweiz/

The following report gives an overview about small-scale-hydropower actors in Switzerland, showing the Swiss strength and abilities as well as the variety of actors along the hydropower value chain: https://issuu.com/cimark/docs/etude_pch_en_web/37, see especially page 23.

The Swiss Federal Office of Energy (SFOE) outlines its research priorities in the field of hydropower for the upcoming years. As Japan is probably facing similar challenges regarding energy transition and climate change, this could be a starting point in the search for synergies and research cooperation: https://www.bfe.admin.ch/bfe/en/home/research-and-cleantech/research-programmes/hydropower.html

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