

# PLANET

#December 2019



## This mortal soil: remediation and conservation

### **Forum**

Soil remediation: an issue for feeding the planet and addressing climate change

### **Frontline**

Remediating highly sought-after brownfields

### **Outfront**

Reconquering land

### **Explainer**

When soil changes use...

TABLE OF CONTENTS  
**DECEMBER 2019**

**03 THE POST**

by Antoine Frérot

**04 CONTRIBUTORS**

Sandra Vedel, Eduardo Mansur, Jean-François Soussana, Stéphane Le Foll

**06 TRENDS/INSIDE/ DATAVIZ**

The news in brief.  
 An infographic: Land-use key

**12 FORUM**

Antoine Frérot and Eduardo Mansur  
 Soil remediation: an issue for feeding the planet and addressing climate change

**16 #WEARERESOURCERS**

Nick Morgan, Maeleenn Poitrenaud

**20 FRONTLINE**

**WORLD** Carbon: the new "soil capital" asset  
**CANADA** Toronto: The pellet that takes nutrients from the WWTP to the field  
**FRANCE** Remediating highly sought-after brownfields

**32 GALLERY**

Juan Manuel Castro Prieto, Ethiopia: Of trees and men

**40 OUTFRONT**

Reconquering land

**47 COMMUNITY**

Restoring biodiversity: for Sinopec, Veolia makes the ecological and the petrochemical go hand in hand

**48 EXPLAINER**

When soil changes use...

**50 FUTURIST**

Aquaponics: a budding solution to feed cities

Cover photo: Getty Images/Moment RF

# THE POST



**Antoine Frérot**  
 Chairman and CEO  
 of Veolia

## August 23, 2019

### Signature of the B4IG pact to combat inequality

Veolia has gone one step further in the fight against inequality, joining the G7 "Business for Inclusive Growth" coalition. This initiative, coordinated by the OECD, aims to reinforce the efforts made by private companies to encourage inclusive growth and equal opportunity, reduce gender inequality and regional disparities, and create synergies with the public authorities. B4IG brings together 34 major international companies, including Veolia. They employ over 3.5 million people and last year generated a combined revenue of over 1,000 billion dollars. By pooling their resources, these companies are going to invest over a billion dollars in some fifty projects to the benefit of 100 million people. You can recognize trailblazing companies by their ability to pursue both ambitious economic and social goals: for Veolia, it is clear that a company aims for many targets through its activity and that its performance must be appraised in all these areas.

## September 18, 2019

### Veolia and Le Raincy working for clean air in schools

On September 18, Veolia and the town of Le Raincy launched an innovative operation intended to make Le Raincy the first town in France to guarantee 100% clean air inside its schools. Children are more sensitive to air pollution than adults, because their bodies have not yet reached maturity and they are therefore more vulnerable to chemical and biological aggressors, but also because they breathe faster than adults and thus inhale more pollutants. Poor air quality has an impact on their health, as well as their ability to learn and memorize. Hence the importance of addressing as a priority the indoor air quality of enclosed spaces where young people

are present, such as schools. In La Fontaine and Fougères schools in Le Raincy, sensors were fitted to monitor indoor air quality in real time: they measure the temperature, humidity, CO<sub>2</sub>, volatile organic compounds, and particulates. Solutions were then implemented to renew and treat the air inside classrooms. The right to breathe healthy air must become a reality for all, starting with schoolchildren. When you purify air in schools, you protect children's future. With the "Dans mon école, c'est le Bon Air" ["My school's a breath of fresh air"] operation, we are preparing the know-how the 21st century needs, convinced that today's innovation will become tomorrow's standard.

## October 23 & 24, 2019

### Ocean protection, a major issue

Covering 70% of the earth's surface, the oceans remain unknown. However, they are the planet's main carbon sink, making it possible to reduce the rise in temperature up to now. It is therefore satisfying that the Intergovernmental Panel on Climate Change (IPCC) identified the oceans as a major climate change issue during the Our Ocean conference held on October 23 and 24 in Oslo. This is a great acknowledgement of the work of the Ocean and Climate information platform, which has helped raise awareness among decision-makers and deepen scientific knowledge about the complex interactions between the oceans and climate. Veolia has been supporting this platform through its Foundation since 2014. Over and above this major theme, our Group helps protect oceans by decontaminating wastewater from cities and industry before it is discharged into the sea and treating their waste, especially plastic. Sea water quality is the ultimate test of the effectiveness of the environmental policies put in place across continents.

## CONTRIBUTORS



### Editor-in-chief Sandra Vedel

Communication Director, SARPI

While preserving resources such as air and water is now part of our shared language, soils do not seem to have benefited from the same degree of vigilance. Yet, since the last century, human activities have had a particularly destructive effect on this extremely vulnerable resource.

Soil is the skin of our planet: it is nourished by the four elements. It is fragile and can deteriorate in just a few seasons, while it takes over 20,000 years to be replenished. Within the space of 40 years, human activity has increased soil erosion fivefold, jeopardizing soil's essential function — feeding us. In 2050, the global population is set to reach nine billion, whereas soils will not be able to give more than the riches they contain.

All the same, innovative methods and techniques are making it possible to clean up run-down areas, nourish and regenerate soils, and move toward sustainable land management. This issue of Planet is dedicated to this very subject. Offering expert points of view and highlighting specific solutions and know-how developed by Veolia, it confirms that answers currently do exist to ensure our future survival.

I wish to warmly thank all those involved in putting this magazine together.

### Also in this issue

#### Eduardo Mansur

Director of the Land and Water Division, Food and Agriculture Organization of the United Nations (FAO)

Having joined the FAO in 1984, his long career path has led him to steer financial strategies and mechanisms for sustainably managing natural resources. Since 2012, as Director for the Forest Assessment, Management and Conservation Division (FOM), then at the head of the Land and Water Division, he has been helping countries guarantee sustainable food and agriculture. To make the planet's food and farming systems more resilient in the face of climate change effects, he particularly champions the importance of restoring degraded land and making farmers part of the climate solution.



#### Jean-François Soussana

Research Director and Vice-President for international policy, French National Institute for Agricultural Research (INRA)

Jean-François Soussana holds a PhD in plant physiology and is a renowned expert on grassland ecology and carbon and nitrogen cycles associated with climate change. He is co-president of the Global Research Alliance on Agricultural Greenhouse Gases (GRA), a member of the steering committee of the Climate Knowledge and Innovation Community (Climate KIC) established by the European Institute for Technology, and a member of the Scientific and Technical Committee of the Lima-Paris initiative "4 per 1000." In 1998, he joined the IPCC (Intergovernmental Panel on Climate Change), where he was the lead author for the third, fourth and fifth assessment reports and one of the 107 contributors to the recent "Climate Change and Land" report, published in August 2019.



#### Stéphane Le Foll

Mayor of Le Mans, President of Le Mans Metropolis urban community (France)

A pupil and then an economics teacher in an agricultural college before later becoming the French Minister of Agriculture, Agrifood and Forestry from 2012 to 2017, Stéphane Le Foll remains attached to a development model that meets the needs of the present without compromising the ability of future generations to meet their own needs. The author in 2010 of a report on agriculture and climate change during his term of office as an MEP, today he is continuing this fight in his constituency, where he is promoting the town's urban appeal and encouraging its internal development by reclaiming derelict or underutilized spaces in order to better preserve agricultural land.



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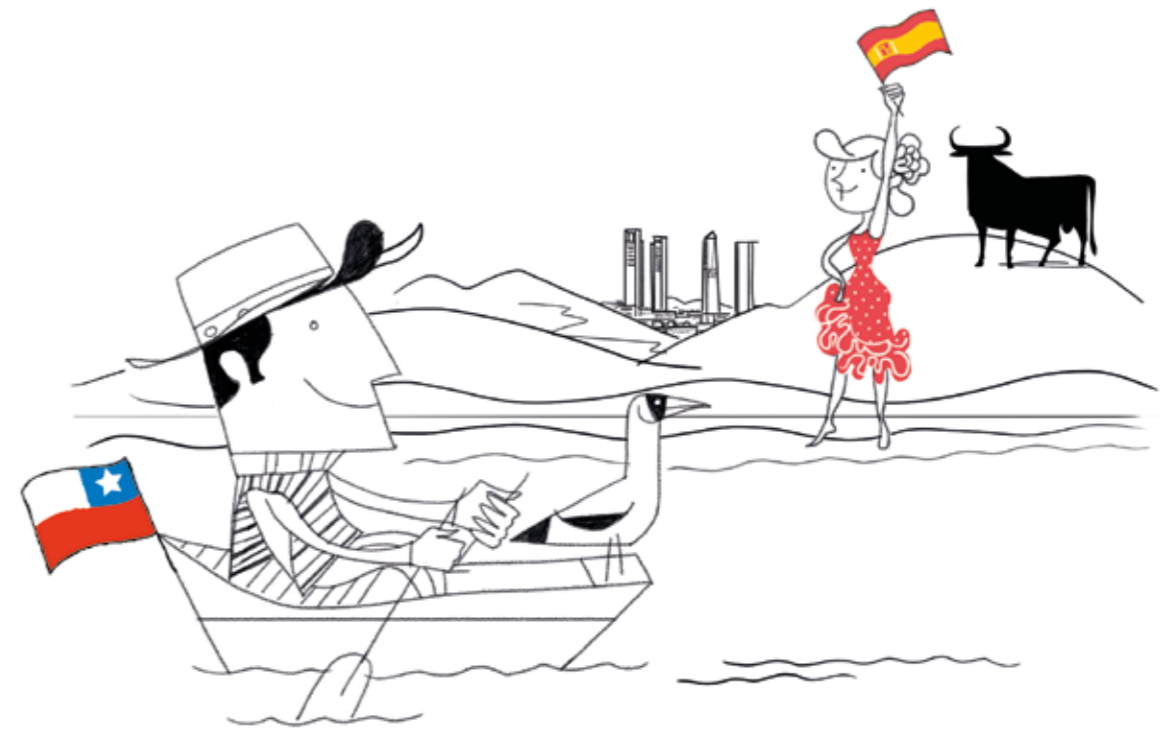
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DECEMBER 2-13, 2019, MADRID (SPAIN)

event

## COP25 RELOCATED THE CLIMATE CONFERENCE COMES TO SPAIN

SPAIN IS TAKING UP THE CHALLENGE OF REORGANIZING THIS MAJOR ANNUAL CLIMATE CHANGE EVENT, INITIALLY SCHEDULED IN SANTIAGO, CHILE, IN JUST FOUR WEEKS. HOWEVER, THE SPANISH GOVERNMENT HAS SUGGESTED THAT CHILE CONTINUE TO CHAIR THE CONFERENCE. A STRONG SYMBOL OF COUNTRIES' ABILITY TO WORK TOGETHER TO RAISE THEIR COMMITMENTS IN 2020 AND MEET THE GOALS OF THE PARIS AGREEMENT.



[HTTPS://UNFCCC.INT/COP25](https://unfccc.int/cop25)

# TRENDS



## In 2100, the largest megalopolis will be in Africa

In the 16th century, there were no cities with over a million inhabitants. Two centuries later, Beijing was the first to reach a million. Then came London and Paris around 1830, with the rapid industrialization of Europe. New York took the lead in the 1930s, reaching the threshold of 10 million residents ten years later. On the whole, cities in the West (the Americas and Europe) held the top positions when it came to the densest megalopolises, apart from Tokyo, which singlehandedly continued to head the field. However, from the 1970s, Asia gained rapid ground with India (Calcutta, Mumbai/formerly Bombay) and South Korea (Seoul) and has continued its demographic development ever since: in the 2000s, Delhi, Shanghai, Beijing and Dhaka passed the 15 million inhabitants mark.

In 2018, Tokyo remained at the top of the list with almost 40 million inhabitants. Delhi, in second position, only counts 28 million, but the Indian capital is set to become the leading global metropolis in 2035 with 43 million inhabitants. However, according to researchers from the Global Cities Institute (GCI), Africa will play a leading role... in 2100. According to the GCI's estimates, Lagos (Nigeria) will become the world's largest city, approaching 100 million inhabitants.

Source: *Futuribles, les mégapoles en 2100*, Julien Damon, Sept. 2019

## Urban agriculture takes off

800 million people worldwide<sup>1</sup> now practice urban agriculture. An increasing number of citizens are thus going to greener pastures... not far from city centers, where there is perhaps a thriving community vegetable garden or even an urban farm — animals included — ultra-connected or otherwise! In the past 20 years, urban agriculture has become a serious business: in France, the number of professional establishments<sup>2</sup> rose from 6 to over 300 between 2013 and 2019. In the United States, their number has grown by over 30% in 30 years<sup>3</sup>. Japan is home to over 300, and in Cuba 50% of the island's fresh produce comes from urban farms.

Urban food production methods vary widely. Yves Christol, CEO of InVivo Food & Tech (of which Veolia is a partner), has explored the question and distinguished several models. "Northern European countries favor interiors with electronically controlled climates, without pesticides but also without direct soil or sunlight. In Singapore, high-tech urban agriculture above all looks to ensure the city-state's food autonomy. The American model ranges from vertical aquaponics farms<sup>4</sup> in New York and Chicago to Californian farms whose priority is to ensure the population's food security, given the risks of desertification that the state could be facing in the next 15 to 20 years," analyzes Yves Christol. Last but not least, in Paris, a 14,000-m<sup>2</sup> urban farm will open its doors in 2020 on the roof of the capital's Parc des Expositions convention center. It will be the largest ever designed in Europe to date.

1. *Urban agriculture*, FAO <http://www.fao.org/urban-agriculture/en/>

2. *L'agriculture urbaine : un outil déterminant pour des villes durables*, Pascal Mayol and Étienne Gangneron, CESE, June 2019

3. *How urban agriculture can improve food security in US cities*, Miguel Altieri, The Conversation. Feb. 2019

4. Aquaponics combines fish breeding with plant growing in a closed circuit



## Forest restoration

### Taking up the forest management challenge

2019 has been a dark year for forests: in the Brazilian Amazon, over 45,000 deliberate outbreaks of fire have been officially recorded since January (a 222% increase compared to 2018); in Indonesia, 328,000 hectares of forest have burned down, primarily due to a particularly long and intense dry season. Nonetheless, these concerning figures should not detract from the initiatives taken worldwide over the past several years to restore forests (discover, for example, the Green Legacy initiative in Ethiopia in Gallery, page 34). Those most cited at the 14<sup>th</sup> session of the Forum on Forests, organized by the United Nations in May 2019, include:

- In Canada, the "Indigenous Guardians Program," created by the government, encourages traditional forest restoration practices.
- In India, 120 joint forest management committees involve indigenous communities.
- In Brazil, an alliance of Brazilian forestry producers Indústria Brasileira de Árvores (IBA) has planted eight million hectares of forests since it was founded (2014).
- Worldwide, the Programme for the Endorsement of Forest Certification (PEFC) has to date certified 313 million hectares of forests, involving 20,000 companies in 71 countries.

## Low-carbon building materials for a greener approach

Reducing the carbon footprint of building materials is a must. Starting with concrete, with its 33 million metric tons produced each year worldwide. Its main ingredient, cement, is singlehandedly responsible for 5% of global CO<sub>2</sub> emissions! New less energy-consuming — and therefore less CO<sub>2</sub>-emitting — recipes are appearing. Such as the cement designed by Solidia Technologies in the USA, which uses an ingenious chemical process to lower the carbon footprint required for its production by 30%. Better still, when it hardens it absorbs atmospheric carbon, reducing its carbon footprint by a further 70%, i.e. avoiding 1.5 Gt of CO<sub>2</sub> emissions per m<sup>3</sup>, according to the manufacturer. Other ideas and materials are emerging. Ultra-light inflated steel metal structures, invented by two young researchers from the Swiss Federal Institute of Technology ETH in Zurich<sup>1</sup>, save on raw material while guaranteeing rock-solid durability. Rigid PET plastic materials used specially for construction needs, designed by a Belgian firm<sup>2</sup>, can now be fully recycled, while the norm remains 20% on average to date. Taking a more futuristic approach, a team from MIT (Massachusetts Institute of Technology) and the University of California<sup>3</sup> has developed a bio-inspired concept of a revolutionary plastic product capable of absorbing CO<sub>2</sub> just like plants! Even more astonishing, researchers from Northwestern Polytechnic University (Illinois, USA) have created a building biomaterial that has the threefold ability to grow by replicating its "DNA," then harden as it grows, thus optimizing the energy needed to produce it<sup>4</sup>. If need be, it can even return to its initial state!

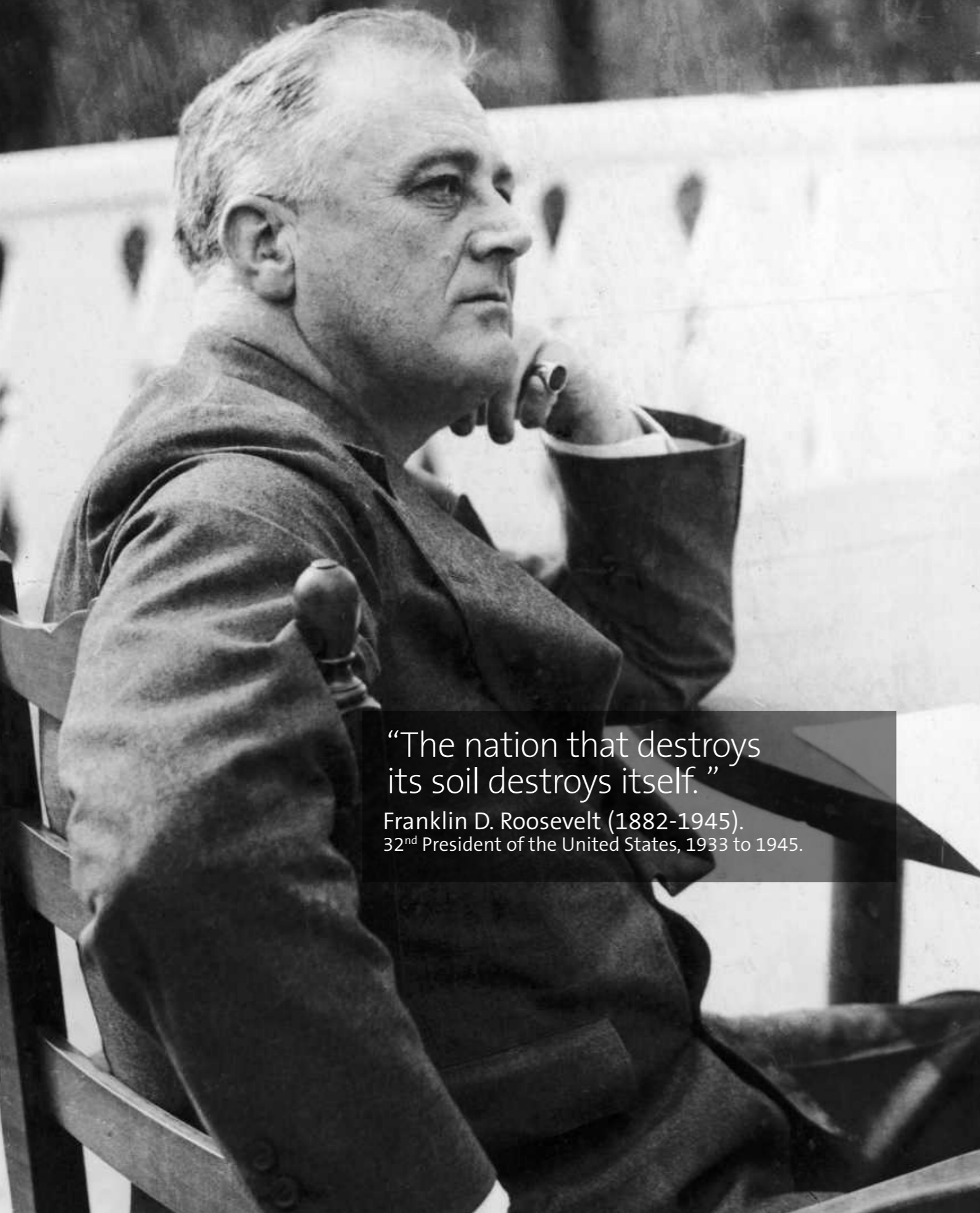
Source: Material Trends to Watch in 2019

1. Philipp Dohmen and Oskar Zieta, ETH Zurich

2. Armacell Benelux

3. The chemist Michael Strano, University of California (Riverside) with MIT (Cambridge, USA)

4. Self-Assembling Material concept



“The nation that destroys its soil destroys itself.”  
 Franklin D. Roosevelt (1882-1945).  
 32<sup>nd</sup> President of the United States, 1933 to 1945.

# INSIDE

## THE FIRST NUCLEAR POWER PLANT IN THE ARAB WORLD RELIES ON VEOLIA'S EXPERTISE

Commissioned by the public authorities for the operation and maintenance of Barakah nuclear power plant in the United Arab Emirates, Nawah Energy Company has entrusted Veolia with managing the site's non-radioactive solid waste and hazardous waste for four years. The Group will supply all the equipment and personnel required for the reception, sampling, sorting, storage, packaging, transport and disposal of waste, in strict compliance with the regulatory provisions and in line with the recommendations and instructions provided by Nawah.

## BORDEAUX METROPOLIS (FRANCE) OPTIMIZES ITS WASTE MANAGEMENT

As part of its 2016-2020 waste plan, the Metropolis is planning to limit waste growth to 24% between 2011 and 2030, whereas the population is set to rise 33% over the same period. To help it meet its targets, Veolia will treat the 225,000 metric tons of waste produced each year by the metropolis' 750,000 residents. While paper, cardboard, glass and aluminum are 80 or 90% recycled in France, plastics have plateaued around 25%. As of February 2020, Veolia will run the Bègles energy recovery unit, the Cenon incinerator and the materials recovery facility. The Bègles materials recovery facility will be robotized, automated and digitized thanks to three large spider robots with artificial intelligence. By late 2021, this investment will make it possible to respond to the extension of the recycling guidelines to include yoghurt pots, plastic bags and various protective films scheduled for 2022. The heat from the incinerators will be used to heat 34,000 houses and power 100,000 additional households with electricity.



### Telex

Chosen for the third consecutive year in the DJSI indices for companies with the best sustainable development performance, **Veolia is ranked 2<sup>nd</sup>** out of the 41 companies in the Multi and Water Utilities sector.

In its fourteenth year, the Veolia foundation's 2019 Environment Book Award was attributed to Sébastien Bohler for "Le bug humain" ["The Human Bug"] and the youth commendation awarded to Amandine Thomas for "Océans... et comment les sauver" ["Oceans... and how to save them"].

Veolia contributed to the debates at the 12<sup>th</sup> Convergences Forum 2019 on September 5 and 6 in Paris on the theme of "Inequalities, transitions, solutions." The subject of its remarks was the circular economy's "raison d'être" and new forms of cooperation in this area.

### In China, Shaanxi Longmen Coal Chemical Company aims for zero liquid discharge

Two major players in the coking and chemical industry, united in the joint venture Shaanxi Longmen Coal Chemical Company established in Hancheng in Shaanxi province, have entrusted Veolia with building a zero liquid discharge (ZLD) facility adjoining their wastewater treatment plant. The aim is to make the site compliant with increasingly strict environmental requirements, in particular by offering optimal wastewater reuse. The 15-year contract will come into effect after the construction phase.



## IN FRANCE, VEOLIA RESPONDS TO PARENTS' CONCERNS ABOUT AIR QUALITY AT SCHOOL

In an Elabe-Veolia survey, conducted to mark the back-to-school period and French National Air Quality Day on September 18, almost 6 out of 10 parents are concerned about air quality inside schools and day nurseries. According to the WHO, indoor air can be up to eight times more polluted than outdoor air, and air pollution is the fourth largest mortality risk factor worldwide. Breathing quality indoor air is therefore a major health issue. For this reason, Veolia has launched its range of services — Air Control, Air Performance and Air Human — to control the entire air quality chain and involve occupants. The Group has transposed its technologies designed for hospital operating theaters and clean rooms, adapting them to schools. It has also announced a trial in two schools in the town of Le Raincy (France) to provide concrete proof of the effectiveness of the solutions offered.

# INSIDE



## IN THE UNITED ARAB EMIRATES, THE SLUDGE FROM THE AJMAN PLANT PRODUCES BIOGAS

Veolia Ajman Biogas project: ASPCL — a joint venture in which Veolia is a shareholder — is planning to turn the sludge from Ajman’s wastewater plant into energy. To do so, it will use two digesters with a total volume of 14,700 m<sup>3</sup> capable of treating 46 metric tons of dry matter per day. The biogas produced will power the combined heat and power production engines to supply green electricity that should cover around 50% of the site’s power needs, while the heat produced by the engines will be used to heat the digesters. Once the project is finished toward the end of 2020, the new facilities will be run by Veolia until 2034, within the framework of the long-standing joint venture Moalajah, created in 2006 with its Belgian partner Besix.

## IN FRANCE, TRIVALIS CALLS ON VEOLIA’S AGRONOMIC EXPERTISE

Sede\* has been chosen by Trivalis, the Vendée departmental authority for researching and processing household and similar waste, to transport (9,000 metric tons/year) and deliver to agriculture standardized composts from its Saint Christophe le Ligneron and Château d’Olonne mechanical and biological treatment plants. Also keen to improve residents’ peace of mind by reducing the olfactory pollution generated by its sites, Trivalis has entrusted Sede — through its subsidiary Biogaz Klearios — with supplying odor neutralizers to its non-hazardous waste storage facilities, along with an assignment to brainstorm and implement technical solutions for odor treatment.

\* Veolia hub dedicated to agronomics: sewage sludge spreading, composting, anaerobic digestion, organic fertilizers based on fish waste, etc.

### Telex

**In Kuwait, Veolia will treat wastewater from the KIPIC refinery in Al Zour**, one of the largest petrochemical complexes in the world, with a “zero liquid discharge” goal. This seven-year contract is worth €63 M.

**In Egypt**, the Drinking water and wastewater construction authority has awarded Veolia the contract for **building Geziret El Dahab’s drinking water treatment plant**. It is one of the responses to the water tensions encountered in the Giza Governorate.

**Veolia’s R&I** has successfully produced a **100% recycled bio-composite material from ground pulpy residue mixed with recycled PolyPropylene**. After the phase to characterize its technical properties, the value chain for this new recycled material will be defined with the sponsor.

**Jaguar Exploration & Production**, a Mexican hydrocarbon company, has signed a five-year contract with Veolia for the handling, transport and final disposal of solid and liquid waste from PEMEX boreholes in the Tabasco and Tamaulipas region.

**IN THE UNITED STATES, Danone promotes “zero waste to landfill”**  
With Veolia’s help, the Danone plant in Bridgeton, New Jersey, has become the food giant’s first American site to achieve the goal of zero waste to landfill. To meet this target, Danone had to find ways to recover and reuse by-products of the food chain, such as food waste, sewage, packaging residue, and hazardous and non-hazardous waste. Veolia rose to the challenge, providing advice and services to keep over 40 metric tons of waste from landfill in 2019 alone.

## IN GERMANY, VEOLIA WINS BRAUNSCHWEIG’S ENERGY NETWORK CONCESSIONS

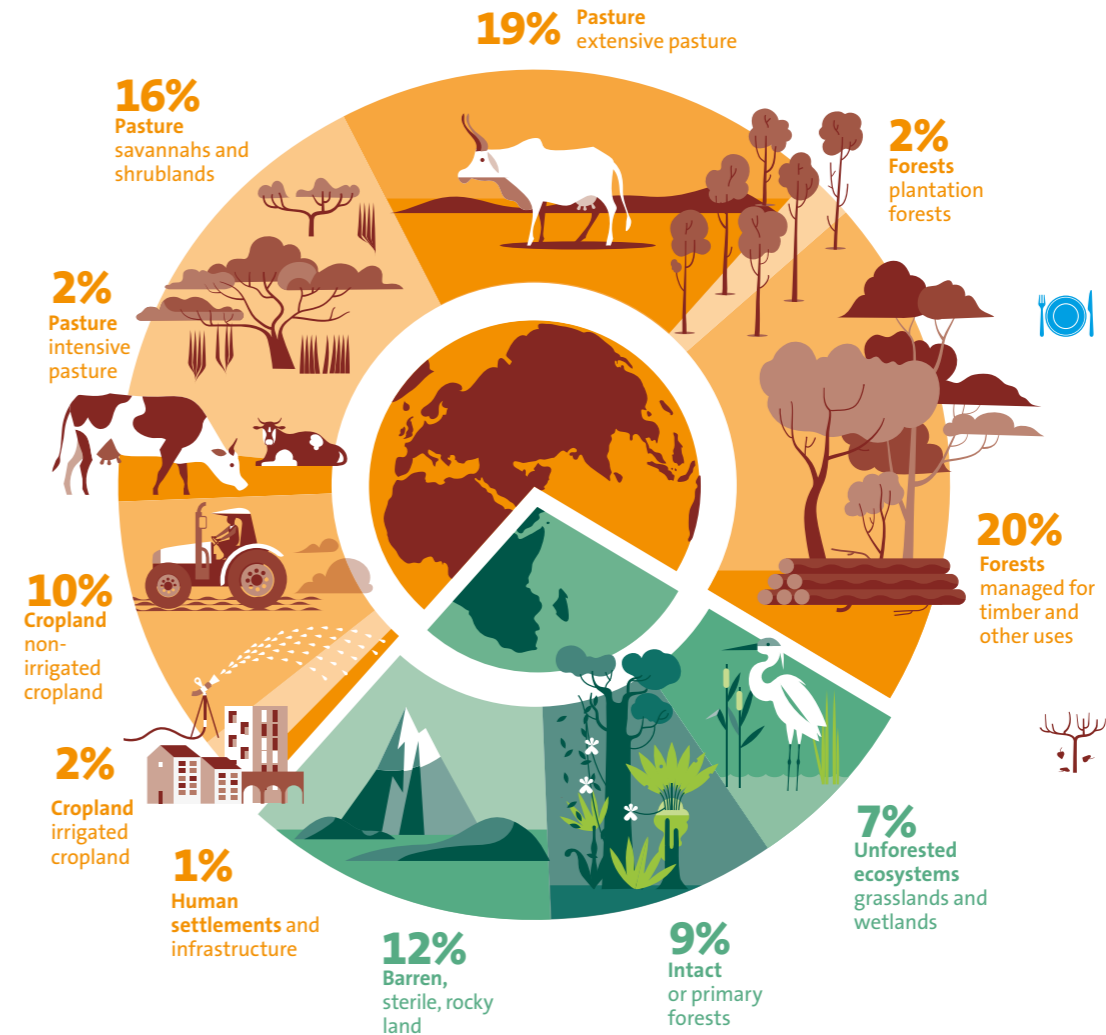
In this country, a real alternative energy laboratory that is aiming for 100% renewable power by 2050, Veolia (via its subsidiary BS|Energy) has been awarded the concessions for the city of Braunschweig’s 2,960-km power grid and 1,140-km gas network for 20 years. The main tasks in this €2.6-billion contract: supplying electricity and gas at affordable rates, and offering high-performance services and high comfort of use, while complying with the strictest environmental standards. This involves modernizing the networks based on decentralized supply and neighborhood systems, incorporating renewable power plants, and implementing a cutting-edge maintenance system including software solutions. In addition, to support urban electric mobility, BS|ENERGY will invest in charging infrastructure over the 2021-2026 period. Finally, by relying on regular audits, BS|Energy will optimize its own energy efficiency. In the long term, it also intends to have an automobile fleet entirely made up of vehicles running on alternative fuel (electricity, gas and hybrids).

# LAND-USE KEY

It’s a first for the IPCC: in their special report\*, the climate experts present all the data regarding the pressure humans put on land. And issue a warning: by over-exhausting resources and exploiting soils and forests too intensively, humans are endangering their ability to cope with global warming, along with their living conditions and livelihood.

## LAND USE WORLDWIDE...

### 72% of land used



### 28% of land unused

## ... AND 3 MAJOR STRESSES

### AGRICULTURAL PRODUCTION

Between 1961 and 2017, total food production (cereal crops) rose by 240% due to the expansion of cultivated areas and an increase in yields. The main corollary over the same period is a leap of almost 800% in the use of inorganic nitrogen as fertilizer. Fiber production (cotton) increased by 162% (until 2013).

### FOOD DEMAND

The increase in agricultural production is linked to changes in food consumption. Between 1961 and 2017, the world’s population increased by 150% and meat consumption more than doubled. This has been accompanied by an almost twofold increase in the prevalence of overweightness and obesity since 1975 (+80%).

### DESERTIFICATION AND LAND DEGRADATION

Land-use change, land-use intensification and climate change have contributed to desertification and land degradation. Between 1961 and 2017, the share of the population living in areas experiencing desertification almost tripled (+200%). At the same time, the surface area occupied by wetlands shrunk to 30% of its 1970 level.

## Outlook

In its conclusion, the IPCC recommends adopting an array of policies targeting the food system, including food waste. These combined policies should bring about more sustainable land management (conservation agriculture, agroecology, agroforestry, permaculture, etc.), improve food security, limit land degradation and desertification, reduce poverty, improve public health, and help reduce greenhouse gases.

\*“Climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems” (August 2019). <https://www.ipcc.ch/report/srcl/>

# Soil remediation: an issue for feeding the planet and addressing climate change

## We meet Eduardo Mansur and Antoine Frérot.



**Eduardo Mansur**  
Director of the Land and Water  
Division, Food and Agriculture  
Organization of the United Nations  
(FAO).



**Antoine Frérot**  
Chairman and CEO  
of Veolia

*In a context of global warming, unprecedented demographic growth, and reduced and impoverished arable land, Humanity will have to meet the twofold challenge of food and housing. Two basic needs that require both restoring soils' health and productivity by implementing sustainable farming practices and organizing urban planning in order to increase cities' density while exploiting their potential in terms of urban agriculture.*

**What solutions could rapidly and lastingly improve and maintain soil quality and availability, which is essential to feed 10 billion people by 2050?**

**Eduardo Mansur:** Due to unsustainable farming practices, lots of soils worldwide have become degraded, seen their productivity drop, and ultimately been abandoned. However, they can be remediated! Provided that there is massive investment, as proposed in our "Voluntary Guidelines for Sustainable Soil Management" report. Adopted in 2017 following an open process by the Global Soil Partnership, it contains ten Guidelines — minimizing soil erosion, salinization, alkalization, contamination, and improving soil water management — which serve as a reference and provide a vast array of engaged stakeholders with general technical and strategic recommendations. Of course, this above all applies to soils currently being farmed using intensive, unsustainable methods.

**Antoine Frérot:** Like other natural resources, soils have become a rare resource. Their degradation has multiple causes and their disappearance is primarily down to urbanization and rising sea levels. 30% of the planet's arable land has disappeared in the space of 40 years. We need measures commensurate to the problems: enriching soils to maintain their fertility, restricting urban sprawl by increasing the density of buildings, developing urban agriculture making it possible to revert artificial land cover into farmland, and using farming methods that protect soils while boosting their productivity, such as permaculture.

**In addition to their degradation, cultivable soils are becoming increasingly scarce due to urban sprawl and infrastructure expansion, a consequence of global demographic pressure. How can this be remedied?**

**E. M.:** Land take due to urbanization represents one of the leading global threats to soil. We find this phenomenon in both developed and developing countries. In most cases, the developments prioritized on the most fertile soil (habitat, industrial infrastructure, etc.) are carried out without taking into account their high value for agriculture. Yet once soil is covered with asphalt or concrete, returning it to its natural state is a challenge. Hence the importance of tools such as land development plans, designed precisely to prevent this problem. Many countries have them, but their implementation has failed for various reasons. Starting with a lack of political will and instruments for compliance with the recommendations for soil management and occupation. However, there are a host of options available to urbanists and town planners, such as reusing already built-up areas (brownfield) or using permeable cover materials instead of concrete and asphalt. In practice, these professionals must be able to weigh up the pros and cons and ensure that the policy tools are in place to obtain the best possible results. Taking account, of course, of both human needs in terms of urbanization and the need to preserve the integrity of the land and its services.

**“Land take due to urbanization represents one of the leading global threats to soil. We find this phenomenon in both developed and developing countries.”**

Eduardo Mansur

...  
**A. F.:** 40% of cultivated land is found in a 20-km radius around cities. While stopping urbanization is unrealistic, we can slow it down or direct it. How? By protecting this farmland in land-use plans against competition from more profitable real estate projects. By making cities and infrastructure more compact. To this end, our Group designs facilities with a small footprint and builds underground infrastructure, such as the wastewater treatment plant in the South of France (Marseille). Another solution consists in reintroducing agriculture into the many unused spaces in a city, such as roofs and basements.

**Can solutions to remediate soils or manage soil scarcity be applied in the same way worldwide? For instance, developed countries have advanced technologies to implement off-ground cultivation, which is not the case in developing countries.**

**E. M.:** Soils naturally differ from one region to another. Their management is directly linked to local farming practices, traditions, the political and institutional framework, and the market forces in effect. Logically, the guidelines and best practices adopted worldwide must be adapted to the local context and environment: know-how, traditional knowledge, resources and technologies, the availability of materials, etc.

**A. F.:** This also applies to urban agriculture. It comes in many forms: outside or inside buildings; horizontal like the community gardens in São Paulo, or vertical like in New York; manual like in Addis Ababa, or automated like in Japan's farming factories; using basic farming methods or ultra-modern technologies that maximize yields and minimize inputs, etc. This wide technological diversity allows every country to promote urban agriculture, irrespective of its level of development.

**Another of soils' benefits is that they are a major potential carbon sink. What role can they play in reducing carbon emissions worldwide?**

**A. F.:** To win the climate battle, we must utilize all carbon sinks. Forests are well known; soils less so. As part of the 4 per 1000 research project conducted by INRA (cf. page 20) in which we are involved, one of our aims is to help farmers manage soils better and increase their ability to trap carbon. Of course, over and above processes designed to capture more CO<sub>2</sub>, it is essential to reduce greenhouse gas emissions at source.

**“To win the climate battle, we must utilize all carbon sinks. Forests are well known; soils less so.”**

Antoine Frérot

**E. M.:** Over and above being an excellent way to mitigate air pollution, carbon storage in soil offers a host of ecological benefits: release of nutrients, water retention, aggregation and absorption of organic and/or inorganic pollutants, etc. Its sequestration also reinforces other ecosystem services derived from soils, such as farming production, drinking water supply and biodiversity, by increasing the amount of organic matter in the soil and thus improving its quality. Through this smart double use of carbon — optimized sequestration in cultivated and degraded soils and a supply of nutrients to soils that are already rich, such as peatlands, black soils, permafrost, etc. — we will meet the challenge of compensating for global emissions.

**Veolia is developing numerous initiatives and experiments allowing both more responsible and more effective use of natural resources and soils. Could you give us a few examples of your solutions?**

**A. F.:** For a long time, we have been providing the farming sector with renewable resources to limit its environmental footprint. As an alternative to highly chemical products, we produce fertilizers using organic waste (cf. page 24) in the North of France (Nord-Pas de Calais region); we recycle wastewater to irrigate food crops in Queensland, Australia, which conserves freshwater resources; we produce green energy for aquaculture in Hamamatsu, Japan. At the same time, our Group has begun to produce animal protein from insect larvae. In France and Malaysia, Veolia is partnering two start-ups specializing in insect farming, which breed fly larvae on biowaste, turning them into oil and flour for fish food.

**How is the FAO encouraging more environmentally friendly practices that guarantee food security, such as agroecology?**

**E. M.:** The FAO does not advocate a single approach but rather diversified practices, which take account of local needs and specific circumstances and encourage complementary food systems. We wish to maintain a leading role in promoting alternative approaches to conventional farming. Agroecology is one such approach and must be promoted on the basis of many successful experiments worldwide. The same applies to forgotten crops (cover crops,



terrace crops, etc.), all of which play a protective role in terms of food security and nutrition and have a low impact on environmental footprint.

**What role can companies specializing in sustainable resource management play in meeting these challenges?**

**E. M.:** The private sector has a very important role to play in terms of agriculture and sustainable soil management. Take the example of the International Code of Conduct for the Use and Management of Fertilizers, recently approved by all FAO member countries. Designed to guide the judicious use of (mineral and organic) fertilizers, it consequently gives a large place to each actor in the sector. If we are able to motivate industry and companies to adopt responsible practices, they will trigger

**FAO** > The aim of the Food and Agriculture Organization of the United Nations (FAO) is to help eliminate food insecurity worldwide. It draws on its skills and experience to support member countries in their fight against the growing challenges in agricultural development. Naturally, soil quality and sustainable farming practices are at the heart of its action. Its Intergovernmental Technical Panel on Soils has identified ten major threats\* to soil that detract from the quality and health of soils, leading to their degradation. These threats are directly linked to human activity, primarily to unsustainable soil management. For example, intensive agriculture, which requires a considerable amount of agrochemicals and heavy equipment. All these factors accelerate pollution, erosion, organic carbon and biodiversity loss, nutrient imbalance, etc., severely reducing soil's capacity to produce food sustainably.

\*Erosion, organic carbon loss, nutrient imbalance, pollution, acidification, salinization, sealing, biodiversity loss, compaction, waterlogging (source: <http://www.fao.org/3/a-i5126f.pdf>)

**“The private sector has a very important role to play in terms of agriculture and sustainable soil management.”**

Eduardo Mansur

the investment required for the sustainable use of natural resources. Single-handedly, private funding can profoundly transform this global approach and help countries achieve their Sustainable Development Goals.

**A. F.:** Private companies have a role to play in researching and developing solutions to remediate soils to make them fit for cities or agriculture, practice sustainable and productive agriculture, and create the urban agriculture of the future, which will support food security in cities. Since 1990, our Group has been developing expertise to give polluted soil a new lease of life. To invent more effective and less expensive techniques, it has begun several research projects for decontaminating soil using micro-organisms or phytoremediation. ■



*Dividing his time between the United Kingdom and Switzerland, Nick Morgan supervises the cross-border transport of hazardous waste worldwide. In France, Maeleenn Poitrenaud explores new areas of activity linked to the circular economy of soils.*

# Above and beyond

Meeting Veolia employees from all over the world

## Nick Morgan

Director at Veolia Field Services, United Kingdom, and SARPI, Switzerland

**Nick Morgan is, so to speak, a hazardous waste adventurer.** A sort of super bomb disposal expert and pollution buster. Explosives, soils contaminated with napalm, toxic waste, chemical pollution, etc. are his business. He is motivated by the challenge — posed by each new assignment — of transforming a high-risk area into a healthy space where nature can safely reassert itself.

Nick has been the Director of Veolia Field Services in the United Kingdom and SARPI in Switzerland since 2019. Interested in chemical waste treatment for 25 years, he began working for Veolia in 2005, after studying biochemistry and environmental management. Having joined SARPI in 2012, he has gained unique experience on the ground in the highly specific field of hazardous industrial waste packaging, cross-border transport, and treatment on an international scale.

After crisscrossing the globe for several years, he now divides his time between Switzerland and the United Kingdom, from where he supervises the transport of hazardous waste worldwide, ensuring that it is safely brought to Europe for different types of treatment: activated carbon regeneration, chemical waste decontamination, or the treatment of mercury-containing products, particularly batteries.

From Argentina through Morocco to South Africa, this hazardous waste is extracted from its country of origin and treated thanks to SARPI's network of plants in France, the United Kingdom, Switzerland, Spain and Poland.

To illustrate this singular job, about which he is as passionate as ever, Nick tells of his experience in Mozambique, where Veolia Field Services is working with the UN as part of a health and environment program. He heads up teams that collect products from the agrochemical industry, such as abandoned pesticide stocks, and package them for transport. "By transporting this hazardous waste outside a country to a treatment site that has adequate infrastructure, we leave a safer, better environment behind us," explains Nick. "I was really struck by the beauty of Mozambique. Knowing that we can help preserve it is a great source of satisfaction and motivation in the work that we do day to day. The impact of our activity on people's health and the environment is really something to be proud of." ■





**Maelenn Poitrenaud**  
Innovation and Development  
Manager, SEDE  
Arras, France

**While the United Nations has been celebrating World Soil Day** on December 5 since 2014, Maelenn has been an ardent champion of soil protection for many years. The young engineer and geologist had only just joined Veolia's Research & Innovation division (VERI) over 20 years ago when she published a scientific article on the subject in partnership with INRA\*. In it, she set out what would become her hobby horse: compost's potential in the fight against soil degradation. This thinking is now coming into its own, with the UN calling for a stop to soil erosion in its 2019 campaign. Maelenn very soon had the opportunity to dig into subjects relatively unexplored at the time, such as organic matter return to soil and waste recovery. In particular, she would experience one of VERI's key projects conducted in partnership with INRA from the inside: the QualiAgro field trial, a scheme in which compost from urban waste is compared to a benchmark bovine manure. In 2014, she set up a unit dedicated to innovation and development within SEDE, Veolia's Agronomic hub, where she is flourishing today.

At the head of her team, Maelenn continually looks for new expertise to integrate into the range of solutions offered to clients. Starting with fields linked to the circular economy (anaerobic digestion, biofuels, etc.) and digital. "For me, innovation lies in significantly improving our sectors of activity, as well as disruption and preparing for the fields of the future," she explains. She also spends a good deal of time unearthing start-ups and SMEs with original ideas that have the potential to be developed in SEDE and its subsidiaries' areas of activity: treating and recovering sewage sludge and organic and mineral waste (dewatering, biodrying, composting, anaerobic digestion, agricultural reuse, energy recovery, etc.), and commercializing composts, fertilizers and biostimulants.

The efforts of this "Resourcer," firmly committed to projects invariably on the frontiers of science, agriculture and regulations, have paid off! In 2018, her SmartFertiReuse pilot project — a concept based on reusing treated wastewater in agriculture in response to the water stress taking hold worldwide — received funding and the ministerial order for testing in the Hautes Pyrénées region. Another source of pride is the partnership with the Israeli start-up Bioplasmar, two years after discovering this young company that had just patented a concept for biodegradable flower pots. This meeting led to a joint venture by the name of "PoEthic." A plant is currently being built near Chatellerault, in France's Vienne department, and millions of flower pots will be produced from 2020. ■

\* French National Institute for Agricultural Research



# World

## Carbon: the new “soil capital” asset

*If it is properly managed, farmland proves to be an effective weapon in mitigating the impacts of climate change. This requires agriculture that emits fewer greenhouse gases. The key is agro-ecological practices that promote an increase in both soil organic matter and atmospheric carbon capture by trapping carbon in soil, incidentally improving the properties of cultivable land. To help agriculture meet these challenges, Veolia is establishing an agronomic knowledge base through international research partnerships and rolling out innovative digital solutions.*

**On a global** scale, soils (apart from permafrost) store the equivalent of 2.6 times the amount of carbon found in the atmosphere in the form of organic matter. They also absorb around a quarter of the planet’s CO<sub>2</sub> emissions. This storage takes place through the combined action of photosynthesis, which extracts carbon from the atmosphere, and the decomposition of plants, which transfer the carbon they contain to soil. However, most of this absorption is done by forests, with farmland still only playing a secondary role. Nonetheless, an ambitious



### Interview

**Stéphane Le Foll,**

Founder and vice-president of the 4 per 1000 initiative, former French Minister of Agriculture (2012-2017), Mayor of Le Mans and President of Le Mans Metropolis



#### Why do we talk of “4 per 1000”?

I launched the “4 per 1000” project in March 2015, based on an INRA study. It’s a fantastic message of what agriculture can do under certain production conditions to mitigate the amount of gas contained in the atmosphere.

#### What stage has the initiative now reached?

Launched nearly four years ago on a multi-stakeholder basis, the 4 per 1000 initiative has two major dimensions: an action program involving multiple state and non-state actors for better soil carbon management and an international research and scientific cooperation program. It is now supported by over 250 organizations (governments, research institutes, NGOs, universities, foundations, companies, etc.) and counts 80 signatory countries\*, a scientific board, and a consortium. The actors in the initiative and NGOs are continuing the work and its implementation on a global scale.

#### What place does agriculture hold in the fight against global warming?

On the eve of COP21, it amounted to eating less meat and a vague concept of climate-smart agriculture. It was therefore necessary to review its place in the debate, affirming that agriculture is not a problem but a solution, provided that we rethink the terms of the agricultural production and development model.

Of course, agriculture must reduce its greenhouse gas emissions. However, it has an asset that other sectors do not. Thanks to plant photosynthesis, it can store — particularly in farmland — excess carbon from the atmosphere.

\* [https://www.4p1000.org/sites/default/files/francais/original\\_partenaires\\_membres.pdf](https://www.4p1000.org/sites/default/files/francais/original_partenaires_membres.pdf)

#### Issue at stake

➤ Reducing CO<sub>2</sub> emissions into the atmosphere by sequestering them in soil

#### Objective

➤ Make agriculture a key player in food security and the climate change fight

#### Veolia solution

➤ Supporting the international research program “4 per 1000” to sequester carbon in soil and developing innovative solutions to support farmers in this direction

...

farming policy could reverse the trend and offer a way of fighting climate change more effectively. A winning strategy that would “build up the soil nutrient bank and increase soil fertility,” according to the French Ministry of Agriculture. Mindful of the issues at stake, Veolia encourages farming practices that would increase soil carbon stocks, without significantly changing the production system.

## “4 per 1000,” or carbon sequestration in agriculture

The international “4 per 1000, Soils for Food Security and Climate” initiative (cf. interview) was launched by France during COP21 in late 2015. The idea: a 4% annual rise in the amount of carbon in all soils worldwide would compensate for all human-related greenhouse gas emissions. Applied to the first 40 centimeters, the 4 per 1000 target corresponds to soil carbon storage of 3.4 Gt of CO<sub>2</sub> per year, which would theoretically stop the current rise in the concentration of carbon in the atmosphere. “As the leading company selling composts on the national market, with over a million metric tons sold in France today, Veolia is very much involved in this initiative,” states Paul-Antoine Sebbe, CEO of Sede Environnement, Veolia’s agronomic hub. A sign of the general interest in carbon storage, the subject is being studied as part of the European Union’s Common Agricultural Policy (CAP) reform.

However, carbon storage is also

## SmartFertiReuse for responsible irrigation

Repurposing treated wastewater while optimizing field fertilization is the aim of the SmartFertiReuse project, which combines several concepts in one: Reuse, which gives the water from the wastewater treatment plant a quality compatible with irrigation criteria; Ferti, because it involves fertilizing and irrigating crops simultaneously; and Smart, due to a monitoring and control interface (sensors) to promote responsible farming. In collaboration with Veolia’s Research and Innovation division and Veolia Water, Sede is steering this demonstration project that brings together a number of laboratories (AgroParisTech, etc.), industrial partners (Bio-UV, the start-up Ecofilae, Polymem, etc.), and players from the farming world (FDSEA 65, Hautes-Pyrénées Chamber of Agriculture, etc.). Launched in 2018, having received a label from the Agri Sud-Ouest Innovation and Aqua-Valley clusters and been named an Interministerial Single Fund winner, it is aiming to carry out the first irrigation tests without fertilizers in 2020, then with fertilizers in 2021.

In practice, the module is installed at the outlet of the wastewater treatment plant and analyzes the treated water. The latter contains nitrogen and phosphorus, which are mineral fertilizers in small quantities. The module takes into account the amounts of these minerals in the water and adds additional nitrogen to deliver optimal water for irrigation. In the long term, this would make it possible to decrease water withdrawals from the natural environment while ensuring crop irrigation throughout the year, even during periods of drought.

### Key figures

**24%** of global soils are degraded to various degrees, including almost half of agricultural soils  
**1,500 billion** metric tons of carbon in soil organic matter worldwide, over twice the carbon in atmospheric CO<sub>2</sub>

**1.2 billion** metric tons of carbon per year could be stored in agricultural soils (crops and grasslands), i.e. an annual storage rate of around 4 per 1000 compared to the surface soil horizon.

*\*Sources: IPCC, 2013 & 2014*

one of the key issues in food-related soil security. “In our so-called developed countries, there is currently no threat, as the population is not lacking food in terms of quantity. However, requirements are becoming higher and higher in terms of quality,” adds Paul-Antoine Sebbe. “This is leading to a reduction in artificial inputs that guarantee a minimum yield even in poorly maintained soils... We therefore need to go back to one of the basics of farming: the agronomic potential of soil!” Improving the organic matter content of these soils by using composts as well as simplified farming techniques will make it possible to ensure both the

quantity and quality of food products in the future. This is the thinking behind the Soil Advisor® project, developed in close collaboration with INRA.

## Soil Advisor®: the app that keeps soils healthy

To support farmers in adopting responsible, more soil-friendly practices, the Soil Advisor® app “has been designed so that they can optimize organic fertilizer and amendment input,” explains Maelenn Poitrenaud, Innovation and Development Manager at

Sede. Its strengths: taking into account the specific features of the land and crops as well as the farmer’s agronomic practices, suggesting optimal compost use, and predicting the soil carbon storage capacity. “Providing guidelines for use based on renowned agronomic models allows us to reassure the end users and contributes to the enhanced deployment of our offerings,” adds Paul-Antoine Sebbe. “Developed in partnership with the University of Colorado and INRA, Soil Advisor® is currently the only tool on the market allowing farmers to optimize their organic fertilization strategy. It does so by incorporating the long-

term effect of the compost and its impact on changes to soil organic matter and soil carbon storage.”

After five years’ R&D, the application was rolled out in 2019 to a test panel of farmers and farming advisors, and will be launched for routine use\* as of 2020. “Initial feedback is extremely positive, as no steering tool of this kind currently exists. Farmers are also more aware of the benefits of using organic matter,” states Maelenn Poitrenaud. Beyond their impact on the climate, organic amendments and fertilizers are also less expensive than chemical fertilizers, offering stable yields and resilience to climate

events (by increasing soil water storage capacity, they help phreatic groundwater function correctly, for instance). For Sede, the next step is developing a probe — “Soil Diag.” Capable of measuring and diagnosing the properties of soil (carbon and organic matter, nutrients, potassium, etc.) in real time, it offers farmers a reliable diagnosis. “Paired with the Soil Advisor® app, it will provide them with instant simulations!” enthuses Maelenn Poitrenaud. ■

*\*This represents a move to a larger, less “experimental” scale, as only a few farmers were in the loop up to now.*



## Interview

Jean-François Soussana,  
Vice-President for international policy, INRA



### How is INRA involved in the “4 per 1000” initiative?

As well as providing a scientific framework for the initiative, INRA launched a scientific committee with other national and international bodies in 2015, along with an initial research program that has led to several publications. We contribute to the work and publications of the 4 per 1000 initiative’s Scientific and Technical Committee and to thinking about its governance and goals. We also conducted a national study on the carbon storage potential of French soils in light of the 4 per 1000 goal, simulating the effect of farming and forestry practices on changes to carbon stock over 30 years. This new knowledge should shed light on public policies and show the importance of maintaining permanent grasslands, wetlands and forests where soils generally have high carbon stocks, as well as putting a stop to land take. This knowledge supplements expertise focused on increasing low carbon stocks, primarily in field crop areas. By implementing these two complementary goals all across France, it would be possible to achieve a rise in soil carbon stock levels in metropolitan France of nearly 4% per year.

### Veolia and INRA enjoy a long-standing relationship. What is special about this partnership based on the 4 per 1000 initiative?

The partnership with Veolia has made it possible to develop the beginnings of an answer to the dynamic of organic waste products in soil, the future of micropollutants from organic waste products, and the biological and microbiological functioning of soils spread regularly. Every year in France, 330 million metric tons of organic waste matter is recycled in agriculture. Returning these products to the soil improves its fertility and could also contribute to increased carbon stocks, thereby helping achieve the goals of the 4 per 1000 initiative.

### What makes Veolia and its subsidiary Sede a key partner for INRA?

It is necessary to document that returning these organic waste products to the soil has no negative impacts on the environment. A network of experimental sites has thus been developed by Veolia through its subsidiary Sede. Designed on a plot scale, these sites make it possible to measure — sometimes for over ten years — the long-term development of an agrosystem spread with organic waste products.

# Canada



Toronto

24/25

## The pellet that takes nutrients from the WWTP to the field

*In Ontario, Canada, Veolia produces a nutrient-rich fertilizer inspired by the circular economy — Nutri-Pel, which is used as a soil amendment. What’s more, it has proven to be a real cost-effective alternative to expensive chemical fertilizers!*

### In the Canadian

province of Ontario, winter takes hold from late October to May, freezing farmland for many long months. During the period favorable for farming, the race is therefore on to grow crops as quickly as possible and maintain the rhythm of two annual harvests. The key to profitability is benefitting from fertile soil. While chemical fertilizers remain widely used, their more natural alternatives are becoming increasingly popular. This has

encouraged Veolia to produce a rather special fertilizer dubbed Nutri-Pel at its Ashbridges Bay wastewater treatment plant (WWTP).

### Rapidly visible results

The sludge from the WWTP is heated at a high temperature to be turned into pellets

rich in nutrients and organic matter. “This project perfectly illustrates Veolia’s circular economy philosophy. A material seen as waste is turned into a commercially viable product that is very appealing to the end user,” notes Michael Vujicic, the project’s manager.

This view is shared by Marj Jewell, a local cattle breeder. “When we took over the farm, the soil was very poor. When we were looking for solutions to enrich it, I



#### Issue at stake

➤ Turning waste — sewage sludge — into a usable material

#### Objective

➤ Protect soils while encouraging agriculture

#### Veolia solution

➤ Design, produce and sell a high-quality agricultural fertilizer that is inexpensive, easy to use, and rich in nutrients and organic matter

... met the promoters of Nutri-Pel, a product that I'd never heard of. When I learned where it came from, I hesitated for a long time... But I was won over by the ecological arguments and we went for it in the end. Today, we can see the results. The land is richer and the volume of hay has significantly increased. It's a great product and I'm delighted with it!"

## Long-term effects

The fertilizer is also well suited to pasture. "When we were using manure, the cows had to be taken out of the fields because they would flounder in the mud. We also had to deal with lots of restrictions, such as a ban on spreading it near homes. We can spread the pellets everywhere, even when there are cows!" highlights Paul Purser, Sales Manager for Nutri-Pel in Canada. The product also has the advantage of being cheaper than chemical fertilizers: it costs 25 to 35% less than the fertilizer MAP (Monoammonium phosphate), for instance, offering the same amount of nutrients. Moreover, Nutri-Pel provides additional minerals and organic matter, which nourishes the micro-organisms in soil, increases the water retention capacity, and limits erosion. Finally, the nutrients are gradually released and farmers see results in two to three years.

## A key awareness-raising campaign

Today, Veolia produces and sells 25,000 metric tons of Nutri-Pel annually. However, a great deal of information provision and dialogue was required for the product to be accepted. "In 2007, when the plant started up, we were selling 5,000 metric tons per year. It was a real challenge for me as Sales and Marketing Manager," remembers Paul Purser. "Farmers had bad memories of biosolid-based products sold well into the 1990s, whose quality was appalling." Their main cause of concern was the presence of heavy metals. However, nowadays we know that certain natural concentrations are useful for plant development. Zinc, for instance, is used in the plant's first stages of growth. Moreover, new standards guarantee a very low level of metals in the soil in the long term. Last but not

least, controls are done twice a month in the WWTP to check compliance with standards. The quantities of 11 metals are measured, as well as nutrients such as nitrogen and calcium. Following many organized discussions about the product, farmers began to use it and then were

quickly won over. Nowadays, Nutri-Pel is so popular that Veolia is struggling to meet demand. Extremely satisfied with the scheme, the city of Toronto is currently renewing the contract with Veolia to produce pellets for the next decade. ■

### Key figures

75 orders per year  
50 to 1,000 metric tons of Nutri-Pel per order  
25 to 40% improvement in yield (and revenue) observed by users



## With Pro-Grow™, the United Kingdom has a natural peat-free<sup>1</sup> fertilizer

As Veolia treats over 400,000 metric tons of green household waste (grass, leaves, etc.) in the United Kingdom each year, the Group has designed and produces a peat-free compost that meets industry's highest quality standards: Pro-Grow™. This solution has been encouraged by the British government, which is concerned about the depletion of peatlands (wetlands with a remarkable biodiversity), as 3 million m<sup>3</sup> of peat is extracted annually for horticulture.

The process to produce Pro-Grow™ compost requires several steps. First of all, green waste is transported to one of Veolia's ten composting centers to be shredded before being mixed with green and woody materials. The shredded material obtained is then formed into 100-meter-long windrows<sup>2</sup>. The temperature gradually rises until pathogens and weed seeds are destroyed. Once it has reached at least 70°C for 48 hours, the windrows are aerated and turned for four months.

Made up of 80% organic matter (which improves the soil) and 20% nutrients, Pro-Grow™ is suitable for all plants and is particularly appreciated in horticulture. While 150,000 bags of compost currently leave Veolia's ten centers each year, the government's strategic plan for resources and waste could accelerate this activity.

1. Peat, fossil plant matter from wetlands — peatlands — is an organic amendment that has the ability to enrich soil. It is the result of the decomposition of semi-aquatic plants over several thousand years; it takes 100 years to produce 5 cm. Its extraction is endangering biodiversity-rich ecosystems, which have become fragile all across Europe.

2. A row of plant residues spread over a plot of land.



## Vegetal Signals keeps track of plants

Plants can talk. They communicate with each other in various ways. For example, through mycorrhizae, which are associations between roots and fungi like neuronal networks in humans. Or by sending electrical signals, modulated according to the time of day or night, temperature or hygrometry. To better intercept this type of language, record it in real time and interpret it, the Bordeaux start-up Vegetal Signals uses techniques borrowed from neuroscience. It has also developed a system of connected sensors compiling a huge amount of data every day. To date, it has been able to identify a specific marker for water stress and develop an experimental irrigation scheme directly controlled by the plant. On the same wavelength, in 2018 SEDE Environnement became a shareholder in this budding company and has been involved in this research work since early 2019. The long-term aim is to provide decision-making tools allowing farmers to very finely tune (in terms of quantity and location) irrigation, doses of crop protection products or fertilizer intake in response to the demand coming... from the plant itself.

### 3 questions for Paul-Antoine Sebbe, CEO of SEDE Environnement



#### How does Angibaud Derome & Spécialités' incorporation fit into your business strategy?

It allows SEDE, which is celebrating its 40th birthday this year, to supplement its fertilizer offering. Our mission is to capture organic resources, process them, and then make them available for farmers, in the form of fertilizer, for instance. Angibaud will continue to offer high-end organic fertilizers highly appreciated by the winegrowing world and market gardeners.

#### What types of products make up the range developed by Angibaud?

Specifically crop fertilization and nutrition solutions for every stage of growth. First of all, organic amendments, which represent the basis of soil fertility. Then organic, water-soluble and foliar fertilizers, which deliver precision fertilization. Finally, biostimulants (algae extracts, etc.), which improve fertilizers' efficacy and accelerate plant growth.

#### What makes these fertilizers "circular"?

In total, 60% of the raw materials used by Angibaud come from the circular economy. Whether this concerns our long-standing product, fish guano<sup>1</sup>, with the natural processing of (unsold and excess) fishery by-products, or, more recently, recovering frass ("fly poop"), a co-product of insect protein production, to make an excellent fertilizer from it.

1. Fertilizer based on animal waste.



# Fra Remediating nce highly sought-after brownfields

*Constrained by increasing pressure on urban land, local authorities, manufacturers and developers are taking a close interest in many polluted sites on the outskirts of cities. However, in order to be able to launch any project to regenerate these brownfield sites, the land must first be decontaminated. Through its subsidiaries GRS Valtech and EOD-EX, Veolia's entity, SARPI, boasts wide-ranging know-how in this domain. This expertise also allows it to work within very restricted time frames.*

**France** counts 400,000 abandoned polluted sites. In other words, hundreds of hectares to be treated and restored before they can be used for hosting public facilities, setting up light industry, building housing, or even developing an urban farming business. This land resource offers a solution to the problem of urban sprawl. However, soil decontamination is an indispensable prerequisite to allow future users to work and live in a healthy environment.

## Managing complex and sensitive pollution

"Sarp Industries, Veolia's entity dedicated to hazardous waste treatment and recovery in Europe, is represented on this market through its subsidiaries GRS Valtech and EOD-EX," explains Cédric L'Elchat, its CEO.



### Issue at stake

► Responding to urban densification and preventing urban sprawl

### Objective

► Free up land in cities by rehabilitating former brownfields and making them safe

### Veolia solution

► Treating extreme pollution, and comprehending, managing and neutralizing the risk of explosion

...

“GRS Valtech, created in 1990, is involved in the decontamination of soils and liquid and gaseous effluents,” he continues, “while EOD-EX is a major player in the remediation of explosive-contaminated<sup>1</sup> soil.” An integrated approach, paired with cutting-edge expertise, allows both companies to respond rapidly and prove their efficacy and adaptability on projects that often have many constraints. For example, in Saint-Ouen (France), GRS Valtech cleaned up ground set to accommodate the maintenance and storage site for carriages from the Paris metro’s line 14. “We began in October 2014 and the work should be finished by the end of 2019,” explains Pascal Escoubas, CEO of GRS Valtech and EOD-EX. “Within this framework in keeping with an approved process, we excavated and then treated over 350,000 metric tons of earth and sludge, maintaining an average evacuation rate of 1,500 to 2,400 metric tons per day.” Over 50,000 metric tons of material was transported by river to limit the number of trucks in the northern Paris suburbs, where the road traffic is already very dense. “Our schedule frequently changed, because we had to adapt to the vagaries of the progress of the earthworks and civil engineering. Given this constraint and the volumes in play, we prepared the evacuation of the earth and sludge at a very early stage. So the volumes were divided into different batches according to their quality, which allowed us to optimize management costs and draw up contracts with different channels,” continues Pascal Escoubas. As well as evacuating earth and sludge, GRS Valtech also pumped and treated over 730,000 m<sup>3</sup> of phreatic groundwater on site.

## Demining explosive sites

The subsidiary EOD-EX, which is active in France and Europe (see boxed text), is most often called on to clean up explosives-contaminated land, primarily by the French Ministry of Defense and manufacturers. The aim is to guarantee optimal safety for construction companies during their work. In the Paris region, EOD-EX won the

## Hunting down and handling explosives, wherever they are

EOD-EX was created in 2006 by SARPI, Veolia’s “hazardous waste management” branch, and the SNPE group (leader in the design and manufacture of explosive items and substances). In 2011, the company became a fully-owned subsidiary of SARPI, enriching Veolia’s offering in terms of global explosive risk management. EOD-EX is involved in four areas of activity: geophysical diagnosis, dismantling for the pyrotechnics industry, landmine clearance, and underwater demining. The company has 45 highly qualified experts to carry out these missions. These include former army bomb disposal experts and applied geophysics engineers. Requests primarily come from the French Ministry of Defense and manufacturers looking to sell land. EOD-EX uses several sources to perform a geophysical diagnosis. For instance, experts study warplane flight plans and photos taken before and after the bombings. For detection on site, techniques are constantly evolving, with the positioning of materials allowing more precise distinction of the magnetic anomalies detected. The use of drones has led to a significant improvement in mapping operations. Once the elements have been detected, they are excavated and dealt with in situ or in specific centers. Construction workers can then work under optimal safety conditions.

diagnosis and explosives decontamination contract for the former 217 air base in Brétigny-sur-Orge in 2017. The Second World War has left its mark there. During the Occupation, the base was heavily bombed by the Allies. After sounding the 300 hectares looking for grenades or bombs dating from this period, EOD-EX’s teams carried out the geophysical diagnosis and decontamination of 120 hectares to a depth of six meters. The specialists work using radars. Once they obtain an echo, they dig to find out the nature of the “object” detected. Two 50-kg bombs

— still intact — were found, one buried at a depth of 70 cm, the other 2.5 m down. They were covered with 200 metric tons of sand and encircled by a trench to limit the propagation effect. Then charges were put in place to explode them. In total, this site uncovered over 15,000 “targets,” forty or so of which were still active. ■

*1. Related to explosive devices, such as unexploded bombs and munitions cases (which may contain toxic compounds such as arsenic and lead).*

### Key figures

**€750 M**, estimation of the soil decontamination market in France  
 Almost **200 projects** carried out by GRS Valtech in 2018, around 500,000 metric tons of earth and 2 million m<sup>3</sup> of liquid effluent treated  
**45 million metric tons** of earth to be excavated for the Grand Paris Express projects, 10% of which are thought to be polluted  
 Over **300 projects** conducted by EOD-EX since its creation (2006)  
 Over **80 metric tons** of munitions extracted and/or treated since 2010 by EOD-EX



Explosives decontamination of the former 217 air base in Brétigny-sur-Orge.



In Saint-Ouen (France), GRS Valtech cleaned up ground set to accommodate the maintenance and storage site for carriages from the Paris metro’s line 14.

## Cleaning up Agent Orange residue in Vietnam

From 1964 to 1973, during the Vietnam War (1955-1975), Americans sprayed 80 million liters of a powerful herbicide, Agent Orange, on the country. Still found in soil in the form of dioxin, it represents a highly toxic element for the population and the environment. In 2012, the Vietnam Ministry of Defense and the United States Agency for International Development launched a project to treat 87,000 m<sup>3</sup> of soils and sediments near Da Nang airport. Tasked with carrying out the project, Veolia chose the only technology capable of meeting the set target with the least environmental impact: in-pile thermal desorption. It involves heating the earth to 335°C for several months so that the



dioxins evaporate in the form of chlorine. In concrete terms, a huge structure 100 meters long, 70 meters wide and 8 meters high was built on airport land. Initially, 50% of the earth was transported there by truck. Once the container was filled, 1,252 heating wells were sunk into the soil. The structure was then covered in order to be able to treat the gaseous effluent in situ. Liquid effluent was also collected for treatment. After ten months, the earth could be used as filler material for Da Nang airport. The process was repeated for the other half of the material. The objective was ultimately fulfilled and similar projects could be launched.



# Of trees and men

In Ethiopia more than elsewhere, people and trees are closely linked. Ramparts against desertification, places to meet and trade, a construction raw material, etc., trees are one of the pillars of the time-honored lifestyles of the different ethnic groups photographed by Juan Manuel Castro Prieto. These traditions are being shaken up by the modern world.

Today, Ethiopia is concerned about its trees: a major tree planting campaign is underway, which reached its height on July 29, 2019 with almost 350,000 trees planted in a single day according to government figures. The aim is to achieve an additional four billion trees by the end of October. The effectiveness of this kind of campaign remains to be seen: during previous reforestation efforts, most of the trees planted died due to lack of maintenance. Whereas half a century ago, Ethiopia had 40% forest coverage, it currently stands at only 15%.



**Karo children** playing on the banks of the Omo River. The construction of a giant hydroelectric dam on this river poses a long-term threat to this people's traditional way of life.

**An old Surma man surrounded by children in the village of Tulgit.** The Surma people — an ethnic group from Western Ethiopia — live according to their ancestral traditions. They are related to the Mursi, an ethnic group known for its “lip-plate women.” Surma women also wear labrets on their deformed lips, although the younger generation is increasingly abandoning this practice.



**Konso Market** The Konso, an ethnic group from Southern Ethiopia, sell their — mostly farm — produce on the market in the shade of the acacias, an indigenous tree. They also swap certain goods. **Hamer family after the market** Every Sunday, a traditional market is held in the town of Dimeka. Hamar families meet there to sell and exchange their products. After the market, the Hamar celebrate their sales by drinking local beer, then each family returns home on foot, sometimes traveling great distances. **Ruppi, the good shepherd** A child shepherd studying English under a tree and sheltering from the rain.

**The Kaffa highlands (at an altitude of 1,500 meters) in the south-west of Ethiopia** The region par excellence for arabica coffee, which grows there in the wild.



**Eucalyptus forest in Limu, Western Ethiopia** Eucalyptus is not an endemic species in this region. It is one of the invasive species that have developed to the detriment of local species, leading to undesirable ecological changes.

**Man from the Djimmah region** pruning eucalyptus branches to build a hut.



**Landscape of the Kafa region** This land enjoys a mild climate and dense vegetation.

## Analog photography to capture Ethiopian light

### Juan Manuel Castro Prieto

wasn't initially interested in trees but people, as he was fascinated by traditional ways of life. However, trees naturally caught his attention. First of all, for environmental reasons, because deforestation is one of his major concerns. But also for artistic reasons. "Their shapes create a singular personality," he observes. Ethiopia is not new to the photographer. He has traveled there many times and this report falls in line with a much larger body of work on the country,

shot between 2005 and 2017: "People's on-going relationship with their environment — trees in this case — is essential to me and a source of inspiration." While it was virtually impossible to talk to the people photographed due to the language barrier, a strong, empathic relationship was nonetheless created through glances, smiles, and short phrases. "What surprised me most," he highlights, "is that beyond customs and lifestyles, the fundamental 'core' of indigenous people is just the same as ours. There are no major intrinsic differences." Juan

Manuel Castro Prieto also has a somewhat "traditional" side: he only works with silver film, using a large-size classic camera (20 x 25 cm) when he has the time. "Color photographic film lets you obtain much more beautiful shades," he explains, "especially with this specific camera, which offers an extraordinary range of colors." He then scans the negative to give it the final shade. The results are striking: incredibly beautiful photos that bear witness to a way of life that is slower, more peaceful, and more communal than ours. As well as its fragility.

### Bio

Juan Manuel Castro Prieto began taking photos in 1977. He is self-taught, studying the work of the masters at length in books and exhibitions. He takes photographs in complete freedom, preferring to work on the themes of his choice, which he then proposes to magazines. His only condition before accepting a commission is to have carte blanche to shoot the given theme as he pleases. Because he likes to devote himself to long-term projects, he is constantly working on several projects at once. Some take him ten, twenty, even forty years...

# RECONQUERING LAND

40/41

According to the FAO, “soil pollution affects the food we eat, the water we drink, the air we breathe, and the health of our ecosystems.” Mindful of the complexity of soils — at once a living environment, a filter and memory of human activity, a land resource, and a regulatory field (town planning and environmental codes) — and the associated issues at stake, Veolia is taking a far-sighted approach. The Group has decided to put its areas of activity and expertise to good use in order to remediate this sustainable ally in the fight against climate change. And to restore the “skin” of local regions to better respond to the environmental, social and economic issues of tomorrow.

## Industrialization,

mining activity, urban densification, agriculture intensification, and war have contributed to soil contamination. This pollution is said to be responsible for some 500,000 deaths worldwide in 2015<sup>1</sup>, due to chemicals and pathogens transmitted to humans through direct contact (skin exposure or inhalation of polluted soil particles) or the consumption of food and water having accumulated large amounts of pollutants from soil.

million in the European Union plus the Western Balkans. In the United States, at least 1,300 sites appear on the list of polluted spots identified as a national priority. Last but not least, China recognizes that 16% of all its soils are polluted. This worrying inventory also includes numerous derelict sites (mines, industries, military bases): 450,000 in the United States, 200,000 in Canada, 300,000 in the United Kingdom, and 400,000 in France<sup>2</sup>. In other words, hundreds of hectares that could be treated and restored, then reused for agricultural, real estate, or other purposes. However, despite these identification efforts to estimate the scale of the phenomenon, the absence of a global assessment represents an obstacle to harnessing the

## An overview of soils

According to FAO, at present “about 33% of all soils are degraded, and the state of soils is deteriorating at an alarming rate.” For example, Australia counts almost 80,000 polluted sites, while there are three

...

... necessary economic resources and powerfully engaging public and private players in this fight. Urgent action is required worldwide to tackle this pollution and the many threats that it poses to food security and public health.

### A global resolution, national strategies

During the third session of the UN Environment Assembly (UNEA3) in 2017, the member countries adopted a resolution calling for faster action and collaboration to treat and manage soil pollution: measures must be taken on a national and regional level to understand the extent of soil pollution in their countries and strengthen policies aiming to prevent, reduce and manage soil pollution. In this respect, research to develop new scientific decontamination methods is continuing. Increasingly expensive physical decontamination techniques, such as inactivation or the sequestration of chemicals in landfills, have been replaced by biological methods, such as microbial degradation and phytoremediation. Maintaining soil health and preventing and reducing soil pollution is achieved by promoting ecologically reasonable management practices and environmentally friendly industrial processes, reducing

waste production, recycling and reusing products and materials, and sustainably storing waste.

### A combination of skillfully mastered expertise

In this international context, Veolia — a world leader in water, waste and energy — is bringing its expertise to bear on soil decontamination with a broad array of (chemical, thermal or biological) treatment technologies. The choice of one in particular or a combination depends on multiple criteria: the level of reduction and/or stabilization required (according to future use), the type of pollutant concerned, the time available, the environment of the site, the volume to be treated, and finally the cost. “Soil remediation is an expertise that Veolia has already been developing for a long time through its different subsidiaries: Sarpi with GRS Valtech and Sede,” explains Cédric L’Elchat, CEO of Sarp Industries, a Veolia subsidiary. “Depending on the case, we can treat both soils and phreatic groundwater. Each situation requires one or more specific techniques, as sites polluted with explosives, chemicals, heavy metals and hydrocarbons are treated differently. The solutions chosen may be in situ, where the soil is treated on the spot with treatment

methods using heating tips or intrusive techniques. Depending on the need, we use thermal desorption<sup>3</sup>, chemical or biological soil treatment. However, the solutions may also be ex situ, such as excavating soil and transporting it to dedicated centers in Veolia’s channels.” Jean-Christophe Taret, Senior Vice-President, Strategy, believes that this could become a rapidly expanding market: “The vast majority of our activities are based in France, pending our next development in China, a part of the world so concerned by this issue that the government has put in place strong legislation on the treatment of soils to make them fit for industrial, agricultural or urban use.”

### Exploring the field of the possible

To complement the arsenal of traditional technologies at its disposal, Veolia is exploring a whole field of innovations, which are all the more promising as they are more natural, resource-efficient and inexpensive. The Group is taking a particular interest in treatments using phytoremediation<sup>4</sup> and microbacteria<sup>5</sup>, which are currently at the R&D phase. Both are transpositions of know-how and technologies that already exist at Veolia to treat water. “With phytoremediation,” explains Jean-Christophe



Éric Lesueur, CEO of 2EI, a Veolia subsidiary

**“Reusing freed soil is an excellent opportunity to increase the local region’s density with a smart habitat”**

**2EI provides urban project leads with contracting authority support services to define and implement a sustainability strategy and cities with regional strategy consultancy services: risk and disaster management plans, resilience, or the integration of digital tools linked to new social, economic and environmental dynamics. Its added advantage is delivering the methods and know-how of an engineering and consulting firm, enriched by the Veolia Group’s expertise as an environmental services provider, adapting them to each situation.**

### How do you implement your strategy in such different locations?

Thanks to the rigorous methodologies we adopt, we are equally capable of supporting the city of Milwaukee in designing its resilience strategy — as we did in 2018 — as providing contracting authority support services to developers and planners in the Greater Paris area. Our contracting authority support business, concentrated in France, is linked to soil utilization and the move from heavy to lighter industry. These industrial plots of land in local areas — for the most part in cities’ inner suburbs — are sources of urban renewal. With GRS Valtech and Sede, we are studying projects that reuse this industrial land to create new urban developments.

### How does soil remediation contribute to urban development?

Reusing freed soil is an excellent opportunity to increase the local region’s density with a smart habitat. And prevent urban sprawl with its inherent problems in terms of providing public services (transport, energy, etc.). As a corollary, we advocate urban projects mindful of issues such as the energy transition, access to eco-friendly mobility options, water reuse, etc. And ensure that they bring nature back to the city, or even develop urban agriculture such as micro-market gardening and aquaponics, as well as improve quality of life, for example by working on heat islands.

### How do you reconcile the issues of an urban project with the many competing interests to create a resilient region?

It’s true that there is always a tension between the wishes of an elected official, represented by the planning authority, and the economic interests of the developer. For me, the main driver is what residents and users want: a digital and participatory democracy that drives the projects and gives them a sustainable direction. There is a groundswell to bring quality, traceability and a local approach into everything the city needs to survive and be livable. This will generate a re-concentration of interactive strategies between cities and their region. A large field of work for 2EI and a great challenge for the world!

... Continued on page 44



**Loïc Couttelle**, Project Director at 2EI, a Veolia subsidiary  
**“Urban agriculture, Veolia’s new business line”**

A farmer in the Lille area who joined Veolia 25 years ago, over the past five years Loïc Couttelle has become interested in building new agricultural systems and exploring the role that Veolia could play in this.

**What credibility has Veolia in urban agriculture?**

This is going to become a strategic issue for cities. One of Veolia’s missions is supporting regions in the challenges that arise, particularly the question of food. Awareness is rising, requests are flooding in, but decision-makers are rather at a loss when it comes to constructing agricultural production systems. Veolia can help them in two ways. By calling on its three areas of expertise: water, as agriculture requires water management for irrigation; waste, as recycling of the organic matter produced by the city must be controlled; and, in certain cases, energy, to recreate climates conducive to production. Veolia can also play the role of coordinator, as building a farming production system in an urban environment involves facilitating all the connections with stakeholders. In short, a new Group business line is beginning to take shape.

**What experiments are you working on?**

Our aim is to offer local regions farming systems that combine high-quality production with social and environmental benefits. We are thus focusing on high-performance production models that meet this twofold challenge. To this end, we are concentrating our efforts in two areas. The first concerns the practice of biointensive micro-market gardening\*, which uses little machinery but requires a great deal of manual labor and a high level of farming expertise. For this purpose, we have built an experimental farm in Lille’s Marché d’Intérêt National (MIN) market, studying topics such as “how to handle soil fertility and enrichment using the city’s organic waste resources.” The second concerns aquaponics, and in this respect Veolia has invested in BIGH in Brussels, the largest aquaponics farm in Europe (see Futurist). These two projects allow Veolia to acquire the expertise required for deployment. Veolia can suggest one or

other of the solutions to regions, or even both combined, in order to build high-performance farming production systems.

**You have set up a partnership with ISA Graduate School of Agriculture and Bioengineering in Lille: what benefits does it bring you?**

We are convinced that the micro-market gardening model, which allows highly intensive production on a small surface area while delivering a wide range of complementary benefits (hosting biodiversity, carbon storage, soil regeneration, reduction in heat islands, etc.), is extremely pertinent in the urban environment. However, the soil in the spaces available is very often degraded or even polluted. It is thus crucial to be able to recreate soil when it is absent or unusable. To achieve this objective, we have created a research program with ISA Graduate School of Agriculture and Bioengineering in Lille. The challenge is to construct a functional technosol\*\* using recycled organic and mineral resources. Inspiration is taken from the characteristics of fertile natural soil to create an environment conducive to the biological development of microfauna in the soil.

A major project to characterize the components of natural soil began in May 2019, followed by an inventory of all the available sources of mineral and organic materials in an urban area. The definition of the different mineral categories was completed in October. The beds still need to be established in January 2020 to identify the most effective formulation and measure the settlement of organisms in the schemes. The first results are expected before the summer and will be monitored for three years.

\* Growing a wide variety of vegetables on very small surface areas  
 \*\* Blend of different organic and mineral elements

... Taret, “we are breaking away from chemical treatment, but we still have to find a way to treat the plants in turn, once the post-remediation work has been done. As they are loaded with metals, they must be incinerated to prevent them from contaminating the environment again. The same applies to biological treatments: it’s a matter of identifying the right bacteria, making them proliferate so that they become more insatiable and absorb more pollution and, finally, knowing how to treat bacterial residue.” As soon as they are able to treat heavy metals and compounds such as PCBs (polychlorinated biphenyls), these solutions may be applied to all kinds of soil uses: urban planning, industry and agriculture.

**Changing the scale of regulatory standards**

The international roll-out of standards and methods for diagnosing or characterizing polluted soils and sites is a key challenge to be met by Veolia. “The parameters to be analyzed in soil treatment, identifying the nature or source of the pollution, how the pollution is spreading in the soil, and the impact on the population and biodiversity are all complex data that require a standard methodology across the board,” argues Jean-Christophe Taret. ...

Continued on page 46



DECEMBER 5, 2019

#WORLD SOIL DAY  
 STOP SOIL EROSION,  
 SAVE OUR FUTURE

WITH THIS CAMPAIGN THEME, THE FAO WANTS TO RAISE AWARENESS OF THE IMPORTANCE OF SUSTAINING HEALTHY ECOSYSTEMS AND HUMAN WELL-BEING BY ADDRESSING THE INCREASING CHALLENGES LINKED TO SOIL MANAGEMENT AND DEMONSTRATING THE PROGRESS MADE IN THE FIGHT AGAINST CLIMATE CHANGE AND FOR SUSTAINABLE DEVELOPMENT.



[HTTP://WWW.FAO.ORG/WORLD-SOIL-DAY/EN/](http://www.fao.org/world-soil-day/en/)

Pilot biointensive micro-market gardening farm - Lille's MIN market



...  
 “Starting with the countries most concerned — the United States and Europe — in other words, the most industrialized.” This point of view is shared by Jean-François Nogrette, Senior Vice-President of Veolia Technologies & Contracting and CEO of Veolia Water Technologies, who underlines the importance of a widespread regulatory framework to ensure the traceability of the treated soil: “There is an important need for regulation applicable on a wide scale and, without a doubt, the water sector will be the one to trigger a stricter view of Environmental law.” With a soil remediation methodology in place since 2017, France is leading the way in this area. And other countries are tackling the issue, including China, which has already enacted a number of laws.

**Prevention rather than cure**

As is true of many sectors, it is much more expensive to repair damage than prevent it. For this reason, one of the developments on the site and soil remediation market will be supporting companies and local authorities upstream in anticipating pollution risks. This approach will be reinforced by the introduction of preventive regulations, along with increasing pressure due to citizens’ growing

environmental awareness — which garners broad media and social media coverage — and CSR policies, which have become a must. This heightened preventive role already preempted by Veolia could also be facilitated by technological progress. “Our ace card on this market is access to polluted water and phreatic groundwater. By combining our soil and water treatment technologies and expertise, and drawing on digital tools, we are going to upskill to model the condition of soils, control the spread of pollution in phreatic groundwater, etc.,” envisages Jean-Christophe Taret. “We will have all the data to anticipate health crisis risks linked to soil pollution and implement appropriate solutions.” For Veolia’s Senior Vice-President, Strategy, “in the years to come, prevention will become a major issue at stake, along

with the question of having to feed a constantly growing population.”

**Kindling a promising market**

With its 2.7 billion euros, the soil remediation market is still in its infancy. However, “in the context of a growing global — and especially urban — population, the need for available land areas will also increase,” explains Jean-Francois Nogrette. Veolia must therefore be able to provide solutions that are entirely acceptable from an environmental and health point of view, regardless of the problem or the client in question. In order to have the right to carry out their activities, industry must take this issue into account, prevent the risk, and be able to handle it if it arises. In order to develop, cities must offer

land that can be used. While farmers must be able to work on the healthiest possible soils. “Under combined pressure from the public authorities (regulations) and private players (particularly industry), we should expect the market to double in size over the next twenty years,” predicts Jean-Christophe Taret. ■

1. *The Lancet, October 2017*
2. *L’Usine Nouvelle “Dépolluer les sols, un travail de fourmi,” April 2018*
3. *This decontamination method, well suited to both light and heavy hydrocarbons, consists in heating land to between 400 and 600°C so that pollutants are volatilized. The dust is removed from the gases emitted and they are purified by a bag filter.*
4. *Plants absorb pollutants from soil, especially metals (nickel, arsenic, lead)*
5. *Microbacteria feed on pollution (e.g. PCBs, among other powerful pollutants) and accelerate its breakdown*



The Beijing Yanshan Petrochemicals (BYP) complex, one of the largest Chinese petroleum product manufacturing sites and a subsidiary of Asia’s leading oil and gas company, Sinopec, processes over ten million metric tons of crude oil per year. For several years, protecting the site’s natural ecosystem has been an absolute priority for the manufacturer, which has made it one of the pillars of its strategy. It has been spurred on in this regard by an array of draconian laws, regulations and standards enacted in 2011, particularly targeting the city of Beijing and its petrochemical industry!

**Restoring biodiversity: for Sinopec, Veolia makes the ecological and the petrochemical go hand in hand**

To support it in this transition to more sustainable and responsible industrial practices, BYP chose Veolia, its partner since 2006 in managing the wastewater treatment and recovery facility, as well as optimizing the entire water cycle. The challenge: restoring the NiuKouYu park’s derelict wetlands, by treating the wastewater from BYP’s site. Once reintroduced into these wetlands via “filtering” plants, the site’s treated wastewater thus undergoes a second natural treatment, ensuring that the ecosystems that depend on it will continue to thrive. This vast area, encompassing eight hectares of wetlands, dry grasslands, ponds and willow forests, is home to a wealth of landscapes and ecosystems: plants, insects, amphibians, badgers, hares, rodents, etc. To restore

biodiversity, Veolia has created 23 “terraces” near the petrochemical complex. Each of these terraces has specific vegetation carefully chosen for its purification qualities, in order to optimize the quality of the water entering the natural environment. Restoring the ecosystem has encouraged over fifty bird species to repopulate the area. All the same, the park has also been designed to serve a social purpose: the site has become a hub of activity for the local communities. A popular leisure spot, it has attracted over 600,000 visitors since opening free to the public on November 1, 2017. Thanks to this type of exemplary action to promote biodiversity, Sinopec is now one of the top 10 Chinese companies heavily investing in reducing greenhouse gas emissions. And ranks among the country’s 50 greenest companies.

**Key figures**

- > Over **140 bird** species reintroduced, including black storks, swans and kingfishers
- > **8 hectares** of rehabilitated wetlands including **2.7 hectares** of plantations
- > **1 hectare** dedicated to leisure spaces



Keen to know more about the wetland? Download the app and join the NiuKouYu community.



## When soil changes use...

All around the world, public authorities and industry are turning to Veolia for its methodology of action (cf. infographic) and extreme rigor when it comes to repurposing waste storage sites. This includes coordinating the work and the controls required by local regulations. And when this legislation is evolving, Veolia applies its operating standards on behalf of its clients, going beyond the country's legislation.

48/49

**A**ny decision by the public authorities to repurpose a waste storage site, whatever the geographical area, must take two parameters into account: the ensuing change of use of the soil and the accompanying strong social and environmental pressures (residents, communities, nature protection organizations, health bodies, etc.). These two powerful drivers strengthen the public will to implement a project to reintegrate the site into its natural environment, urban or otherwise. In France, as in the majority of developed countries, final waste — in other words, waste from households,

companies and institutions that cannot be recycled, recuperated or recovered — is stored in non-hazardous waste storage facilities (ISDND). These structures are subject to extremely strict environmental standards to prevent any pollution of the natural environment by infiltration and to guarantee complete remediation of the site when it reaches the end of its commercial use. Its expert knowledge of these issues and contexts today allows Veolia to answer calls for tender and requests to intervene in extreme situations of uncontrolled landfills, especially in emerging countries. The example of Akouédo in Côte d'Ivoire is a good illustration (cf. opposite). ■

# The key steps in the remediation of a waste storage site



### 1 BEFORE THE PROJECT BEGINS

- Make sure that the site is administratively closed.
- Think about the site's possible reconversion: landscaped park, farming activities, leisure facilities, etc.

### 3 WORKS PHASE up to 2 years

- Veolia is particularly keen to manage the methane-rich gas from waste decomposition (biogas) along with the polluted water (leachate) produced by the site.
- Veolia controls and supervises the program of works:

- A Earthworks and impermeability
- B Drainage
- C Capturing and collecting leachate and biogas (methane)
- D Purifying the leachate before discharge into the natural environment
- E Turning biogas into energy
- F Revegetation

### 2 STUDY PHASE ~3 to 6 months

- Carry out an environmental diagnosis and research into remediation solutions.

**The Veolia plus:** Providing full engineering services for the project.

### 4 POST-CLOSURE MONITORING up to 30 years

- After the work to remediate and recondition the site: effluent management and monitoring of receiving environments (surface water, groundwater, air, human health).

**The Veolia pluses:** Controlling and supervising the program of works / Capturing and collecting effluent / Purifying the leachate before discharge into the natural environment / Turning biogas into energy.

## VEOLIA WILL CARRY OUT THE REMEDIATION PROJECT FOR THE AKOUÉDO LANDFILL IN ABIDJAN (CÔTE D'IVOIRE)

Pollution of the soil, subsoil, air, groundwater, and the neighboring Ebrié lagoon... The closure of the Akouédo landfill is the culmination of environmental considerations and the political will to improve the living conditions of neighboring communities and those downstream of this heavily polluted site.

### WHAT ARE WE TALKING ABOUT?

- The term **“non-hazardous waste storage facility (ISDND)”** denotes storage sites that comply with current regulatory requirements and standards. As they are Environmentally Protected Facilities, these centers are subject to strict regulations regarding their design, construction, operation, and even post-closure.
- The term **“controlled landfill”** is used for any non-hazardous waste storage site subject to regulatory post-closure monitoring. These sites may not have an active formation barrier or leachate and/or biogas management.
- The term **“uncontrolled landfill”** is used for uncontrolled waste storage sites not subject to post-closure monitoring.

### TIMING OF THE OPERATION

30 MONTHS (INCLUDING RESEARCH)

**December 2018** Closure of the Akouédo landfill by the operator PFO Africa, at the request of the Ivorian government

**Early 2019** PFO Africa asks for Veolia's support and expertise

**September 2019** Veolia submits to PFO Africa the detailed design for the works and the results of the preliminary studies

**End of 2021** Completion of landscaping

### AKOUÉDO IN FIGURES

- **53 years** of uncontrolled open-air dumping
- **1.8 million metric tons** of untreated waste stored
- **~1.2 Mt/year** of all kinds of (household, hospital, industrial, agrifood, etc.) waste dumped
- **90 ha** of land to be remediated
- **2.5 years' research** and work
- **~€100 M** for the total cost of the operation

### VEOLIA PROJECT MANAGER, REFURBISHING AND SECURING THE SITE

- Creating an impermeable layer based on geosynthetic products
- Laying pipelines and peripheral drains for runoff
- Facilities for capturing, collecting, storing and treating 80,000 m<sup>3</sup>/year of leachate
- Facilities for capturing, collecting and treating biogas
- Installing a cogeneration unit with a production capacity of 2 MW of green electricity

### MAJOR SOCIAL AND SOCIETAL SUPPORT

- Landscaping the site into an urban green space: sporting facilities, training center for environmental professions, open-air cinema, etc.
- Compensation system for the pollution suffered by the village of Akouédo: improving the thoroughfares, creating a covered market, community clinic and a high school for young girls
- Information/awareness-raising campaign for residents regarding the works
- Hiring mostly local residents for the site's post-closure plan



## Aquaponics: a budding solution to feed cities

In the urban agriculture family, aquaponics is in demand: a contraction of the words aquaculture (fish breeding) and hydroponics (soilless plant cultivation), aquaponics is one of the concrete solutions to tomorrow's food issues\*. Its main advantage is a high-performance, high-quality farming production system that can be easily integrated at the heart of the urban fabric.

This system, which falls under the Fertile Cities by Veolia project's field of study, harnesses the expertise of the Group's long-standing sectors of activity, which aim to build a circular

economy in terms of energy, water and organic soil enrichers. For several years, Veolia has therefore been developing know-how in designing and constructing high-performance aquaculture systems. "Constructing agricultural production in an urban environment already involves a circular perspective, as the city has a great many useful resources. One of the key factors in aquaponics' success is adopting a systemic approach. The role of a coordinator like Veolia is thus decisive in the success of this type of practice," explains

Loïc Couttelle, Project Director at 2EI Veolia. Whether it concerns controlling the water cycle for irrigation or the organic matter cycle to ensure crop fertility, along with the energy to create a favorable climate for plants, Veolia's three main areas of expertise complement each other at each step in the aquaponics system. In Brussels, the Group is helping the start-up BIGH (see boxed text) with the technical development of the largest aquaponics farm in Europe: 1,000 m<sup>2</sup> of aquaculture ponds, 2,000 m<sup>2</sup> of outdoor productive vegetable gardens, and 2,000 m<sup>2</sup>

of horticultural greenhouses. Installed on the roof of Foodmet food hall, it enjoys a huge surface area, an essential condition for breeding high-quality aquatic species for consumption and growing large amounts of plants. An aquaponics pioneer, BIGH can count on Veolia's international business network and its technical capacity to roll out a vast network of urban farms.

\*According to the FAO, to feed the projected global population of 9.5 billion by 2050 (80% of whom will be living in cities), global food production must increase by 70%.

➤ **Founded in 2015 to create an aquaponics-based urban agriculture model**, the start-up BIGH (Building Integrated GreenHouses) opened the "Ferme Abattoir" in Brussels in January 2018. Built under and on the roof of Foodmet (a recently rehabilitated food market), this farm allows it to distribute top-quality produce while favoring short supply chains and local consumption. Working in close collaboration with BIGH since 2017, Veolia became a company shareholder in September 2019.

MARCH 21, 2020

## INTERNATIONAL DAY OF FORESTS LEARN TO LOVE FORESTS

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How and why, at a glance

# Organic waste recovery



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