

CLEANTECH IN PERU

A diversified and growing market (Part 1)



Official Program Partner

Cleantech in Peru A diversified and growing market.

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Content

- 1. FOREWORD _____ 7
- 2. EXECUTIVE SUMMARY _____ 8
- 3. MARKET OVERVIEW _____ 10
 - 3.1. What is cleantech? _____ 10
 - 3.2. Background: Key Swiss cleantech sectors _____ 11
 - 3.3. Which Cleantech products can Switzerland offer to Peru? _____ 13
 - 3.3.1. SUSTAINABLE AGRICULTURE AND COUNTERFEIT AGROCHEMICALS _____ 13
 - 3.3.2. SUSTAINABLE WATER MANAGEMENT _____ 15
 - 3.3.3. SUSTAINABLE MINING AND PROTECTION FROM NATURAL DISASTERS _____ 16
 - 3.3.4. SUSTAINABLE WASTE MANAGEMENT AND RECYCLING _____ 16
 - 3.3.5. SUSTAINABLE MOBILITY AND ENERGY EFFICIENCY _____ 17
 - 3.3.6. RENEWABLE ENERGIES _____ 19
 - 3.3.7. ENVIRONMENTAL TECHNOLOGY SERVICES _____ 20
 - 3.3.8. ENVIRONMENTAL TECHNOLOGY FOR TEXTILES _____ 20
 - 3.4. Swiss trade in Cleantech relevant products _____ 21
 - 3.5. What are Peru’s needs in the Cleantech area? _____ 21
 - 3.5.1. Sustainable agriculture and counterfeit agrochemicals _____ 21
 - 3.5.2. Sustainable water management _____ 23
 - 3.5.3. Sustainable mining, protection from natural disasters _____ 24
 - 3.5.4. Sustainable waste management and recycling _____ 26
 - 3.5.5. Sustainable mobility and energy efficiency _____ 28
 - 3.5.6. Renewable energies _____ 29
 - 3.5.7. Environmental technology services _____ 31

- 3.5.8. Environmental technology for textiles _____ 32
- 4. OPPORTUNITIES AND CHALLENGES _____ 33
 - 4.1. Opportunities _____ 33
 - 4.1.1. Sustainable agriculture _____ 33
 - 4.1.2. Sustainable water management _____ 34
 - 4.1.3. Sustainable mining, protection from natural disasters _____ 36
 - 4.1.4. Sustainable waste management and recycling _____ 36
 - 4.1.5. Sustainable mobility and energy efficiency _____ 38
 - 4.1.6. Renewable energies _____ 40
 - 4.1.7. Environmental technology services _____ 41
 - 4.1.8. Environmental technology for textiles _____ 41
 - 4.2. Challenges to do business in Peru _____ 42
- 5. CONCLUSION / CALL-FOR-ACTION 44

List of Tables

Table 1. Cleantech Swiss exports to Peru21
Table 2. Mineral Production in Peru 2010-2019.....25
Table 3. Peru's position in world metal production, 201925
Table 4. Renewable energy resources: power plant potential.....31

List of Figures

Figure 1. Swiss Cleantech key figures12
Figure 2. Distribution of emissions by greenhouse gas categories22
Figure 3. Distribution of emissions by greenhouse gas categories23
Figure 4. Drinking water sales, by size of sanitation service provider, 2013-2019.....24
Figure 5. Value of exports by mineral product, 2019.....26
Figure 6. Mining investments by item, 2019.....26
Figure 7. Sales of hybrid and electric vehicles Dec. 2019 - Dec 2021.....29

List of Abbreviations

AC	Alternating Current
ANA	Peruvian National Water Authority
ATU	Urban Transport Authority for Lima and Callao
B2B	Business to Business
B2C	Business to Customer
BEV	Battery Electric Vehicle
C&I	Commercial & Industrial
CCI	Cotton Council International
CCSP	Swiss Chamber of Commerce in Peru
CENAGRO	National Agricultural Census
CINTYA	Nacional Program for Environmental Science and Technology
CO	Carbon Monoxide
CO2	Carbon dioxide
CONCYTEC	Nacional Council for Science, Technology and Technological Innovation
DAA	Declaration of Environmental Adequacy
DGEE	General Directorate of Energy Efficiency
DIA	Environmental Impact Statement
DIGESA	Ministry of Health - General Directorate of Environmental Health and Food Safety
EAE	Strategic Environmental Assessment
EIA	Environmental Impact Studies
EIA-d	Detailed Environmental Impact Study
EIA-sd	Semi Detailed Environmental Impact Study
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FISE	Energy Social Inclusion Fund
GDP	Gross Domestic Product
GgCO2eq	Gigagrams of Carbon Dioxide Equivalent
GHG	Greenhouse Gas
HEV	Hybrid Electric Vehicle
HORECA	Hotels, Restaurants and Catering and Retail
IDB	Inter-American Development Bank
IIMP	Institute of Mining Engineers of Peru
INACAL	National Quality Institute
INDECI	National Institute of Civil Defense
INGEI	National Greenhouse Gas Inventory
INGEMMET	Geological, Mining and Metallurgic Institute
IoT	Internet of Things
ISO	International Organization for Standardization
kVA	Kilovolt-Amperes
LPG	Liquefied Petroleum Gas
MIDAGRI	Ministry of Agrarian Development and Irrigation
MINAM	Ministry of the Environment
MINEM	Ministry of Energy and Mines
MINSA	Ministry of Health
MRE	Ministry of Foreign Affairs

MRL	Maximum Residue Limits
MTC	Ministry of Transport and Communications
N2O	Nitrogen Oxide
NGV	Natural Gas Vehicle
Nox	Nitrogen Oxides
OEFA	Environmental Evaluation and Oversight Agency
OTASS	Technical Organization for the Administration of Sanitation Services
PAMA	Adaptation and Environmental Management Program
PENP	Peru's National Energy Policy
PHEV	Plug-in Hybrid Electric Vehicle
PI	Municipal Management Improvement Incentive Program
PLANAE	Concerted National Plan for the Promotion and Development of Organic or Ecological Production
PPP	Purchasing Power Parity
PRODUCE	Ministry of Production
PROINVERSION	Private Investment Promotion Agency
PV	Photovoltaic System
REEV	Range Extended Electric Vehicle
RER	Renewable Energy Resources
RO	Reverse Osmosis
RPMV	Public Stock Exchange Registry
SEDAPAL	Lima Potable Water and Sewerage Service
SEIA	National Environmental Impact Assessment System
SENACE	National Environmental Certification Service for Sustainable Investments
SENACE	National Certification Service
S-GE	Switzerland Global Enterprise
SIMIM	Society of Mining and Metallurgy of Peru
SNI	National Society of Industries
SINACYT	National System of Science and Technology and Technological Innovation
SINEFA	National System for Environmental Assessment and Enforcement
SMEs	Small and medium-sized enterprises
SMV	Peruvian Securities and Exchange Superintendency
SNMPE	National Society of Mining, Oil and Energy
SRI	Sustainable Recycling Industries
SUNARP	National Superintendence of Public Registries
SUNARP	National Superintendence of Public Registries
SUNASS	According to the National Superintendence of Sanitation Services
SUNAT	National Superintendence of Customs and Tax Administration
TDS	Total Dissolved Solids
UNDP	United Nations Development Programme
VIVIENDA	Ministry of Housing, Construction and Sanitation
WEEE	Waste of Electrical and Electronic Equipment

1. FOREWORD

The Swiss Chamber of Commerce in Peru has elaborated this report on Cleantech in Peru with the support of Switzerland Global Enterprise (S-GE). The Chamber thereby fosters and promotes the free-market system and encourages trade and investment within a framework of social responsibility, strong values and business ethics.

Aware of the significant needs of Peru for Cleantech products and services, this report seeks to identify business opportunities for Swiss firms addressing the following questions:

- What are the Cleantech technologies of Swiss SMEs addressing key energy and climate challenges?
- What are the major issues faced by Peru that could be alleviated with Swiss Cleantech technologies?
- What is the legal regulatory framework in the main areas subject to Cleantech products and services?
- How to deal with logistics and distribution?
- What is the potential of the Peruvian market for Swiss Cleantech products and services and what are the main challenges to succeed?

The analysis is qualitative because only a few Swiss firms are present in Peru to offer Cleantech products and services and because trade statistics cannot be used as both Cleantech and non-Cleantech products are generally classified in the same tariff positions. A Report on Peru is nevertheless fully warranted: due to very important needs, the Peruvian market for Cleantech products and services will grow at a very strong pace in the coming years.

Several firms active in the Swiss and Peruvian Cleantech sectors are to be thanked for valuable contributions through interviews and videos. We are also grateful to Mrs. Andrea Baldeon and Mr. Diego Guevara for undertaking the research, data analysis, elaborating the figures and tables and writing the various chapters.

Special gratitude is expressed to Dr. Philippe G. Nell for designing the project, selecting the main categories of Swiss Cleantech products and services, writing the Factsheets document on 33 Swiss Cleantech SMEs and various parts of the report as well as for the overall direction and detailed review of the report.

The Swiss Chamber of Commerce in Peru is confident that this report will increase the awareness of Swiss firms for Cleantech business opportunities in Peru confirming our mission of being the main reference for trade and investment relations between Peru and Switzerland.

We wish you an instructive and pleasant read of the report on Cleantech in Peru.

Lima, February 2022

Corinne Schirmer
General Manager
Swiss Chamber of Commerce in Peru

2. EXECUTIVE SUMMARY

Peru is a middle-income country with a GDP per capita at PPP of US\$12,555 and a relatively large population (33 million). A significant part of the population lives in the large cities of Lima (9.5 million), Piura (1.9 million), La Libertad (1.8 million), Arequipa (1.4 million) and Cusco (1.2 million). The differences in the standard of living are considerable, with a poverty rate of 27.5%.

As elsewhere in the world, clean technologies can be a source of growth for the economy and simultaneously contribute to solving important environmental and social problems in the context of the United Nations 2030 Sustainable Development Goals.

Peru's needs in clean technologies are considerable and appropriate solutions must be proposed corresponding to the financial, social and technological capacity of absorption.

Market overview: Based on the Swiss cleantech product offering and a S-GE study identifying Swiss cleantech firms present in Peru or interested in establishing themselves there, the following eight areas were identified for this report:

- Sustainable agriculture and counterfeit agrochemicals
- Sustainable water management
- Sustainable mining and protection from natural disasters
- Resource and material efficiency (including waste management and recycling)
- Sustainable mobility and energy efficiency
- Renewable energies
- Environmental technology services
- Environmental technology for textiles

In each of these areas, some Swiss SMEs have developed cleantech technologies addressing agriculture and energy issues as well as climate change. They hold a highly-specialized and impressive know how and seek to further expand abroad. The technology of more than 20 firms is briefly presented in the report and an additional document "FACTSHEETS" showcases 33 Swiss Cleantech SMEs.

Swiss technology could contribute significantly in alleviating problems in Peru such as greenhouse gas emissions, water scarcity in agriculture, waste management and recycling in cities and in the countryside, natural disaster protection in mining, pollution, clean energy and counterfeit in agrochemicals.

Regulatory overview: Peru has adopted legislation to promote sustainability. Particular measures are foreseen for conservation and sustainable use of water, environmental management of mining, overall waste management including plastic packaging, disposal of electric and electronic equipment, transition toward electric mobility and Renewable Energy Resources (RER) to improve the quality of life of the population and protect the environment. Legislation on RER covers energy resources such as biomass, wind, solar, geothermal and tidal.

A regulatory framework has also been established on single-use plastic, other non-reusable plastics and disposable containers or packages made of expanded polystyrene for food and beverages for human consumption.

The Environmental Management Regulation for the Manufacturing industry aims at a sustainable development of natural resources in the manufacturing industry and at promoting environmental protection procedures and measures.

Opportunities and challenges: Peru offers great opportunities for Swiss firms in agronomy with meteo analysis, drones to spray crops, animal feed to reduce greenhouse gas emissions and systems to irrigate dry areas with less water, higher productivity and restoration of salt-saturated soils, and water platforms for vegetable production.

Opportunities are also identified for water treatment and purification for consumption; in mining to protect against rockslides; in waste management to recycle tyres and to build efficient plants to segregate material and eliminate waste; in renewable energy, to produce solar energy; in mobility, to improve fuel efficiency and introduce electric vehicles.

Business faces significant challenges with complex administrative procedures and a climate of political uncertainty with constant changes of ministers. According to the 2020 World Bank's "Doing Business" report, Peru ranks 73rd overall but only 133rd for starting a business. Taxes obligations are very time-consuming (rank 121st). Cross-border trade is slow and costly (rank 102nd).

Important market players: Through its regulatory power, the government plays an important role for business. Specific ministries are in charge in each area. It is essential to know them as well as their regulations. Regional and local governments also hold some responsibilities for instance for water management. Academia and civil society are active in particular in waste recycling as well as the private sector with important firms in waste electrical and electronic equipment (WEEE), in electricity, in renewable energy and in textiles.

Logistics and distribution: Logistics in the Cleantech sector is handled differently according to the business models in each specific field. For important projects, environmental studies must be presented to the authorities. Usually, the products must be imported in Peru and foreign firms must provide services related to installation and after-sales service. Depending on the development of the business, the foreign provider may work with a local distributor or establish its own firm under various company structures.

Case studies: Cleantech technologies bring significant benefits to society by addressing key challenges in various areas. The case studies illustrate business in solar energy, in the production and exports of food under internationally-recognized organic certifications using cleantech technologies such as drones and solar energy, in producing agricultural brands using efficient cleantech irrigation systems including AQUA4D, in enabling access to energy in remote areas off-grid and in managing waste at a company and at a municipality level.

Conclusion: Peru's needs in Cleantech technologies will grow exponentially over the coming years to meet big challenges associated with climate change, pollution, energy, waste and water. Swiss SMEs are well positioned in all these areas with high-quality, highly-performing and reliable Cleantech products and services. Market entry will continue to require major efforts to overcome procedural barriers, understand local culture and choose the best local partners.

3. MARKET OVERVIEW

Swiss firms have developed cleantech technologies to address energy issues and climate change and seek to expand abroad. They could contribute significantly in alleviating important problems in Peru such as emissions in cattle raising and transportation, water scarcity in agriculture, waste management and recycling in cities and in the countryside, natural disaster protection in mining, pollution, renewable energy sources and counterfeit in agrochemicals.

Peru is a middle-income country with a GDP per capita at PPP of US\$12,555 and a relatively large population (33 million). A significant part of the population lives in the large cities of Lima (9.5 million), Piura (1.9 million), La Libertad (1.8 million), Arequipa (1.4 million) and Cusco (1.2 million). The differences in the standard of living are considerable, with a poverty rate of 27.5%.

Geographically, the country has several distinct regions: the Pacific desert coast, the Andes, the central jungle and the jungle. Their climate differs with specific challenges to maintain and constantly improve the quality of life of the inhabitants.

The country's needs in the areas of education, health and infrastructure are considerable. In addition, there are multiple pressures related to high population growth in recent years, reinforced by large immigration from Venezuela (about 1 million).

As elsewhere in the world, clean technologies can be a source of growth for the economy and simultaneously contribute to solving important environmental and social problems in the context of the United Nations 2030 Sustainable Development Goals.

Water is a very important strategic asset, especially for daily use by the population, mining and agriculture. Climate change is affecting the country, particularly with the melting of glaciers and the increasing scarcity of water.

Pollution from traffic is affecting the health of the population, especially in the large coastal cities, which are largely deprived of sunlight and live under a stratus cloud nine months a year.

Waste disposal and separation are huge challenges. Waste affects the health of the poor population and has a negative impact on the environment.

Renewable energies are more and more necessary to meet the needs for electricity and to limit air pollution.

In this context, on the one hand the needs of Peru in clean technologies are considerable for the whole economy, and on the other hand appropriate solutions must be proposed corresponding to the financial, social and technological capacity of absorption.

3.1. What is cleantech¹?

Cleantech refers to sustainable production methods that respect resources and include technologies, manufacturing processes and services that help to protect and preserve resources and natural systems. All links in the value-added chain are involved, from research and development to exports and the production of capital goods.

¹ Source: Masterplan Cleantech en Suisse. Federal Department of Economic Affairs, Education and Research, Federal Department of the Environment, Transport, Energy and Communications, October 2011, p. 13. Available on line: [Microsoft Word - 101031_MP_CLEANTECH_VERSION 8_DC_F_printdef.doc \(admin.ch\)](#) Accessed 19/10/21

Cleantech includes the following areas:

- Renewable energies
- Energy efficiency
- Energy storage
- Renewable materials
- Resource and material efficiency (including waste management and recycling)
- Sustainable water management
- Sustainable mobility
- Sustainable agronomy and forestry management
- White, green and yellow biotechnology
- Environmental technology in the strict sense of the term (including measurement technology, remediation of contaminated sites, filter technology, etc.)

3.2. Background: Key Swiss cleantech sectors²

Cleantech provides a significant opportunity for innovation and manufacturing in Switzerland, a means of creating jobs with a high value added. At the same time, efficient and clean technologies play an important role in meeting global challenges such as climate change, depletion of natural resources or increasing environmental pollution. Swiss firms' main objectives are to achieve a leading position in cleantech research, considerable progress in knowledge and technology transfer and develop constantly new products and services.

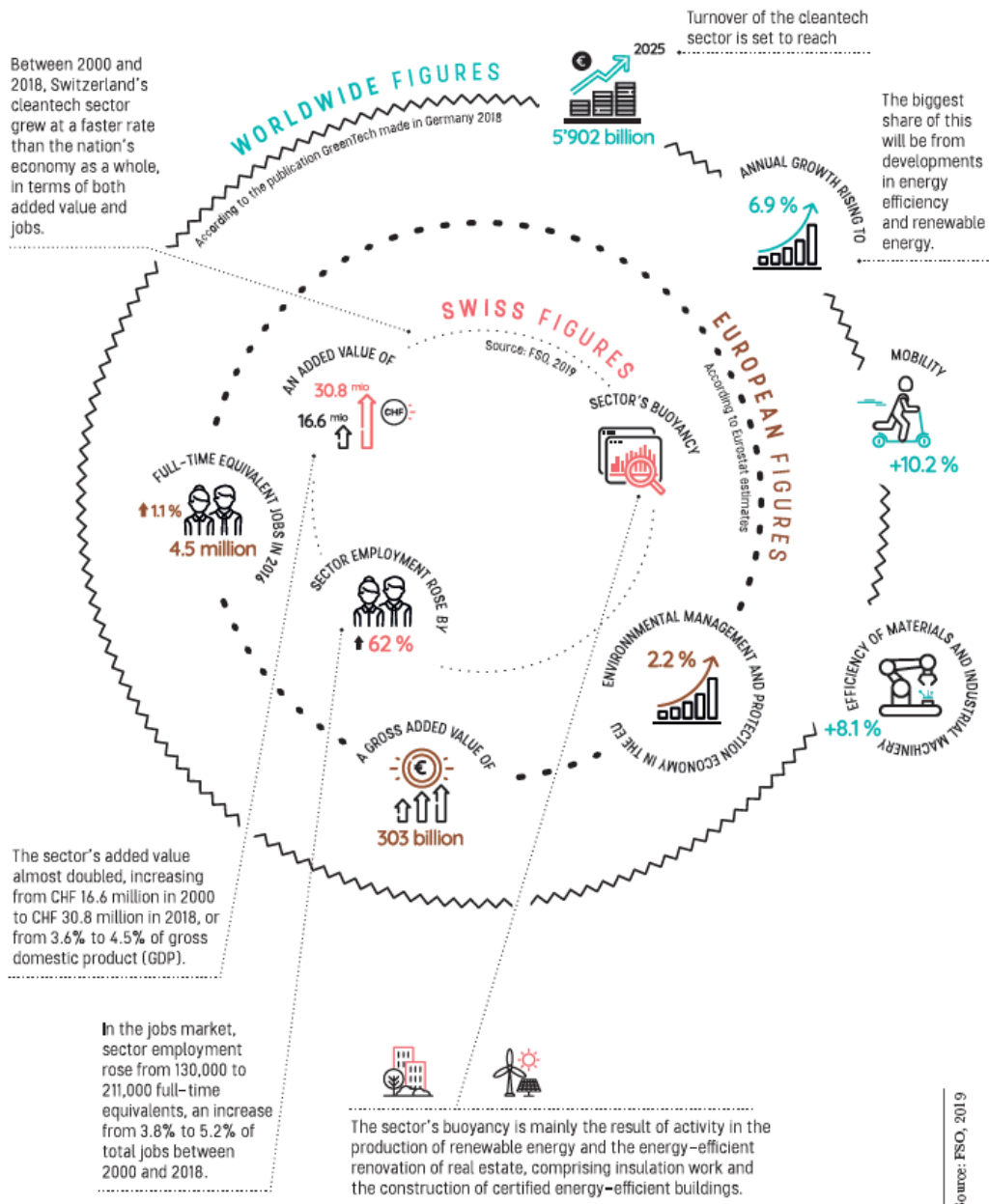
Cleantech includes the traditional sector of hydroelectric power, which is widely developed in Switzerland with glaciers, dams and rivers. This is complemented by more efficient electricity management with smart grids to optimize consumption and production. The circular economy is also part of a major effort to recycle resources after they have been used by producing new raw materials with used or waste products. In order to meet the energy challenge and decrease pollution, solar panel technologies for electricity generation and photovoltaic panels for heat generation are set to play an increasing role. This implies the need to store excess energy produced for later use or sale to other users. Finally, finance plays a key role in facilitating research and development of new technologies, and then bringing innovations to market.

Clean energy and energy efficiency are at the core of combating climate change. Electric cars have opened up a new era with multiple needs, especially for batteries and charging stations. Switzerland is participating in this effort with the production of various vehicles, key parts and charging stations. Energy efficiency is also essential; it is constantly being improved in a wide range of areas including building insulation, reduced use of oil in engines or new techniques in the field of textiles. Recycling offers enormous opportunities and is an integral part the circular economy. It is not only about preserving the environment but also about producing new raw materials i.a. from waste paper, glass, metals, wood and electronics. The growing scarcity of water is also leading to the development of new techniques to reduce its use in agriculture. The aim is to achieve a sustainable agriculture based on existing resources. Peru is facing this challenge to continue its agricultural development.

Finally, prevention measures can be taken to mitigate the impact of natural disasters. Hybrid technologies are useful to prepare the path to full transition to new approaches bearing their own challenges.

² This section is based on the Swiss Cleantech Report 2020.

Figure 1. Swiss Cleantech key figures³



The cleantech sector is gaining momentum. Worldwide growth figures are impressive with a focus on energy efficiency and renewable energies. Clean mobility, material efficiency and industrial machinery are also growing rapidly. At the European level, gross value added is substantial (303 billion euros) and jobs are growing, although still rather weakly (1.1%). Switzerland has also embraced cleantech, with strong growth in value added and employment since 2000.

The importance of Cleantech is evidenced by its significant share of patents granted worldwide with 18.4%. Switzerland is also very active, its patents with a Cleantech content representing 15.9% of its patents and 0.47% of the world's.

³ Source: Ibid, p. 7.

The quality of Swiss patents is highlighted by their high ranking in terms technological relevance and market coverage. Switzerland's position is far superior to that of its neighbours Italy, France and Germany. Only Israel, Singapore, the United States and Denmark are technically superior. There are considerable differences with middle-income countries such as China, South Korea, Brazil, Poland and Russia.

International comparison by field shows that patents of Swiss origin are of higher technological quality and cover larger markets across the board. Switzerland's position is particularly strong for photovoltaics, transport and mobility, and urban solutions.

Despite its small and highly protected agricultural sector, Switzerland is also active in smart farming with breakthrough technologies saving water to be used around the world. Photovoltaic technology alone accounts for 727 patent families of Swiss origin.

3.3. Which Cleantech products can Switzerland offer to Peru?

Switzerland has a large offer of Cleantech products covering several sectors of the economy. Most of them cannot be identified precisely in trade statistics because product categories that include cleantech products also include other products. For example, customs classifications do not yet distinguish between electric vehicles (cleantech), gas and petrol vehicles.

Nevertheless, it is possible to identify some cleantech products corresponding to specific sectors. In some areas, it is feasible to quantify the economic dimension of the field and the potential for cleantech to gradually increase its relative share.

In this context, based on the Swiss cleantech product offering and an S-GE study identifying Swiss cleantech firms present in Peru or interested in establishing themselves there, the following areas and products were identified:

- Sustainable agriculture and counterfeit agrochemicals
- Sustainable water management
- Sustainable mining and protection from natural disasters
- Resource and material efficiency (including waste management and recycling)
- Sustainable mobility and energy efficiency
- Renewable energies
- Environmental technology services
- Environmental technology for textiles

3.3.1. Sustainable agriculture and counterfeit agrochemicals

In this area, Swiss Cleantech may be best illustrated with the products of five companies.

a) Animal feed

According to the United Nations Food and Agriculture Organization, dairy cows and beef cattle produce nearly five billion tons CO₂ equivalent every year worldwide, accounting for around 10% of all emissions generated by human activities. 40% of these emissions are generated by the animals belching during the digestion process.

In order to address this issue, Agolin (Bière, Vaud) developed a feed additive that contains plant extracts and is available in both a standard version and in an organic version that complies with organic farming regulations. The additive, called Agolin Ruminant, was originally

developed to improve cows' digestive function with a view to increasing milk production – or weight gain in the case of meat herds. This is because more efficient digestion gives the cows a 4% better energy yield from their feed on average.

Using this additive could reduce the methane impact of cattle by 200'000 tons CO₂ equivalent per year in Europe, based on current cattle numbers. The potential for methane emissions reduction worldwide is huge: 200 million tons CO₂ equivalent. And the cost involved is relatively modest, being estimated at 25 euros per ton of methane saved. The feed additive was awarded Carbon Trust certification in 2018 in recognition of Agolin's efforts in combatting climate change. (See FACTSHEETS DOCUMENT: 1.1 Agolin).

b) Drones

The Swiss firm Aero41 specialises in crop spraying by drone, working with a network of partners to develop and manufacture sprays and provide spraying services to farmers and winegrowers. There is almost zero waste because the direction of almost every droplet can be controlled.

Aero41 drones are licensed as a ground treatment because they don't need to fly high to be effective. By minimising its flying altitude, the drone is able to use the downward air currents generated by its propellers to disturb the leaves, ensuring a more even distribution of the sprayed product. This feature is of particular interest to organic producers because plant coverage must be optimised for the product to be effective.

Winegrowers using difficult-to-access land quickly realised the advantages of this product and were the first to adopt the technology. Switzerland and Austria have already licensed the use of drones, and certification is pending in France, Germany and Italy. Wine producers on the West Coast of the United States have shown an interest too (See FACTSHEETS DOCUMENT: 1.2 Aero41).

c) Meteo analysis

The Swiss firm Meteotest⁴ provides a wide range of services covering i.a. weather forecasts (consultancy, extreme weather), air quality (environmental studies, critical loads), energy and climate (climate data, meteorology), wind assessments (energy yield, wind loads), energy economics (solar cadastre, solar forecasts), air quality (environmental studies, critical loads), icing (forecasts, production loss), measurements (webcams, weather stations), web and software (data management, online maps), and geoinformatics (spatial analysis, geodata models).

d) Feasibility studies

The Swiss firm terraplant⁵ is specialized in feasibility studies to improve the **environment** and is committed to preventing environmental impacts and/or reducing them with appropriate measures to a minimum. Within permit procedures, terraplant verifies whether a building project is in compliance with the relevant environmental laws and regulations and support the construction process. Terraplant helps companies assess the environmental impact of their activities, be in compliance with the environment laws and regulations and define their own environmental strategy. In the scope of **risk prevention**, terraplant develops natural hazards maps and delivers the basic information to determine risk zones for spatial planning. Terraplant is committed to implementing the high standard of knowledge of **ecology** in the real world and

⁴ Meteotest is a leading company in weather, climate, environment and computer science. It is characterised by a high customer focus, expertise and technical competence. Information available on line: [We are Meteotest | Meteotest](#)

⁵ Terraplant provides environmental and engineering services. Information available on line: [Company overview - Terraplant](#)

offers practical services and products for the conservation of the ecosystem. Applied ecology deals with the implementation of ecology into practical solutions for daily life. Terraplant offers a series of **interdisciplinary services**, including computers applications and related topics.

e) Agrochemical's counterfeit

Agrochemical's counterfeit is very widespread in South America (20% of products sold) and in Europe (10%). These products are dangerous to human health, the environment and the crops. A blockchain-based digital technology provides not only proof of the authenticity of the chemical products being sold, but also full traceability and transparency throughout the value chain.

Two Swiss companies, Authena and Lonza, have developed one of the first blockchain-based digital technologies in the industry. (See FACTSHEETS DOCUMENT: 1.3 Authena).

3.3.2. Sustainable water management

In this field, seven companies are showcased.

a) Irrigation water saving

Water and soil preservation are key to reaching sustainability goals on a global scale.

AQUA4D has developed a clean technology allowing irrigation water savings (~30% average), restoring salt-saturated soils, and saving resources - sustainably and without any chemicals.

The technology is efficient, operational, scalable worldwide, and is fully complementary to existing irrigation infrastructure and e-monitoring.

This innovative system has a strong track record for tangible transformation of soils, resource use, and plant health. It enables better water penetration in soil micropores, improved nutrient uptake, and continued irrigation with saline water. The systems are fully modular and easily integrated into existing irrigation setup. All flow rates are catered to, with Treatment Units added as required. The overall irrigation process becomes more sustainable, efficient and less labor-intensive.

The technology solves some of the most persistent problems in water systems, including limescale, corrosion and biofilm- without chemicals and without costly maintenance. Limescale deposits are completely removed. The structure of the minerals is changed by transforming calcite into finer aragonite, and finally into ions. These remain in the water, are no longer deposited. Unlike water softeners, AQUA4D leaves the calcium and magnesium in the water which give drinking water its natural taste together with other minerals (See FACTSHEETS DOCUMENT: 2.1 AQUA4D). Another Swiss firm is specialized in saving water for vegetable production (See FACTSHEETS DOCUMENT: 2.2 Cleangreens) and another one in water treatment (See FACTSHEETS DOCUMENT: 2.3 Fimars Metering Pumps).

b) Water treatment and purification for consumption

The Swiss firm Trunz Water Systems provides efficient solutions for drinking water supply in challenging applications (such as remote areas, mobile applications, defence and disaster missions).

Trunz Water Systems treats fresh water considered as any non-saline water source like river, lake or well water. Its ultrafiltration units remove organic contaminants, viruses, bacteria, cysts, etc. down to a size of 0.02 micron without requiring toxic chemical treatment. Raw water is filtered under pressure through a high-technology hollow fibre membrane and the natural minerals remain in the water.

For brackish water - water with a higher salinity, typically from wells or boreholes- the Trunz Brackish Water Systems are designed for maximum salinity of 18'000 TDS⁶. Seawater is desalinated with an energy efficient RO system that removes salt, bacteria, viruses and cysts down to a size of 0.0004 micron without requiring toxic chemical treatment. The RO filtration technology is based on a multi-layer membrane which filters the water under high pressure. In order to reduce energy consumption, the Trunz desalination units include an energy recovery pump (See FACTSHEETS DOCUMENT: 2.4 Trunz).

Other Swiss firms are specialized in waste water treatment (See FACTSHEET DOCUMENT: 2.5 Wabag Water Technology), water dispensers (See FACTSHEET DOCUMENT: 2.6 Aveho), piping systems (See FACTSHEETS DOCUMENT: 2.7 Georg Fischer), identification of water contamination, solutions for digitization, internet, cloud, data services (green.ch) and water contamination (Geotest: see FACTSHEETS DOCUMENT: 3.2 Geotest),).

3.3.3. Sustainable mining and protection from natural disasters

a) Steel meshes and barriers

Geobrugg contributes to mitigate the effects of climate change producing highly robust steel meshes. The company's wire-mesh nets were first used in 1951 to provide protection from avalanches, and later on to protect against rockfalls. They have been continuously improved ever since. In 1999, an innovative production method was introduced that allowed meshes to be manufactured using high-tensile steel wire with exceptional protective properties and corrosion resistance, which means they are able to provide protection from rockfalls, land- and mudslides and avalanches. These meshes are used for safety applications in mining and tunnel construction and on motorsport courses (See FACTSHEETS DOCUMENT: 3.1 Geobrugg).

Swiss firms also providing specialized services are Geotest, engineering services (AFRY) or avalanche release systems (Wyssen Avalanches).

3.3.4. Sustainable waste management and recycling

a) Disaggregation process to separate waste

SELFRAG has industrialised a process that uses pulses of high-voltage electricity to break down materials into their component parts. Applied to the waste-processing industry, this technology enables almost 100% of metals and low-polluting construction waste to be reclaimed from slag. Slag already in landfill may be processed to reclaim the valuable materials it contains and create additional space on landfill sites that are already over capacity.

The Lab system of SELFRAG is a laboratory scale solution for selective fragmentation. The Lab uses a SELFRAG high voltage discharges to fragment batches of material and liberate individual components from the whole, whether rock or electronic waste. The Lab is self-contained, compact, and constructed in Switzerland to meet all EU health and safety regulations. The Lab system is ideal for use in geosciences, mining and recycling research.

⁶ TDS: total dissolved solids.

The SELFRAG Rod Crusher is specifically designed to fragment mono or poly-crystalline silicon for the solar and semiconductor industry with virtually zero contamination. The unique non-contact crushing provides rapid size reduction and preserves the chemical purity of the material, making it perfect for high purity applications (See FACTSHEETS DOCUMENT: 4.1 Selfrag). Recycling plants are also produced by WeeeSwiss Technology (See FACTSHEETS DOCUMENT: 4.2 WeeeSwiss Technology).

b) Recycling of tyres

TRS Tyre Recycling Solutions enables sustainable recycling of the materials contained in scrap tyres. Creator of a circular economy solution, TRS tyres is a technology developer and integrator. The company has developed a toolbox of technologies and know-how to implement the best available process.

TRS implements technologies and processes into tyre recycler operations and has become a supplier of a unique specialty chemical – TyreXol™ rubber powders commercialized in specific market applications. At the center of a transformation, TRSs solves a hazardous waste issue, creating value for existing players of the recycling chain, providing cost-efficient new materials and unique compounding solutions. (See FACTSHEETS DOCUMENT: 4.3 TRS Tyres Recycling Solutions).

Other products and systems in this field include waste facility (SIDSA), BOT turnkey recycling production of biogaz/methanisation (erep), e-waste and similar hazardous waste streams, projects (sofies SA).

3.3.5. Sustainable mobility and energy efficiency

a) Electric vehicles

Since 2009, KYBURZ (Freienstein, canton of Zurich) has been supplying the Swiss Post with three-wheeled delivery vehicles for its entire fleet.

Kyburz vehicles have replaced motorbikes of the Swiss Post that guzzled up to 18 litres of petrol for every 100 km of stop-and-go driving and had a relatively short service life. The tricycles were the first electric vehicles to go into widespread circulation in Switzerland.

The delivery vehicles have also proved popular in other countries. They are used in various European countries and by the Australian and New Zealand postal services, and have also recently been rolled out in Thailand and India.

The company also offers a lightweight 600 kg electric sports car as well as fleet management software that companies, cities and municipalities can use to manage their vehicle fleets in an energy-efficient and cost-effective way (See FACTSHEETS DOCUMENT: 5.1 KYBURZ).

b) Electric vehicles charging points

The Swiss firm Green Motion (Le Mont sur Lausanne, Vaud) designs and manufactures everything to do with electric vehicle charging points, from domestic installations to public charging stations. It has also developed a software platform designed to manage charging networks which features a charge invoicing system. These two offers are complementary but are also available separately.

Having recently been granted UL (Underwriters Laboratories) certification, its products now meet the standards applicable in the United States and Canada.

The company has a long-term vision and highly localised production facilities enabling it to tailor its charging point components to each market. Last but not least, charging points – with a loss of less than 4% – boast the best power conversion rate in the world.

Products include the most popular Swiss public charging station. Modular, scalable, tailored to all types of private or public parking. Private One is the iconic charging station everywhere in Switzerland, one of the most demanding markets in the world.

For residential use, a cost-effective charging station can be attached to an indoor or outdoor garage wall thanks to its integrated mount. Smartphone control via Bluetooth allows the user to access consumption data as well as lock the station.

SMART ONE makes it possible to balance the available power between charging vehicles and control up to 100 charging stations. Greenmotion also offers the world's first standard electric airplane charging station called SKYCHARGE. It brings the world's highest performing charging station – with efficiency higher than 96% – to electric airplane (See FACTSHEETS DOCUMENT: 5.2. Greenmotion).

c) Cable cars and ropes

Low cost, the Wyssen Skymule⁷ is ideal for downhill transport on steep terrain due to its simplicity and flexible design. Its major characteristics are: unlimited ropeway length, quick and easy assembly and disassembly, high productivity as several loads can be transported simultaneously, easy transportation with low weight (4.5 kg), speed control by means of pneumatic propeller brake, simple lifting of the load through the use of pulleys and finally slow and controlled descent into the valley.

Other products under sustainable mobility include lithium batteries (see FACTSHEETS DOCUMENT: 5.3 Libattion); other e-charging stations (e-CarUp AG); light aircrafts, turnkey services (Skyforce LTD); other cable cars (Doppelmayr Garaventa).

The Swiss firm «CombiFuel®» (Wangen, canton of Schwyz) has developed a gas injection system saving gas and reducing pollution. This new drive system has the potential to leave a unique ecological and economical footprint. The plug-in technology has been designed in a way which enables universal application to all kind of combustion engines. Thus, new vehicles (ex-works), as well as used vehicles can be equipped easily and with low costs. In comparison to conventional petrol and diesel engines, CombiFuel® can **save up to 40% on fuel costs** and also **eliminate up to 80% of vehicle emissions** (See FACTSHEETS DOCUMENT: 5.4. CombiFuel).

The Swiss firm Ganser has developed the Common Rail injection technology, which has contributed significantly to the new era of the modern diesel engine. The diesel engine becomes more powerful, runs quietly and produces far less emissions than in the past. The Common Rail injection system is an engine-internal measure to reduce the environmental impact in contrast to exhaust after-treatment systems, which are added components on the engine.

⁷ More information on Wyssen Skymule is available on line: [Plantation Cableway - Skymule • Wyssen Seilbahnen AG](#)

Ganser's Common Rail systems provide the following environmental improvements:

- Diesel fuel savings: 5 to 15%
- CO₂ savings: 5 to 15%
- Reduction of black smoke: 70 to 90% (not visible anymore, even in transient mode)
- Reduction of NO_x emissions: 20 to 50%
- Reduction of CO emissions: 80 to 90%

These advantages with Common Rail injection have led to a widespread modernization of diesel engines in the passenger car and truck domains. The same shift to Common Rail systems is happening now in the off-road diesel engine markets. In the coming years, diesel engines in the off-road market will continue to be a vital instrument for transportation of goods and people, for construction works and for power generation at remote sites or in emergencies.

Ganser designs and produces high performance injectors with impressive injection quantities in a very short injection time, if needed also far beyond regular operating modes. The extremely high injection rate of these injectors is perfectly suited for applications in medium-sized engines (power output in the range of truck engines) with a high rated engine speed (See FACTSHEETS DOCUMENT: 5.5 Ganser).

Other firms interested in the Peruvian Cleantech market are specialized in high, medium, low voltage (amperio), renewable energy storage in an economical and sustainable way (ENERGY VAULT), energy management technology and related products, cloud (smart-me).

3.3.6. Renewable energies

a) Photovoltaic solar installations

Solar energy is the energy that comes from the light and heat of the sun and can be used by different technologies. The sun is a clean, free and infinite source of energy. Solar energy production reduces **gas emissions** that increase global warming. It is a **clean** and **green energy** and **cost effective**. Solar panels that capture solar energy are made of reliable and durable materials, require very little maintenance. They encompass high technology, aesthetic systems and innovative accessories. Photovoltaic thermal panels, called hybrid installations, can combine the production of electricity and heat.

SOLEOL (Estavayer-le-Lac, canton of Fribourg) offers services aimed at private and industrial customers, farmers, but also at public authorities and all the actors of the real estate sector (architects, management companies, general contractors). Services also include solar carport, solar battery, charging station and monitoring system. SOLEOL has a subsidiary in Peru with 17 employees (See FACTSHEETS DOCUMENT: 6.1 SOLEOL).

Other Swiss companies in this field include CleanFizz that offers photovoltaic panels with an electrodynamic system (See FACTSHEETS DOCUMENT: 6.2 CleanFizz) and dhp technologies that has developed a support structure that uses cables to enable the photovoltaic modules to fold out over built surfaces and fold up again when required (See FACTSHEETS DOCUMENT: 6.3 dhp technology AG).

b) Power conversion products

Power conversion products for the off-grid market are manufactured in Switzerland by Studer Innotec (Sion, canton of Valais). They are robust devices with power outputs of up to 72 kVA,

ensuring Studer Innotec position as leader on the high-end market. Studer Innotec produces inverter chargers; they are multi-functional devices that allow to supply an alternating current (AC) voltage from a battery, the charge of the battery of an AC source and a transfer function when an AC is available.

The latest additions to the range, the new generation of smart inverters, offer even higher power and greater connectivity. (See FACTSHEETS DOCUMENT: 6.4 STUDER INNOTEK SA).

Ongresso Energy advises stakeholders along the energy value chain with a specific focus on decentralized structures such as mini-grids and distributed generation. Ongresso develops commercial & industrial (C&I) solar and energy efficiency projects, operates and manages investors' assets. Its sister firm Ongresso incorporates and administers project companies (e.g. a portfolio of C&I solar projects), executes technical, legal and commercial due diligences, offers strategic advice/second opinions to stakeholders along the energy value chain and develops concepts and feasibility studies (See FACTSHEETS DOCUMENT: 6.5 Ongresso Energy).

3.3.7. Environmental technology services

Several Swiss firms active in Peru or having expressed an interest in that market provide support for life-cycle projects, digitalization and automation (See FACTSHEETS DOCUMENT: 7.1 Aveny); services of climate protection solutions and renewable energy (See FACTSHEETS DOCUMENT: 7.2 firstclimate); exploration, validation (See FACTSHEETS DOCUMENT: 7.3 INNOVETO).

3.3.8. Environmental technology for textiles

The "HeiQ Clean Tech" system is used in the dyeing of polyesters.

The "HeiQ Clean Tech" system does not only save time for textile manufacturers, but also reduces their water and energy consumption by 30% in comparison with standard processes.

See FACTSHEETS DOCUMENT: 8.1HEIQ). Special textile membranes without (PFC) are also being developed (Dimpora AG).

3.4. Swiss trade in Cleantech relevant products

The Cleantech products manufactured by Swiss firms are classified under the following tariff positions:

Table 1. Cleantech Swiss exports to Peru
(In million Swiss francs; tariff positions include non-Cleantech products)

HS tariff number	Name	Exports to Peru	Year
3302.90	Mixture of substances	3.420.092	2018
7314.41	Netting, fences	767.398	2019
8412.90	Parts, non-elect. engines	5.858	2018
8421.21	Filtering, purifying water	220.260	2018
8436.80	Agricultural machinery	-	-
8474.10	Waste management plant	153.679	2017
8504.32.10	Transformers	21.813	2020
8504.40	Static converter	3.612.894	2019
8504.50	Inductors	218.071	2016
8504.90	Parts electrical transformer	222.949	2016
8506	Batteries	57.801	2019
8536.90	Elect. app. for switching elect. circuits	222.298	2019
8541	Diodes, photovoltaic cells	116.456	2018
8713.90	Electric vehicles	-	-
8802	Drones (helicopters)	-	-
9030.33	Instruments for measuring voltage	103.009	2015

Source: SwissImpex, Swiss Customs Administration. The year features the highest Swiss exports (2015-2020).

3.5. What are Peru's needs in the Cleantech area?

By the end of 2019, the Peruvian economy had achieved more than 20 consecutive years of GDP growth. Thus, Peru has doubled the size of its economy during the last two decades.

This growth had a strong impact on the environment. This section will highlight key issues that require cleantech technologies. Business opportunities for Swiss companies in Peru will then be identified in Chapter 4.

3.5.1. Sustainable agriculture and counterfeit agrochemicals

Agriculture - crop farming, livestock, hunting and forestry- plays an important role in the Peruvian economy, especially in terms of employment and through its linkage with other economic activities, such as tourism, hotels and restaurants. In 2018, agriculture contributed to 6.1% of GDP and grew at an average of 3.4% between 2014 and 2018. Its contribution to employment was much greater with 24.1% (2017). Agricultural activities occupy 30.10% of the national territory (38.7 million hectares) of which the coast represented 11.5%, the jungle 30.1% and the highlands 57.5%⁸.

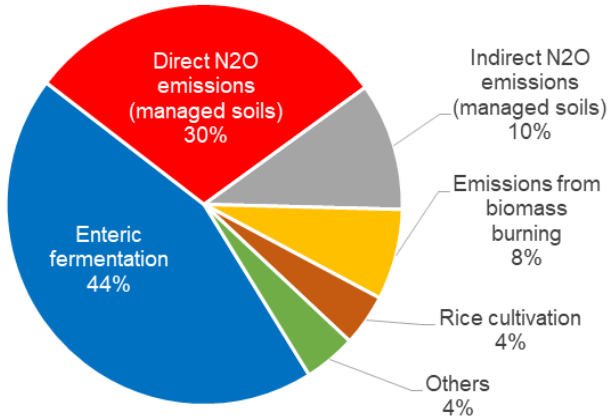
Peru produces a wide variety of agricultural goods including sugar cane, oil palm, grapes and coffee. The main fruits are banana, orange, pineapple, mandarin and mango.

⁸ Source: National Agricultural Census (CENAGRO), 2012. Available on line: www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib1177/resumen.pdf

Greenhouse gas (GHG) emissions from agriculture include two categories: first, livestock with enteric fermentation (methane emissions) and manure management. Second, aggregate sources and non-CO2 emission sources on land composed of the following six subcategories: emissions from biomass burning, urea application, direct and indirect N2O emissions from managed soils, indirect N2O emissions from manure management, and rice crops⁹.

In 2016, GHG emissions from these two categories were 25,910.29 GgCO2eq (Gigagrams of Carbon Dioxide Equivalent), representing 12.6% of total emissions nationwide. The main source of emissions is enteric fermentation from cattle, representing 44.2% of the total, followed by direct N2O emissions from managed soils, representing 29.8%. These two subcategories represent 74% of total emissions in agriculture (see figure 2).

Figure 2. Distribution of emissions by greenhouse gas categories
(Agricultural sector, 2016)



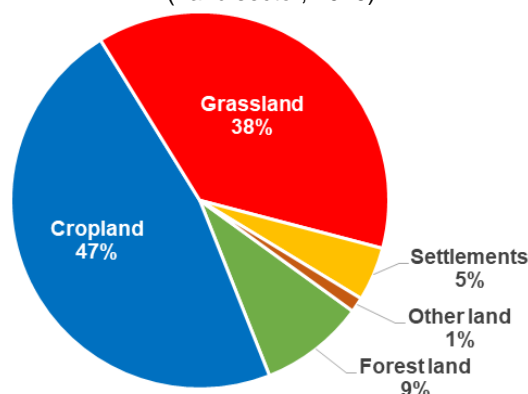
Source: INGEI, 2016

One of the major drivers of CO2 levels is changes in land use and forestry with: forest land, cropland, pastures, settlements, and other land. Forest land includes changes in forest carbon stocks due to human activities (establishment of forest plantations, commercial logging, harvesting of wood for use as fuel, etc.). For the other land types, the estimation of GHG emissions and removals due to changes in living biomass, dead organic matter and soil organic carbon is included.

In 2016, GHG emissions from changes in land use and forestry were 108,991.29 GgCO2eq, representing 53.1% of total emissions nationwide. The main source of emissions was cropland representing 47.2% of total emissions in the sector. The second most important source of emissions is pastures, representing 37.9% of total emissions in the sector.

⁹ National Greenhouse Gas Inventory conducted in 2016. Available on line: https://infocarbono.minam.gob.pe/wp-content/uploads/2021/06/INGEI_2016_Junio-2021_Final.pdf

Figure 3. Distribution of emissions by greenhouse gas categories
(Land sector, 2016)



Source: INGEI, 2016

Illegal trade in agrochemicals (counterfeit, adulterated and smuggled) is increasing in Peru¹⁰. The sale of smuggled agrochemicals amounts to US\$10 million. Cultivida's executive director, Carlos Rodríguez Koch, indicates that "what they use for adulteration are containers recycled in the field. Containers that can cost between 20 and 50 soles, depending on their state of conservation. These products are marketed at over S/. 400 per liter, so the profitability is quite high". Low-cost products (such as pyrethroid or phosphorous products whose value is around 50 soles) are generally used with the label of a high-value product and sold between 300 and 400 soles, a 60% discount from official value. Agrochemical smuggling enters Peru through all borders, the northern one being the most active. Agrochemicals most likely to be adulterated are insecticides.

3.5.2. Sustainable water management

Water resources available in Peru can be classified into three watersheds: Atlantic or Amazon (2.4 million Hm³¹¹), Pacific (37 thousand Hm³) and Titicaca (6 thousand Hm³). In the case of the Atlantic watershed, 78% of the water is available on the surface and 22% subway. Likewise, for the Pacific and Titicaca watersheds, surface water represents 92% and 91%, respectively¹².

In 2019, consumptive use of surface water, i.e. water removed from available supplies without return to a water resource system, was mainly used by agriculture (89%) and households (9%), followed by mining and industrial activities (2%). Likewise, the non-consumptive use of surface water (water with return to the water system) is largely represented by the energy sector, which represents 97.6% of this type of use at the national level.

The intensive use of water by agriculture is by far the driving force in the market for technological products that offer an efficient use of water resources.

According to the National Water Resources Plan, irrigation water efficiency is 35%, indicating a significant waste of water. Moreover, only 12% of crops are irrigated under irrigation systems, while the rest use gravity irrigation. Irrigation infrastructure is undoubtedly one of the main factors explaining low productivity. Out of 55,237 kilometres of canals evaluated, only 15% were covered like a pipe or a canalization.

¹⁰ Available on line: <https://andina.pe/agencia/noticia-venta-agroquimicos-contrabandeados-alcanza-los-10-millones-peru-822652.aspx>

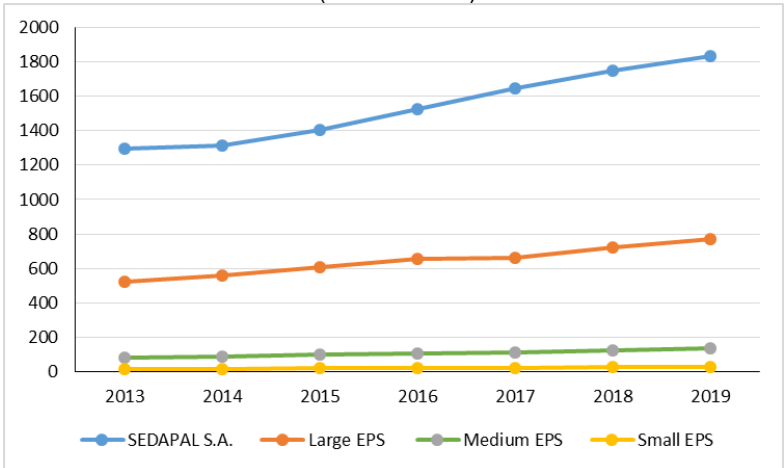
¹¹ Hm³ (cubic hectometres) = 1 million cubic meters.

¹² Source: Peruvian National Water Authority (ANA).

The Food and Agriculture Organization of the United Nations (FAO) points out that food production could increase considerably with economically effective methods for storing water before critical crop stages and applying it during periods of low rainfall¹³.

The sale of drinking water in Peru has increased substantially in recent years (44%). According to SUNASS, SEDAPAL S.A. has billed 1.8 billion soles in 2019 for sanitation services, a 41% increase from 2013; other large companies grew by 46%, and the medium and small companies by 61% and 62% respectively.

Figure 4. Drinking water sales, by size of sanitation service provider, 2013-2019
(Millions soles)



Source: INEI, Yearbook of environmental statistics 2020

A key element in understanding the importance of drinking water quality is the free residual chlorine that remains in the water upon supply to consumers or for use to neutralize new contamination. If the water has traces of chlorine, it means that most of the dangerous organisms have been removed and that the water is safe to drink.

In Peru in 2019, the departments with inadequate levels of residual chlorine in water were Pasco, Amazonas, Apurimac, Puno and Cajamarca.

52.8% of households in urban areas have adequate levels of residual chlorine, but only 3.8% in rural areas. This situation leads to the need to implement technologies for the treatment and purification of water for human consumption.

Finally, with respect to wastewater, conditions have been improving, although there is still much to be done. According to the National Superintendence of Sanitation Services (SUNASS), untreated domestic wastewater discharges (cubic meters) have decreased by 41% between 2013 and 2019. However, at the national level, the situation is diverse. The departments with the highest increase in untreated domestic wastewater were Ica (371%), Tacna (42%) and Apurimac (32%), while the cities that reduced the number of untreated discharges were Moquegua (-91%), Arequipa (-90%), Lambayeque (-83%) and Lima (-63%).

3.5.3. Sustainable mining, protection from natural disasters

Peru has a significant geological potential in the Andean mountains. Mineral wealth has played an important role in growth and economic development. Between 2010 and 2019, most of the metallic products have featured robust growth with copper almost doubling production (+97%),

¹³ The irrigation infrastructure gap in the agricultural and livestock sector, By Marco Vinelli on March 2, 2021. Available on line: www.esan.edu.pe/conexion/actualidad/2021/03/02/la-brecha-de-infraestructura-de-riego-en-el-sector-agropecuario/

molybdenum (+79%), iron (+67%), lead (+18%) and silver (+6%). On the other hand, production declined for tin (-41%), gold (-22%) and zinc (-4%).

Table 2. Mineral Production in Peru 2010-2019
(Thousands)

Metal	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Gold (kg fines)	164.1	166.2	161.5	151.5	140.1	146.8	153.0	152.0	140.2	128.4
Silver (kg fines)	3640.5	3418.9	3480.9	3674.3	3768.1	4101.6	4375.3	4418.0	4160.2	3860.3
Zinc (MT)	1470.4	1256.4	1281.3	1351.3	1315.5	1421.2	1337.1	1473.1	1474.4	1404.4
Copper (MT)	1247.2	1235.3	1298.8	1375.6	1377.6	1700.8	2353.9	2445.6	2437.0	2455.4
Lead (MT)	262.0	230.2	249.2	266.5	277.3	315.5	314.4	306.8	289.1	308.1
Iron (MT)	6042.6	7010.9	6684.5	6680.7	7192.6	7320.8	7663.1	8806.5	9533.9	10120.0
Molybdenum (MT)	17.0	19.1	16.8	18.1	17.0	20.2	25.8	28.1	28.0	30.4
Tin (MT)	33.8	28.9	26.1	23.7	23.1	19.5	18.8	17.8	18.6	19.9

Note: MT metric tons

Source: Ministry of Energy and Mines (MINEM), Mining Statistical Bulletin. Available on line: www.gob.pe/institucion/minem/colecciones/6-boletin-estadistico-minero

Peru is among the world's and Latin America's leading producers of various metals (gold, silver, zinc, copper, lead, iron, tin, molybdenum, etc.).

Table 3. Peru's position in world metal production, 2019

Mineral	World Ranking	Latin America Ranking
Gold (g fines)	8	1
Lead (MT)	3	1
Selenium (MT)	10	1
Tin (MT)	4	1
Zinc (MT)	2	1
Cadmium (MT)	9	2
Copper (MT)	2	2
Molybdenum (MT)	4	2
Silver (kg fines)	2	2
Mercury (MT)	5	3

Source: U.S. Geological Survey, 2021, Mineral commodity summaries 2021: U.S. Geological Survey. Available on line: <https://doi.org/10.3133/mcs2021>

In 2019, export of metallic mining products amounted to US\$28.1 billion with copper (49%), followed by gold (30%) and zinc (7%). Mining was the main contributor to exports (60.2%) with metallic minerals (58.9%) and non-metallic minerals (1.3%).

In 2019, investments in mining amounted to US\$5.9 billion.

Figure 5. Value of exports by mineral product, 2019
(Percent)

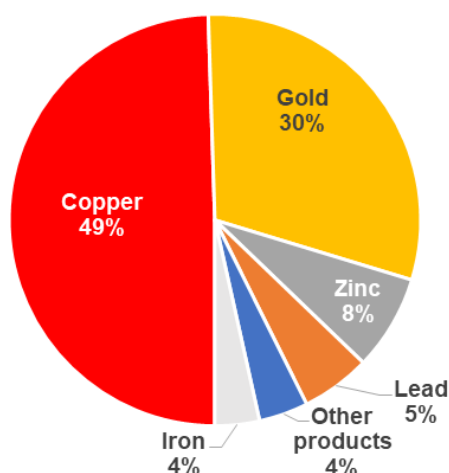
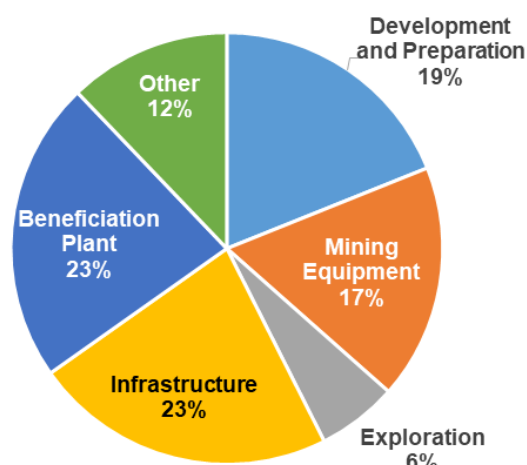


Figure 6. Mining investments by item, 2019
(Percent)



Source: Central Reserve Bank of Peru (BCRP)

While the mining sector makes a significant contribution to the Peruvian economy, it has also a significant impact on the environment leading to serious social conflicts. The pressures that mining activity exerts on the environment include¹⁴:

- Air, water and soil emissions and contamination
- Mercury contamination
- Environmental impact of informal and illegal activities
- Risks and dangers associated with environmental liabilities
- Socio-environmental conflicts

Peru is located in an area known as the Pacific Ring of Fire, which is characterized by natural disasters, such as seismic movements, in the form of tremors or earthquakes. In addition, there are rainy seasons in most regions, which generate flooding and overflowing of rivers. This increases the risk of possible rockfalls from nearby streams and valleys. For the International Society of Mining and Metallurgy of Peru (SIMIM), it is important that mining companies learn from natural disasters that have occurred, so that they can take the necessary precautions¹⁵. The importance of having the right technology to avoid or mitigate the damage caused by natural disasters is absolutely necessary in Peru.

3.5.4. Sustainable waste management and recycling

Peru faces a great challenge for solid waste management. In 2016, 7 million tons of municipal solid waste were generated. Out of them, 18.7% were inorganic recyclable waste which can generate employment through businesses treating paper, cardboard, PET plastic, hard plastic, glass, tetra-pak, metals and electrical and electronic waste - WEEE¹⁶.

¹⁴ Comisión Económica para América Latina y el Caribe (CEPAL)/Organización de Cooperación y Desarrollo Económicos (OCDE), Evaluaciones del desempeño ambiental: Perú, Santiago, 2017.

¹⁵ Available on line: <https://forpost-sz.ru/es/a/2021-10-05/principales-fenomenos-naturales-que-afectan-la-actividad-minera>

¹⁶ Available on line: www.minam.gob.pe/notas-de-prensa/en-el-peru-solo-se-recicla-el-1-9-del-total-de-residuos-solidos-reaprovechables/

In Lima, capital and country's largest city with almost 10 million inhabitants, around 8,500 tons of waste are generated on a daily basis. This corresponds to 47% of the total produced nationwide and only 4% is recycled¹⁷. City with the highest ecological footprint in Peru, Lima exceeds the ecologically permissible parameters.

Municipalities are responsible for the collection, transport and safe final disposal process of solid waste from their residents. Waste management presents great deficit, as about 30% of the rubbish is left on streets and more than 50% does not reach a sanitary landfill, which is a space for safe final disposal.

Source: MINAM

The majority of municipalities have been disposing the district garbage in unauthorized places. Hospital waste has been detected in them and 75% of the municipalities do not have a plan for garbage collection routes and others do not follow their solid waste management plans. What is more, 31% of municipalities do not provide safety equipment to waste collectors¹⁸.

Waste picker associations play a key role in the collection of the valuable part of waste; small-scale waste pickers operate as collectors. The Ministry of Environment seeks to support them in forming larger associations to integrate them into value chains¹⁹. Larger recyclers help to reintegrate waste into the market as an input into other processes; they are key players since they help making the recycling value chain to work.

According to the Ministry of Environment, in September 2021 there were 64 landfills (7 in Ayacucho, 6 in Lima, 5 in Amazonas), 7 landfills with safety cells (repository designed to contain substances potentially hazardous to human health and the environment)²⁰, 3 of which are located in Lima²¹.

The amount of municipal solid waste disposed in sanitary landfills grew from 3.4 million tonnes in 2014 to 3.7 in 2018, an increase of 9%²². It must be noted that according to the Ministry of Environment, Arequipa, Madre de Dios, Moquegua and Tacna departments do not have sanitary landfills²³.

Public investment in solid waste treatment projects increased significantly (+180%) between 2012 (114 million soles) and 2018 (320 million soles)²⁴.

¹⁷ Available on line: www.wwf.org.pe/?uNewsID=328101

¹⁸ Available on line: <https://blogposgrado.ucontinental.edu.pe/como-se-manegan-los-residuos-solidos-en-el-peru>

¹⁹ Available on line: www.minam.gob.pe/gestion-de-residuos-solidos/nueva-ley-de-residuos-solidos/

²⁰ The difference with a sanitary landfill lies in the drainage system and the number of layers of geomembranes applied of regulated thickness. Safety landfills are usually rectangular cube-shaped and have access for heavy vehicles into the interior. The waste is distributed by being separated by cells according to their chemical compatibility. Available on line: www.towerandtower.com.pe/diferencias-entre-relleno-de-seguridad-y-relleno-sanitario/

²¹ Available on line: www.gob.pe/institucion/minam/informes-publicaciones/279709-listado-de-rellenos-sanitarios-a-nivel-nacional

²² Available on line: <https://sinia.minam.gob.pe/informacion/estadisticas>

²³ Available on line: www.gob.pe/institucion/minam/informes-publicaciones/279709-listado-de-rellenos-sanitarios-a-nivel-nacional

²⁴ Available on line: <https://sinia.minam.gob.pe/informacion/estadisticas>

Regarding solid waste, 61% of the collectors for Waste from Electrical and Electronic Equipment (WEEE) are located in Lima (there are 157 in Peru), followed by La Libertad with 9 collection centres, Arequipa (8), Piura (6), Ancash and Cusco (5)²⁵.

In 2017, only 22% of municipalities disposed solid waste in landfills, 79% in dumps, 28% did some recycling and 14% buried it. It must be pointed out that the expenditure for municipal solid waste management in Peru has increased by 1,595% between 2012 (99 million soles) and 2018 (1,671 million soles).

Source: National environmental information system (SINIA)

Over the last years, production and consumption have increased significantly, and therefore, generation of waste²⁶.

The Peruvian government is fully aware of the problems raised by waste management. Commitments were made during the past years to improve the situation to set up an adequate waste management system. It will be facilitated by introducing environmental tools and technologies that are proven to work in developed countries. Peruvian authorities must make important efforts to realize an adequate and sustainable waste management system²⁷.

3.5.5. Sustainable mobility and energy efficiency

a) Sustainable mobility

Over the past decades, the significant growth of the Peruvian economy has led to a steady increase in the vehicle fleet from 1.5 million (2007) to 2.9 million (2018). According to the Ministry of Transport and Communications (MTC), in 2018, Lima and Callao had the largest number of vehicles (65.9%) followed by Arequipa (7.3%) and La Libertad (7%).

In 2016, GHG emissions from transport were 21,041.94 GgCO₂eq, representing 10.3% of total emissions nationwide. The main source of emissions is land transportation (91.7%) followed by civil aviation (5.2%). The remaining categories (railroads, maritime and river navigation and others transports) contribute for 3.1%.

The use of fossil fuels by public transportation has a major impact on pollution in Peru; the death of 14 people per 100 000 inhabitants is due to environmental pollution²⁸.

According to the "Air Quality Life Index" of 2019, or AQLI²⁹ of the Energy Policy Institute of the University of Chicago,

Lima is one of the cities with the worst air quality on the continent reducing life expectancy by 4.7 years. The main cause of pollution is vehicles that consume fossil fuels.

Air Quality Life Index" of the Energy Policy Institute of the University of Chicago.

²⁵ Available on line: www.gob.pe/institucion/minam/campa%C3%B1as/133-manejo-de-residuos-de-aparatos-electricos-y-electronicos

²⁶ Available on line: www.mastercardcenter.org/content/dam/mc-cig/uploads/Inclusive-Waste-Mgmt-in-Peru-March-2018.pdf

²⁷ Available on line: <https://repositorio.unican.es/xmlui/bitstream/handle/10902/15350/EnvironmentalPerformanceofPeruvian.pdf?sequence=1&isAllowed=y>

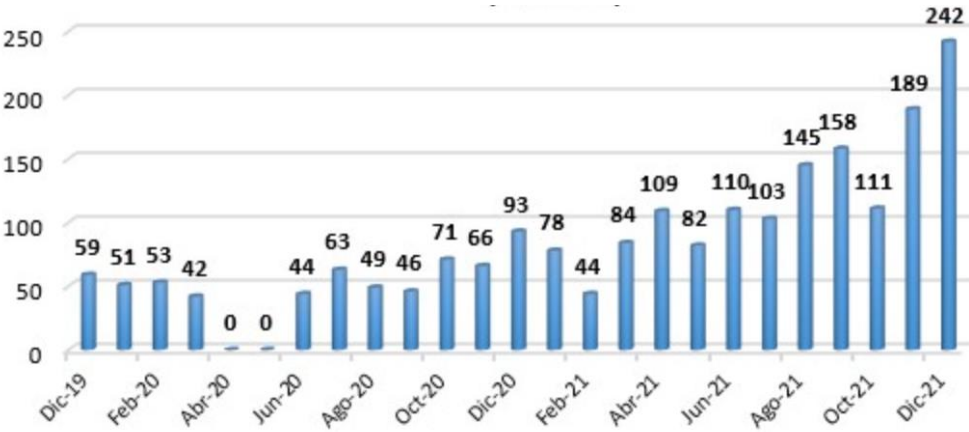
²⁸ Source: Report presented by the WHO in 2016, called "Ambient Air Pollution: A global Assessment of exposure and burden of disease. Available on line: <https://apps.who.int/iris/bitstream/handle/10665/250141/9789241511353-eng.pdf?sequence=1&isAllowed=y>

²⁹ Available on line: <https://aqli.epic.uchicago.edu/the-index/>

An important regional summit on cleaner and more efficient fuels and vehicles for Latin America was held in Lima in May 2019. Jorge Alvarez (UNDP Environmental Sustainability Officer) stated that "If only 5% of the total fleet of used cab cars were changed, approximately 100,000 tons of CO2 could be reduced, a figure with great impact in a city like Lima where 70% of air pollution comes from the vehicle fleet"³⁰.

Sustainable transport is key to protecting the health of millions of people, as well as being fundamental to climate action. According to the Peruvian Automotive Association³¹, in 2021, 1,455 eco-friendly vehicles were sold -including hybrids and electric vehicles-, which was 151.7% more than in 2020. The most sold eco-friendly vehicles in 2021 were conventional hybrids or HEV (Hybrid Electric Vehicle; 1,364 units), followed by plug-in hybrids or PHEV (Plug-in Hybrid Electric Vehicle; 58 units) and pure electric or BEV (Battery Electric Vehicle; only 33 units).

Figure 7. Sales of hybrid and electric vehicles Dec. 2019 - Dec 2021
(Units)



Source: Peruvian Automotive Association

The development of the electric car market is a source of new job opportunities with the setting of recharging stations. Presently, there are around 50 electric charging stations in operation in 17 departments, Lima being the city with the largest number (around 30 stations).

3.5.6. Renewable energies³²

Peru is traditionally low-carbon electricity generation country due to the importance of hydroelectric power. Electricity production has grown at an annual rate of 7% over the last 21 years (12 170 GWh to 50 817 GWh between 1997 and 2018). The Camisea Project (2004) has contributed to increase electricity production with natural gas. Its share was then reduced by the introduction renewable energy resources (RER) plants, which have reached a 7.2% share in 2018.

³⁰ Available on line: www.pe.undp.org/content/peru/es/home/presscenter/articles/2019/peru-avanza-hacia-un-transporte-mas-limpio.html
³¹ Available on line: <https://aap.org.pe/sunarp-vehiculos-electricos-elecromovilidad-ventas-record-aap/>
³²The information in this section has been sourced from the document "Energías renovables: experiencia y perspectivas en la ruta del Perú hacia la transición energética" (Renewable energies: experience and perspectives on Peru's path towards energy transition) published by the Energy and Mining Investment Supervisory Agency – Osinermin in 2019. Available on line: www.osinermin.gob.pe/seccion/centro_documental/Institucional/Estudios_Economicos/Libros/Osinermin-Energias-Renovables-Experiencia-Perspectivas.pdf

The installed capacity for RER power plants³³ has grown at an annual rate of 9.3% from 2008 to 2018 with wind power plants having the highest share (2.9%). In 2018, 11 new RER plants entered into operation, especially in solar and mini-hydroelectric plants, which grew from the preceding year by 197% and 59%, respectively.

Current production of RER power plants

a) Solar production

Peru currently has seven solar power plants with photovoltaic technology located in the regions of Arequipa (2), Moquegua (4) and Tacna (1). The largest (Rubí), started commercial operation in 2018 with an installed capacity of 144.5 MW. The plant has the capacity to generate 440 GWh annually, which is equivalent to the consumption of 350,000 Peruvian households, avoiding the annual emission of more than 209 thousand tons of CO².

The main challenges of the solar energy sector in Peru are to provide information and to increase awareness of private companies, SMEs and energy suppliers on the use of renewable energies.

There is still much to be done in this market. The Swiss know-how and international standards with which SOLEOL works are an important advantage. In order to raise awareness among the population, SOLEOL's communication is done through the media and networks

SOLEOL

b) Mini-hydro production

Peru is a traditionally hydroelectric country with 25 mini-hydro plants with a total installed capacity of 298.86 MW in 2018. Seven of them started operations that year (Renovandes H1, HER I, Angel I, II and III, Carhuac and Zaña), increasing the installed capacity by 110.66 MW. In 2018, mini-hydro plants were concentrated in the departments of Lima, Junín and Cajamarca and their electricity production was 1290.9 GWh in 2018.

RER Potential in Peru

The main renewable energy source is hydroelectric energy (69,445 MW) followed by solar energy (25,000 MW). Peru has a large potential for electricity generation with renewable energies, which has been thus far little exploited.

The Inter-American Development Bank (IDB) expects the total installed capacity to reach 24,976.9 MW by 2040, with a share of RER plants of 4,321 MW (17.3% of the total)³⁴. This would require an investment of approximately US\$8.8 billion, which presents a great challenge for regulation authorities and the regulatory framework.

³³ Sum of the energy capacities that can be produced and delivered by each power plant under ideal conditions.

³⁴ Inter-American Development Bank, Elaboration of the new sustainable energy matrix and strategic environmental assessment as planning instruments, Lima.

Table 4. Renewable energy resources: power plant potential

Renewable energy resources	Technical capacity available (MW)	Installed capacity (MW)	Percentage
Total hydraulic	69,445	4,942.40 (*)	7.12%
Wind	20,493	375.46	1.83%
Solar	25,000	285.02	1.14%
Biomass	[450 - 900]	70.90	7.88% (**)
Geothermal	2,859.40	0	0%

Notes. (*) Includes installed capacity of mini-hydro plants.

(**) Estimated value with respect to the upper limit of the usable technical potential.

Sources: Halcrow Group Consortium and OIST (2011), Consorcio Barlovento and Vortex (2016), Minem (2016), Vilcaña (2018), COES (2019) and Elliot (2019). Prepared by: GPAE-Osignermin.

Adapted by: CCSP

a) Solar energy potential

Due to its proximity to the equator, Peru is located in a privileged area for the development of solar energy. In almost the entire Peruvian territory there is excellent energy availability due to its uniformity and abundance throughout the year. According to the World Bank (2019), Arequipa, Moquegua and Tacna departments have the best conditions for photovoltaic and solar thermal technologies. In these three regions, located in the south of the country, the global horizontal irradiation³⁵ belongs to the 6.8 kWh/ m² and 7 kWh/ m² interval, and for normal direct irradiation³⁶ it is in the 7.5 kWh/ m² and 8.5 kWh/ m² interval.

b) Wind energy potential

For the development of both onshore and offshore wind energy, the greatest potential is on the coast, especially in Piura, Lambayeque, La Libertad, Ancash, Ica and Arequipa departments, with average wind speeds of 6 and 12 m/s (at an average wind turbine height of 100 m)³⁷. As for the highlands, the wind speed is between 6 and 9 m/s, with Cajamarca being the most outstanding department as it has a similar potential as the coastal ones. On the other hand, the jungle has a lower potential.

3.5.7. Environmental technology services

Technology is a key element in speeding up processes and increasing productivity. In an increasingly globalized world, the need to have faster and more efficient companies is a basic condition to compete in the market to be profitable and sustainable. The sectors mentioned in this chapter require different types of technological solutions to optimize their processes, reduce manual work and errors.

For example, in many industries it is vital to optimize the resources used during the life cycle of a product, i.e. from the time it enters the market until it leaves it. It is important to use efficiently the resources for the manufacture of goods as well as to manage the waste of the industry. Digitalization and automation can make important contributions.

³⁵ The total amount of shortwave radiation received from a point elevated by a horizontal surface to the ground.

³⁶ The component of solar radiation that directly reaches the surface.

³⁷ Source: 2016 Wind Atlas of Peru

3.5.8. Environmental technology for textiles

The textile and apparel industry (textiles, garment, leather, and footwear) is the third largest non-extractive activity with 6.4% of manufacturing production in 2019³⁸. It generated around 400,000 direct jobs in 2019.

The need to automate processes in the Peruvian textile industry is becoming more and more a necessity to compete internationally as firms use robots in the different production processes.

According to George R. Schofield Bonello (Industrial engineer with more than 65 years of experience in the manufacturing industry, teacher and union leader) if Peruvian companies do not adopt new technologies, they will not be able to compete³⁹; robots are not only needed in the textile industry but must work together with human beings and complement tasks.

In textiles, one of the most complex production stage is dying because a wide variety of dyestuffs and auxiliary agents are used.

Although there is no precise data on the use of water by the Peruvian textile industry in its dyeing and finishing operations, it is estimated that around 100-150 liters are used to process 1 kg of textile material⁴⁰. These facts point to the need to reduce the use of water with more efficient processes.

“The textile sector faces the challenge of being sustainable in the medium and long term, which implies managing its water and carbon footprint, implementing a circular economy, using renewable energies and eco-labels.”

National Society of Industries of Peru

³⁸ Source: Institute of Economic and Social Studies of the National Society of Industries SNI of Peru; available on line: <https://sni.org.pe/wp-content/uploads/2021/03/Presentacion-Textil-y-confecciones-IEES.pdf>

³⁹ Available on line: <https://apttperu.com/la-industria-tiene-que-incorporar-la-automatizacion-por-la-via-de-cobots-y-robots/>

⁴⁰ Available on line: <https://apttperu.com/tenido-disperso-sin-agua/>

4. OPPORTUNITIES AND CHALLENGES

Peru offers great opportunities for Swiss firms in agronomy with meteo analysis, drones to spray crops, animal feed to reduce greenhouse gas emissions and systems to irrigate dry areas with less water, water treatment and purification for consumption as well as water platforms for vegetable production ; in mining to protect against rockslides; in waste management to recycle tyres and efficient plants to segregate material; in renewable energy, to produce solar energy; in mobility, to improve fuel efficiency and introduce electric vehicles. Business faces significant challenges with complex administrative procedures and a climate of political uncertainty with constant changes of ministers.

4.1. Opportunities

This section matches significant issues in Peru with Swiss clean technologies. These technologies are highly specialized. Some have been developed over more than 10 years by SMEs that grow year after year. Some are still at the start-up level.

These technologies could make substantial contributions to alleviating big problems in Peru. Due to the fact that cleantech is still a new area and that these technologies are usually in the hands of a single firm, the identification of business opportunities makes a link between the issues, the technologies and the firms.

This methodology has been chosen because the number of Swiss firms active in the various cleantech areas discussed in this report is limited and because each technology can briefly be presented with its firm in a FACTSHEETS document joined to this report.

4.1.1. Sustainable agriculture

a) Reduction of Greenhouse gas emissions

In agriculture, the main source of emissions is enteric fermentation from cattle, representing 44.2% of total agricultural emissions (See chapter 3, 3.5.1).

Against this background, **Agolin's** technology, for example by improving the digestive function of ruminants, would allow Peruvian dairy farmers to reduce greenhouse gases, while providing cows with an average 4% higher energy yield from feed (For more information, see FACTSHEETS DOCUMENT: 1.1 Agolin).

b) Better planning with Meteo analysis

The analysis of past and future climate is of vital importance in identifying trends under different scenarios. **Meteotest**⁴¹'s services may efficiently contribute to planning agricultural activities. Peru has 38 types of climates, according to the Warren Thornthwaite Climate Classification method, distributed throughout the country according to temperature, precipitation and evapotranspiration, geographical position⁴². This situation requires, among other things, detailed weather forecasts to manage irrigation.

⁴¹ Meteotest is a leading company in weather, climate, environment and computer science. It is characterised by a high customer focus, expertise and technical competence. Information available on line: [We are Meteotest | Meteotest](#)

⁴² Available on line: <https://sinia.minam.gob.pe/inea/wp-content/uploads/2021/07/CAPITULO-2.pdf>

c) Drones to treat crops

The agricultural sector presents different faces and many producers still use inefficient production means, especially in the highlands. Facing an increasing food demand, the need for modern agriculture is becoming urgent, especially to improve the management of resources, to reduce costs and to increase productivity.

For organic farming, drones can be very useful because they incorporate specific software to know exactly what each crop needs (water, nutrients, pesticides...) saving thereby resources and improving productivity⁴³.

PRONATUR use drones to take periodic aerial photographs to see the development and monitor the plantations in order to carry out the correct fertilization and application of pesticides.

Jan Bernhard, CEO Pronatur

Aero41 specialises in crop spraying by drone for farmers and winegrowers. (For more information, see FACTSHEETS DOCUMENT: 1.2 Aero41).

In Peru, there is an attractive market for the Swiss technology in Pisco, where an alcoholic beverage distilled from grapes is produced. In 2021, there were 524 companies in this sector located in Arequipa (58), Ica (237), Lima (199), Moquegua (17), and Tacna (13)⁴⁴.

d) Agrochemical's counterfeit

Counterfeit agrochemicals will not be effective in controlling the pest and also the chemical load and composition may be inadequate, affecting crops and food safety⁴⁵.

To address this issue, the Swiss biotech **Lonza** and the start-up **Authena** have developed one of the first blockchain-based digital technologies in the industry. This provides not only proof of the authenticity of the chemical products being sold, but also full traceability and transparency throughout the value chain. (For more information, see FACTSHEETS DOCUMENT: 1.3 Authena).

Illegal trade in agrochemicals (counterfeit, adulterated and smuggled) is increasing in Peru.

The sale of smuggled agrochemicals alone amounts to US\$10 million.

Cultivida

4.1.2. Sustainable water management

a) Systems to reduce water use for crop irrigation

In Peru, irrigation water efficiency is 35% indicating a significant waste of water. In this context, this report showcases two Swiss companies that provide clean technology solutions that prioritize water efficiency in agriculture.

⁴³ Available on line: www.bbva.com/es/sostenibilidad/drones-los-aliados-de-la-agricultura-de-precision-y-la-industria-alimentaria/

⁴⁴ Source: National Institute for the Defense of Competition and the Protection of Intellectual Property (INDECOPI) Available on line: <https://ogeiee.produce.gob.pe/index.php/en/shortcode/oe-directorio/directorio-productores-pisco>

⁴⁵ Available on line: <https://andina.pe/agencia/noticia-venta-agroquimicos-contrabandeados-alcanza-los-10-millones-peru-822652.aspx>

First, **Aqua4D** offers precision irrigation, saving resources, and pursuing a more regenerative approach to agriculture. AQUA4D® is a clean technology allowing irrigation water savings (~30% average), restoring salt-saturated soils, and saving resources - sustainably and without any chemicals. The technology is efficient, operational, scalable worldwide, and is fully complementary to existing irrigation infrastructure and e-monitoring. The main advantages of using this technology are: water conservation, reducing agricultural CO2 emissions, saving electricity, restoring salinized lands while saving water, reducing chemical use and fertilizers, producing more with less, while improving quality. **Aqua4D** develops presently important projects in Chile. (For more information, see FACTSHEETS DOCUMENT: 2.1 Aqua4D).

Regarding the current situation of the cleantech market in sustainable water management in Peru, there is a lot of expectation in having new technologies, which generate a lot of opportunity.

However, there is a lack of promotion and education on these products. Training is usually provided one-on-one and through field work with demonstrations and adaptations. Companies are curious about new environmental solutions but often do not choose to innovate their processes.

Javier Bustamante, member of ASAP TRADING AGRO

Second, **CleanGreens** focuses its services on small-scale agriculture. It offers a highly productive system (80 kg per square metre compared to three under conventional methods). Using conventional farming methods, one kilo of lettuce requires 250 litres of water to grow to maturity. Grown on CleanGreens's mobile aeroponics platforms, it needs just seven. Furthermore, 10 to 12 harvest cycles can be grown per year in the facility, compared to just one or two out in the field. (For more information, see FACTSHEETS DOCUMENT: 2.2 CleanGreens).

b) Water treatment and purification for consumption

Water quality is also a big issue in Peru (See Chapter 3, 3.5.2)

In this context, **Trunz Water Systems** provides efficient solutions for drinking water supply in challenging applications (such as remote areas, mobile applications, defence and disaster missions). Moreover, Trunz strongly promotes sharing and transfer of knowledge and therefore supports clients with additional services such as engineering support, installation assistance, technical trainings and after-sales support.

Likewise, its ultrafiltration units remove organic contaminants, viruses, bacteria, cysts, etc. down to a size of 0.02 micron without requiring toxic chemical treatment. Raw water is filtered under pressure through a high-technology hollow fibre membrane. This process remains the natural minerals in the water. (For more information, see FACTSHEETS DOCUMENT: 2.4 Trunz).

c) Water and wastewater treatment plants and piping systems

The wastewater situation in Peru is precarious in most departments. It is therefore necessary to introduce more efficient technologies. **WABAG Water Technology** Ltd. is a large supplier of water and wastewater treatment plants in Switzerland. It specializes in the planning and construction of drinking water/wastewater treatment plants at both a national and international level. Its services include planning, design, execution, commissioning, and customer service – for everything from system components through to complete turnkey plants. (For more information, see FACTSHEETS DOCUMENT: 2.5 WABAG Water Technology).

Fimars is specialized in the design, development and manufacture of metering pumps, polymer preparation systems and emulsions. Its diverse fields of application include water and wastewater treatment, through dissection, flocculation, deodorization, pH control, metal removal, dosing of anionic and cationic polymers, sludge treatment and industrial laundries. (For more information, see FACTSHEETS DOCUMENT: 2.3 Fimars Metering Pumps).

AVEHO provides an innovative and environmentally friendly water dispenser. The company has also other products to offer everyone the opportunity to drink pure water in an economic and ecological way. (For more information, see FACTSHEETS DOCUMENT: 2.6 Aveho).

GF Piping Systems aims to improve water quality to reduce its impact on processes and the environment. GF Piping Systems meets these challenges with a comprehensive offering of piping systems, fittings, valves and the ideal joining technology as well as a selection of components optimally matched to automation technology. (For more information, see FACTSHEETS DOCUMENT: 2.7 Georg Fischer).

4.1.3. Sustainable mining, protection from natural disasters

Mining activity in Peru stands out because its production (gold, silver, zinc, copper, lead, iron, tin, molybdenum, etc.) is among the largest in the world and in Latin America.

Faced with the difficulties of carrying out mining activities, adequate safety measures need to have the most sophisticated mechanisms and tools to avoid or mitigate the damage caused by natural disasters that are frequent in Peru.

Rockslides, landslides, alluviums, floods, avalanches and glacial lakes threaten mines, roads and inhabited areas. **Geobruigg's** wire-mesh nets are used to provide protection from avalanches, from rockfalls, land- and mudslides and avalanches. These meshes are also used for safety applications in mining and tunnel construction. They contribute to mitigate the effects of climate change. (For more information, see FACTSHEETS DOCUMENT: 3.1 Geobruigg).

Geotest offers innovative and pragmatic solutions in geology, natural hazards, geotechnics, geophysics, environment, geoinformatics, maintenance of structures as well as measurements and controls. **Geotest** major clients include mining companies. **Geotest** works closely with Geopravent that proposes sensors to detect a variety of natural hazards and algorithms to process data. In case of an event, alerts are automatically triggered - affected people are informed, and roads and highways are closed within seconds. (For more information, see FACTSHEETS DOCUMENT: 3.2 Geotest).

Wyssen Avalanche Control⁴⁶ offers a reliable and effective remote avalanche control system. By 2020, the company will have installed over 550 Wyssen avalanche towers worldwide.

4.1.4. Sustainable waste management and recycling

a) E-waste and recycling facilities

There is currently a deficient management of electronic waste in Peru. In 2019, Peru generated about 204 kt (kilotons) of electronic waste, and collected, recycled and processed only 2.7 kt (2017 data).

⁴⁶ Wyssen became the market leader in Switzerland, Austria and in Norway. Meanwhile, Wyssen Towers protect ski resorts, roads and mines in Canada, USA and Chile too. Available on line: www.wyssenavalanche.com/en/aboutus/

Facing today's e-waste management challenges, **Sofies**⁴⁷ has developed a unique expertise in the waste electrical and electronic equipment (WEEE), household waste and various industrial waste sectors.

WeeeSwiss also provides technological tools to process e-waste as a pioneer of WEEE (Waste Electrical & Environmental Equipment) Recycling Technology. The company transfers operational and market know-how to customers worldwide. WeeeSwiss designs, builds and operates turnkey WEEE Recycling Plants from small to large scale capacities. Its cutting-edge Swiss made designs provide the highest economic output and yields of reclaimable materials. (For more information, see FACTSHEETS DOCUMENT: 4.2 WeeeSwiss Technology).

SELFRAG does not deal with electronic waste. The company has industrialised a process that uses pulses of high-voltage electricity to break down materials into their component parts. It is a disaggregation process to separate waste. Almost 100% of metals and low-polluting construction waste can be reclaimed from slag. (For more information, see FACTSHEETS DOCUMENT: 4.1 Selfrag).

b) System to recycle tires and waste facility

The Environmental Evaluation and Oversight Agency (OEFA)⁴⁸ determined that in 2018 there were around 1585 informal dumps in Peru.

Regarding the final disposal of end-of-life tires, there is no precise information on the amount of waste, but the number of informal dumps provides an idea of the magnitude of the problem.

The technology of **Tyre Recycling Solutions SA** (TRS) could contribute to alleviate this serious problem. TRS recycles tires into a unique specialty chemical – TyreXol™ rubber powders. TRS commercializes the rubber powders in specific market applications. (For more information, see FACTSHEETS DOCUMENT: 4.3 TRS Tyres Recycling Solutions).

The amount of unprocessed waste is also a business opportunity for several companies. For example, **SID** (Société Industrielle de la Doux⁴⁹) designs, manufactures and erects a wide range of machinery and installations for waste treatment and process technologies. SID is today the leading company for the planning and construction of complete shredding installations.

c) Production of biogaz/methanisation

According to MINAM, in 2016, approximately half of the household waste was composed of organic material: food waste, fruit peels, vegetables, etc. **EREP SA**⁵⁰ provides an efficient solution to this environmental problem; organic household waste and paper difficult to recycle are "biodegradable". This company offers a consultancy specialized in the valorisation of organic waste and effluents, with specific expertise in the application of the methanization process and, more specifically, in the production and utilization of biogas.

⁴⁷ Sofies is headquartered in Geneva and specialized in land resource development and Eco Industrial Parks, organisation sustainability, production and value chains, waste management and alternative energy systems. Information available on line: [About - Sofies \(sofiesgroup.com\)](http://www.sofiesgroup.com)

⁴⁸ Available on line: www.oefa.gob.pe/oefa-identifica-1585-botaderos-informales-nivel-nacional/ocac07/

⁴⁹ This company is established in Saint-Sulpice, canton of Neuchâtel. Information available on line : [SID SA - Société Industrielle de la Doux](http://www.sid-sa.ch)

⁵⁰ Erep is an engineering and consulting firm specialized in the valorization of waste and organic effluents, with a specific expertise in the application of the methanization process and more particularly in the production and use of biogas. Information available on line: <https://erep.rwbgroup.ch/>

EREP also accompanies farmers throughout their recycling projects (management of animal manure and vegetable waste) with the following tasks: state of the art and technological development; information and advice to start a project; technical and economic feasibility studies; assistance in setting up a project; carrying out environmental impact studies, etc.

4.1.5. Sustainable mobility and energy efficiency

a) Electric vehicles, engines, cable cars and gas injection system

The use of fossil fuels by public transportation has a major impact on pollution in Peru.

With respect to substituting polluting energies, **Kyburz** supplies Swiss Post with three-wheeled electric delivery vehicles for its entire fleet. The company also offers a lightweight 600 kg electric sports car as well as fleet management software that companies, cities and municipalities can use to manage their vehicle fleets in an energy-efficient and cost-effective way. (For more information, see FACTSHEETS DOCUMENT: 5.1 Kyburz).

To reduce CO₂ emissions, **CombiFuel** has developed a globally unique and patented retrofit system that can reduce up to 80% of emissions and save up to 40% of fuel costs. (For more information, see FACTSHEETS DOCUMENT: 5.4 CombiFuel).

Another company that also specializes in pollution mitigation is **Ganser CRS**, which has developed the Common Rail injection technology. It is an engine-internal measure to reduce the environmental impact in contrast to exhaust after-treatment systems, which are added components on the engine. (For more information, see FACTSHEETS DOCUMENT: 5.5 Ganser).

Another attractive alternative to address CO₂ emissions is provided by the cable cars of **Doppelmayr/Garaventa**⁵¹. To date, the Group has built more than 15,100 installations in 96 countries. The company is well equipped to meet the challenges of traditional and new markets with flexibility, know-how and pioneering spirit. Its installations offer comfort and safety – in summer and winter tourism regions as well as in the urban transit sector. Its material transport systems and ropeways for preventive avalanche blasting offer efficiency and performance.

b) E-charging stations

The development of the electric car market requires recharging stations. Presently, there are around 50 electric charging stations in operation in 17 departments, Lima being the city with the largest number (around 30 stations). This is a very important market niche as it offers the opportunity to establish the necessary business foundations to have a solid position in the market, as this sector will continue to grow very rapidly in the coming years.

Green Motion designs and manufactures electric vehicle charging points, from domestic installations to public charging stations. It has also developed a software platform to manage charging networks which features a charge invoicing system. (For more information, see FACTSHEETS DOCUMENT: 5.2 Green motion).

c) Batteries

The market using electricity as a source of energy is growing. Many companies have shown an interest to develop business in Latin America. For instance, **Libattion**, a young Zurich-based company, focuses on integrating innovative cutting-edge technologies into industrial

⁵¹ Doppelmayr/Garaventa (ropeway engineering) operates production plants as well as sales and service centers in 50 countries worldwide. Information available on line: www.doppelmayr.com

vehicles, electromobility and connectivity to accelerate the global transition to a more sustainable storage technology with new and second life battery products.

Its goals for sustainable business development are: improving circular economy by intelligent production and reuse of lithium batteries; lower cost of service by increased reliability of batteries; lower cost of product by intelligent management of batteries for extended lifecycle and both responsible consumption and production. (For more information, see FACTSHEETS DOCUMENT: 5.3 Libattion).

Another company that also specializes in lithium batteries is **Swiss Battery**⁵². Its high-performance battery materials and chemicals help to improve relevant battery metrics of the industry such as energy density and power density. Its products are designed for batteries which are frequently used in the mobility, transportation sector and in stationary high-power applications.

d) Energy management technology

Energy Vault⁵³ develops sustainable energy storage solutions that are transforming the world's approach to utility-scale energy storage for grid resiliency. Its Energy Management System software and Gravity-based Energy Storage Technology are intended to help utilities, independent power producers and large industrial energy users to significantly reduce energy costs while maintaining power reliability. Energy Vault uses eco-friendly materials with the ability to integrate waste materials for beneficial re-use.

Smart-me⁵⁴ connects to the cloud via Wi-Fi and provides real-time data. The energy measuring devices and their output can be controlled using automated cloud commands. The smart-me energy meters deliver real-time data in order to optimally control, easily bill and optimize the energy.

e) Other solutions for energy efficiency

Brugg Cables advises customers world-wide on new cable systems, as well as on expanding or converting their existing systems. It focuses not only on technical excellence but also on achieving efficiency in operation and upkeep. (For more information, see FACTSHEETS DOCUMENT: 5.6 Brugg Cables).

Sensile Technologies is a forerunner on the Internet of Things (IoT) market. It is a leading provider of solutions for remote monitoring of tanks and meters for the oil & gas industry. Sensile offers optimized logistics and optimized purchases of fuel, gasoline, LPG, and lubricants. It has more than 100,000 systems installed on tanks in over 70 countries. (For more information, see FACTSHEETS DOCUMENT: 5.7 Sensile).

Bathan specializes in ceramic lubricants which reduce wear and minimize downtime. Engines and gears have lower power losses. BATHAN ceramic greases guarantee smooth operation with extended lubrication intervals and ensure sustainability by reducing the quantities used. Bathan has been advising well-known companies worldwide for the use of high-performance lubricating greases and additives, assisting with maintenance planning and, taking care of the

⁵² Swiss Battery® is a new battery manufacturing company located in the northwest of Switzerland developing a green battery technology. Information available on line: www.swissbattery.com/about-swiss-battery-2021-beyond

⁵³ Energy Vault develops sustainable energy storage solutions that are transforming the world's approach to utility-scale energy storage for grid resiliency. Available on line: <https://www.energyvault.com/>

⁵⁴ Smart-me delivers technology for monitoring, controlling, billing and optimising energy. Smart-me energy metering devices combine with cloud platform functions to form a comprehensive energy management system. Available on line: <https://web.smart-me.com/en/about-us-2/>

plant maintenance independent of manufacturer and in original equipment manufacturer (OEM) quality. (For more information, see FACTSHEETS DOCUMENT: 5.8 Bathan).

4.1.6. Renewable energies

The importance of renewable energies has been growing very rapidly in Peru during the last decade. The technology and the expertise of several Swiss companies could respond to very interesting business opportunities.

a) Solar panels

Almost the entire Peruvian territory offers excellent conditions for solar energy. The industry has grown rapidly with big projects.

Soleol is a leader in Switzerland in the realization and operation of photovoltaic solar installations. The services of SOLEOL are aimed at private and industrial customers, farmers, but also at public authorities and all the actors of the real estate sector (architects, management companies, general contractors). SOLEOL has also a subsidiary in Peru with 17 employees and has realized important projects. (For more information, see Chapter 8 and FACTSHEETS DOCUMENT: 6.1 Soleol).

PRONATUR has been using solar panels for more than 30 years to pump water from the subsoil. Its systems do not have energy accumulators; instead, the pumps are designed to operate only during the day.

Jan Bernhard, CEO Pronatur

CleanFizz technology pushes up the dust and sand and moves them off the surface of solar panels. The operation is monitored by built-in sensors which measure the luminosity, humidity, temperature of the surface and other key parameters. Cleaning is fully automatic and triggered by the integrated sensors and artificial intelligence (AI) controllers any time of the day, thus eliminating the need for human intervention. (For more information, see FACTSHEETS DOCUMENT: 6.2 CleanFizz).

It is also possible to install mobile solar panels. **Dhp Technology** has developed a support structure that uses cables to enable the photovoltaic modules to fold out over built surfaces and fold up again when required. This makes it possible for large photovoltaic solar power systems deployed over wastewater treatment tanks to generate maximum outputs ranging from 150 to several thousand kilowatts and then to be safely stowed away whenever operational imperatives or bad weather dictate. The idea of installing photovoltaic modules over the treatment tanks of a wastewater treatment plan is based on the fact that they offer vast surface areas that can be used to generate solar power. The electricity produced can immediately be used locally. (For more information, see FACTSHEETS DOCUMENT: 6.3 Dhp Technology).

b) Contact systems

Studer Innotec develops and manufactures inverters, inverter/chargers and solar controllers. One application is for example a complete solar system combining an inverter with the "solar charge controller" function. Thus, only one device is needed to supply the alternating current and to charge the battery.

Studer Innotec has realized several projects in Peru (For more information, see FACTSHEETS DOCUMENT: 6.4 Studer Innotec).

c) Solar and energy efficiency projects

Peru has a very large potential in renewable energy. In this respect, Switzerland and Peru have signed in 2020 a carbon offset deal. Peru will get finance for carbon sustainable development projects, while Switzerland will get credit for greenhouse gas emissions cuts.

The Swiss firm **Ongresso Energy** has obtained a mandate to identify renewable energy projects in Peru (Firm Energy Program Peru, FEPP). These solar energy and hydropower projects will replace diesel generators in off-grid zones and contribute commercial and industrial off takers with clean energy supply by replacing non-renewable sources.

At this stage, Ongresso Energy works with partners to establish a program for Peru. The calculation models for CO2 emission savings are presently developed by a specialized local partner. In the next phase, the energy projects will be identified with the support of an engineering firm. A tender may take place to raise awareness and interest in the FEPP. For the Swiss payments to take place, the program will have to be approved by the Peruvian and the Swiss government. The investments required will provide numerous opportunities for Swiss suppliers of Cleantech products and services. (For more information, see FACTSHEETS DOCUMENT: 6.5 Ongresso Energy).

4.1.7. Environmental technology services

a) Support for life-cycle projects, digitalization, automation

Aveny GmbH analyses and optimizes the sustainability performance of companies and their products through sustainability consulting (processes, products and services, along the entire value chain); strategy development; environmental management (ISO-compliant); and software (collaborative software to effectively assess the environmental footprint of companies and their products). (For more information, see FACTSHEETS DOCUMENT: 7.1 Aveny).

b) Exploration and validation

Innoveto offers strategic solutions for different types of sectors. It accompanies businesses in the development of innovations. Innoveto has been intensively involved in design thinking and lean start-ups since 2011. (For more information, see FACTSHEETS DOCUMENT: 7.2 Innoveto).

c) Protection solutions and renewable energy

FirstClimate is a service provider of climate protection solutions and renewable energy. It supports private and public sector organizations in achieving their climate and sustainability objectives. Its core competencies cover products and services relating to carbon neutrality, green energy, green investments, and project development. For public sector clients, FirstClimate provides consulting for industry best-practice as well as emissions trading services. (For more information, see FACTSHEETS DOCUMENT: 7.3 FirstClimate).

4.1.8. Environmental technology for textiles

Dyeing of fabrics and yarns is one of the most complex stages in textiles, since a wide variety of dyestuffs and water are used. Including finishing operations, around 100-150 litres of water are used to process 1 kg of textile material.

HeiQ Materials AG has developed the “HeiQ Clean Tech” system, which is used in the dyeing of polyesters. It not only saves time for textile manufacturers, but also reduces their water and

energy consumption by 30% compared to standard processes. HeiQ has supplied the process to customers in countries as far afield as Turkey and China. The innovative technical process earned the company the Environmental Business Award from the Swiss Environmental Foundation in 2019. (For more information, see FACTSHEETS DOCUMENT: 8.1 HEIQ).

We consider that both the buying habit and the consumption habit have changed. The sales channels (online sales) have changed, and on the consumer side, people are looking for sustainable garments for their use.

The group of millennials is concerned, primarily, about the sustainability in their garments, rather than the price or quality of the product. In Peru, they represent 50% of consumption today.

Faced with this demand, we have improved our production processes. For example, 50% of energy comes from our solar park, while 40% of the water is reprocessed with a microfiltration and reverse osmosis plant. We also use nitrogen in the dyeing process – in search of consuming less water – and have a recycling plant to reuse the fabric balances.

Juan José Córdova, General Manager, Textil del Valle

El Comercio, Lima, May 20, 2020

4.2. Challenges to do business in Peru

Peru offers a framework for trade and investment characterized by administrative procedures often somewhat complex. According to the World Bank's 2020 "Doing Business" report⁵⁵, Peru ranks 76th overall. Economic actors face some important challenges in doing business.

- Starting a business is a bureaucratic process (133th rank). It takes around 24 days and eight procedures to set up a business. The heaviest procedures are the deed of incorporation before a notary public and filing it online with the Public Registry (SUNARP), which takes 8 days, and obtaining a technical inspection of building safety (ITSE) and the operating license (15 days). If the shareholders are from abroad, the incorporation process usually takes much more time.
- Peru ranks 121st for paying taxes. It involves eight payments per year and 260 hours. Profit (22.7%) and labour (11%) taxes are the main ones, with corporate tax at 29.5%. An 18% value-added tax (VAT) is added to most goods for sale, particularly imported items.
- Trading across borders is a slow and expensive process (102th rank). The time required for border compliance is 72 hours with a cost of US\$700 and 48 hours with a cost of 80 dollars for documentary compliance.

Macroeconomic soundness is one of Peru's strength with a rigorous monetary and fiscal policy over many years. This has contributed to achieving one of the highest growth rates and lowest inflation in Latin America during the past decade. However, the current political situation, characterized, among other things, by constant changes of ministers, has generated uncertainty for business. This political landscape embodies risks that may discourage investment and business, slowing down the growth of the economy.

⁵⁵ Doing Business 2020 is the 17th in a series of annual studies investigating the regulations that enhance business activity and those that constrain it. Doing Business presents quantitative indicators on business regulations and the protection of property rights that can be compared across 190 economies. Available on line: <https://espanol.doingbusiness.org/content/dam/doingBusiness/country/p/peru/PER.pdf>

In Peru, corruption is a very big issue. The most famous case involves a large Brazilian construction company, which admitted paying bribes in various Latin American countries, including Peru. Peruvian legislation recognizes the corporate criminal liability applicable to bribes, so companies need to maintain open, honest and compliant business practices which are fully transparent with the law.

“Foreign firms are being forced to forego important business opportunities because they refuse to make illicit payments to officials of public institutions”.

5. CONCLUSION / CALL-FOR-ACTION

1. Switzerland has a growing Cleantech sector with a significant innovative capacity.
2. Most firms are fairly young small- and medium-sized enterprises (SMEs) working closely with universities and research centers in niche products and seeking foreign markets for expansion.
3. Peru's needs in Cleantech technologies will grow exponentially over the coming years to meet big challenges associated with climate change, pollution, energy, waste and water.
4. Swiss SMEs are well positioned in all these areas with high-quality, highly-performing and reliable Cleantech products and services.
5. Despite a difficult administrative environment and political instability, Peru should continue to belong to the leading Latin American countries in terms of economic growth with a strong commodity sector and a growing agricultural export sector.
6. Peru's major strength will remain a strong macroeconomic framework with low public deficits, low inflation, balanced foreign accounts, no restrictions on currency convertibility and a fairly stable exchange rate: these are essential for foreign producers' and foreign investors' confidence.
7. Peru's regulatory framework for Cleantech products and services will have to be further developed in several areas to promote the transition toward these technologies.
8. Major efforts will be required for waste management, water, renewable energies and pollution. The introduction of favourable tax regimes and the implementation of efficient resale of unused solar energy should be envisaged.
9. Market entry will continue to require major efforts to overcome procedural barriers, understand local culture and choose the best local partners.
10. The Swiss economic development cooperation in Peru should strengthen its programs addressing Cleantech issues with the participation of Swiss SMEs and the Swiss Chamber of Commerce in Peru should further investigate market conditions entry for the most promising Swiss technologies in close contacts with Swiss SMEs.

Call-for-action

The Swiss Chamber of Commerce in Peru, with 69 years of professional experience and with 150 partners in different business sectors, is an excellent ally in entering the Peruvian market.

With the elaboration of this report, the Chamber of Commerce has developed an exclusive expertise in the Cleantech field for the benefit of Swiss companies.

Swiss firms have a strong reputation and a lot to offer. They should rapidly increase their presence or establish it in Peru, a market for the future!

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