

PLANET

#February 2019



Climate: What now?

Forum

Winning the climate fight: mission possible?

Frontline

China: Shandong Hongda Chemical promotes energy efficiency

Outfront

When Veolia commits to fighting global warming

Explainer

Heat islands: when water refreshes the city

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Cover photo: Superbien



Antoine Frérot
CEO of Veolia

The climate is shaking up the fate of people, cities and businesses, and we feel the bite of these changes with each passing year.

The longer we wait to act, the more our environmental debt grows. The less effort we make to reduce our CO₂ emissions, the more we will have to do in the very long term to adapt to deep climate changes.

In the light of this fact, should we give up? Should we despair? I do not believe so, and I'm even convinced that **it is still possible to change the game**, by stabilizing global warming before nature decides for us, at a high price for humanity.

Many solutions exist, with a considerable potential impact on reducing greenhouse gas emissions. According to an exclusive study by the strategy consulting firm Roland Berger for Veolia, the environmental services sector alone could deliver **up to 30% of the reduction in greenhouse gas emissions** required to keep the temperature rise below 2°C by 2100.

Not all of these solutions require huge financial resources, a fundamental challenge to our lifestyles, or pressing global coordination. This is why, at Veolia, we want to share **an optimistic yet pragmatic view** of the fight against climate change. **What is both possible and realistic to implement in the short, medium, and long term? And what will be the impact?**

Several categories of solutions emerge depending on how quickly they can have an

impact on reducing greenhouse gas emissions:

- **short-term solutions, in other words those whose impact could be felt by 2025.** In decreasing order of impact on emissions reduction: energy efficiency in industry, the development of cogeneration, organic waste recovery, non-recyclable waste incineration, an increase in drinking water network efficiency, along with — in the case of adaptation measures — the desalination of seawater;
- **solutions that span the short (2020-2025) and medium term (2025-2035):** energy efficiency of buildings, waste heat recovery from industry and wastewater, plastic recycling, recycling of waste other than plastic;
- **medium-term solutions, whose impact will be seen by 2035:** the development of biomass boilers (mitigation solution) and wastewater reuse (adaptation solution);
- **long-term solutions, whose impact will be seen after 2035:** these are CO₂ capture and energy storage.

This special edition of Planet presents some of these solutions that could allow us to win the battle against climate change.

I hope that you enjoy reading it.

Antoine Frérot
CEO of Veolia

EDITORIAL

CONTRIBUTORS



Michał Kurtyka

Secretary of State in Poland's Ministry of Energy and Environment
Michał Kurtyka presided over COP24, which was held from December 2 to 15, 2018 in Katowice. A French speaker who studied at the École Polytechnique and an economic specialist, he actively championed Poland's membership of the European Union. Michał Kurtyka also represents his country at the International Energy Agency.



Thomas Joly

Mayor of Verrières-le-Buisson since 2013,
and town councillor of Verrières-le-Buisson since 1989, for thirty years Thomas Joly has been reconciling environmental protection with municipal management concerns. Since 1986, he has worked to promote the sustainable development of his region within several organizations and is Vice-President of the Paris-Saclay conurbation authority. He currently advises the president of the organization Teragir, where he began his career.



Wei Hongtao

General Manager of Shandong Hongda Chemical, China
Since 2016, Wei Hongtao has been the General Manager of Shandong Hongda Chemical Co. Ltd., a major chemicals manufacturer actively involved in China's industrial transformation in the face of climate change. With over ten years' experience in the chemicals industry, Wei Hongtao has gained solid expertise in areas such as health, safety and management.



Ludwig Narib

City of Windhoek Strategic Executive Director
Ludwig Narib is an engineer who has been working on behalf of the city of Windhoek, the capital of Namibia, since 1998. As Strategic Executive for Infrastructure, Water and Technical Services for Windhoek, he oversees the quality controls of the drinking water produced from recycled water at the Goreangab facility.

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FEBRUARY 27 TO MARCH 1, 2019 - WELS (AUSTRIA)

agenda

WORLD SUSTAINABLE ENERGY DAYS

SUSTAINABLE ENERGY EUROPE

SUPPORTED BY THE INTELLIGENT ENERGY EUROPE PROGRAM, IT IS ONE OF THE LARGEST ANNUAL CONFERENCES IN THE SECTOR, AT THE HEART OF THE EUROPEAN UNION'S COMMITMENT TO A CLEAN ENERGY TRANSITION.

[HTTP://WWW.WSED.AT/EN/WORLD-SUSTAINABLE-ENERGY-DAYS.HTML](http://www.wsed.at/en/world-sustainable-energy-days.html)

TRENDS



2035: a tipping point for the energy transition

In a study published in June 2018, the firm Wood Mackenzie determined 2035 as the irreversible turning point for the energy transition, for companies and states alike. This turning point is explained by the convergence of two curves: on this date, solar and wind power will represent 20% of the world's energy demand, i.e. three times more than is currently the case. At the same time, electric vehicles will cover the same share of the transport sector on a global scale. Together, solar energy, wind power and electric vehicles will replace over 2,800 billion liters of oil each day, becoming the main drivers of growth. Over the coming decades, the study predicts that renewables will become “the default choice across many energy systems around the world.” As of 2036, electric vehicles will represent between 15 and 20% of all kilometers travelled globally by cars, buses, trucks or bikes. This paradigm shift will make it possible to avoid the daily consumption of 6 million barrels of oil by 2040.

10.34 million jobs were created thanks to renewable energy worldwide in 2017, i.e. a 45% increase over 2012.

Source: International Renewable Energy Agency

2.7% increase in CO₂ emissions on a global scale in 2018.

Source: Earth System Science Data

3.5 billion people depend on the oceans for their subsistence.

Source: Sea Change - European Union

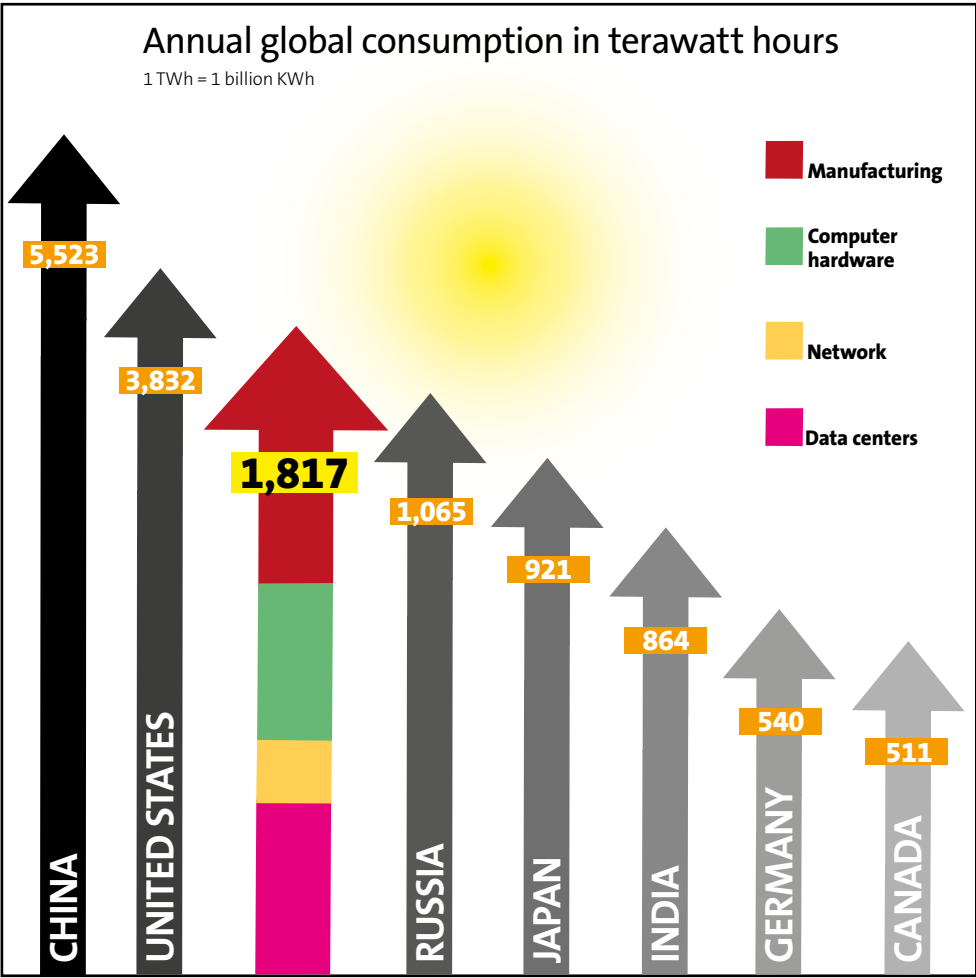
126 billion liters of water are lost worldwide each year due to network leaks.

Source: Frost & Sullivan

COP24: measured ambitions, but operational guidelines

The 24th United Nations Climate Change Conference was held from December 2 to 15, 2018 in Katowice, Poland, marked by a sense of environmental urgency. Despite the four scenarios formulated by the IPCC's experts, the most pessimistic of which forecasts 5.5°C global warming if we do nothing, the 196 participant countries did not unanimously recognize the validity of the scientists' work. To move forward despite this lack of political cohesion, the effective implementation of the Paris agreement was therefore the conference's key issue.

At the end of difficult and technical diplomatic negotiations, all the States that met in Katowice finally came to an agreement to define the framework for implementing the commitment made in Paris in 2015: limiting global warming to between 1.5°C and 2°C by 2100. This shared desire took concrete form in guidelines covering one hundred or so pages, committing the signatory States to the utmost transparency regarding the measures that will be taken as part of their “nationally determined contributions” to reduce their CO₂ emissions. “The decisions made here to implement the agreement give us a solid basis for continuing to build confidence in multilateralism and accelerate the transition throughout the world,” stated Laurence Tubiana, CEO of the European Climate Foundation.



If the Internet were a country, it would be the third largest electricity consumer in the world

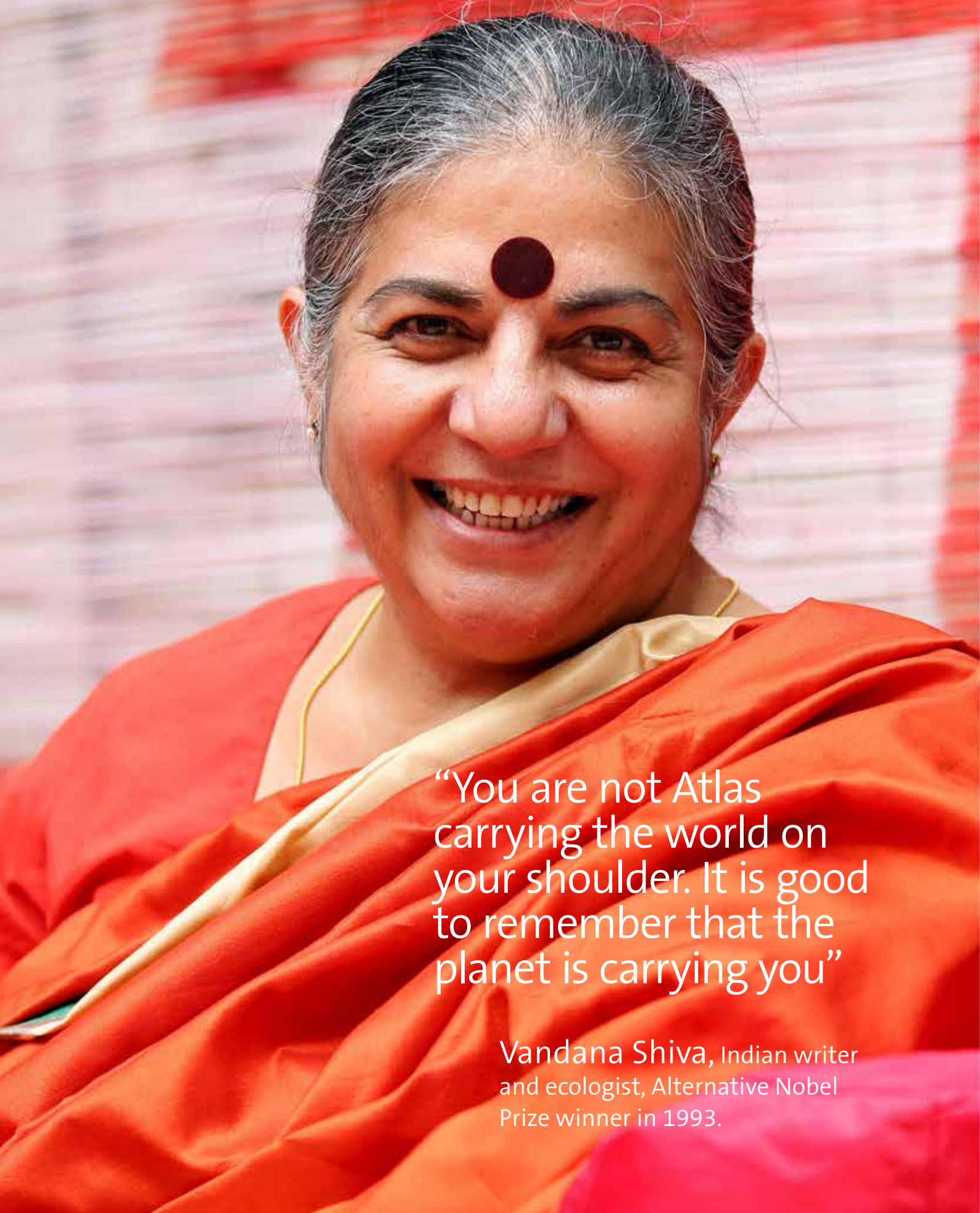
With over 1,800 TWh each year, the Internet is nowadays one of the planet's largest electricity consumers. According to the Clicking Clean report published by Greenpeace in January 2017, the information and communication technologies sector comes in third position, behind China and the United States. Digital absorbs about 7% of global electricity. According to Greenpeace, this consumption is set to double every four years.

Sources:

<https://www.greenpeace.org/international/publication/6826/clicking-clean-2017/>

Nature: a remedy for the global water crisis

By 2025, over two-thirds of the world's population will live in areas potentially under water stress. This alarming information comes from the NGO “The Nature Conservancy” (TNC), which at the same time reckons that nature could improve the water supply for a billion people. Fighting for water integrity has become one of its battles, leading to the creation of a long-term environmental conservation model for watersheds: Water Funds. Building on the momentum of the first one in Quito (Ecuador) in 2000, some thirty Water Funds have been created around the globe and as many are currently being deployed in North and Latin America, Africa and Asia. The success of this form of water governance lies in the fact that each stakeholder — local authorities, companies, governments, multilateral institutions, organizations, etc. — collaborates in protecting the resource and nature by finding mutual benefits. To date, more than 100 companies have invested over 38 billion dollars in this model. TNC is now looking to mobilize more private players under the aegis of the United Nations, especially water services specialists with a strong international presence.



“You are not Atlas carrying the world on your shoulder. It is good to remember that the planet is carrying you”

Vandana Shiva, Indian writer and ecologist, Alternative Nobel Prize winner in 1993.

INSIDE

VEOLIA IN THE GLOBAL TOP 10 OF THE 2018 ECOACT RANKING

Each year, the report published by EcoAct distinguishes the highest-performing companies in terms of climate action. The 2018 ranking, published at the close of Climate Week NYC in September, put Veolia in ninth place. “As a world leader in environmental services management, the Group relies on an environmental management system supervised by its Sustainable Development Committee. Veolia has emerged as an industry leader with aggressive CO₂ reduction plans, a procurement policy and a rigorous supplier monitoring system,” highlights the EcoAct report. Veolia is one of only two French companies to feature on this list.



UZBEKISTAN VEOLIA WILL SUPPORT TASHKENT IN MODERNIZING ITS WATER SERVICE

A memorandum of understanding between Veolia and the Republic of Uzbekistan was signed on October 9, 2018 to modernize the water service in Tashkent, the country's capital. Veolia will manage the drinking water production and distribution and wastewater treatment facilities for a 25-year period. Within the framework of this contract, which will come into effect during the first half of 2019, Veolia will also be responsible for monitoring the investments required to modernize the Uzbek capital's water network in coordination with the local authorities. This memorandum was signed during the President of Uzbekistan Shavkat Mirziyoyev's state visit to France.

Telex

The Veolia foundation took part in the humanitarian emergency operations deployed by the French Ministry of Foreign Affairs and International Development in Palu, on the island of Sulawesi (Indonesia), following the earthquake and tsunami of September 28, 2018.



Veolia took part in the European Commission's consultation with a view to revising the ambient air quality directives. A bill could be proposed in 2019.

Last September, Veolia and New York City collected 18 metric tons of hazardous household waste during the seventh safe disposal campaign carried out among residents.



AUSTRALIA VEOLIA IS GOING TO RUN THE COUNTRY'S FIRST WASTE- TO-ENERGY FACILITY

The future waste-to-energy (WtE) power plant in Kwinana, in the Perth area, will come into service in 2021. The plant, which is the first of its kind in Australia, will treat 400,000 metric tons of municipal solid waste each year and produce 40 megawatts (MW) of green energy, i.e. the energy consumption of 50,000 households. Veolia already manages several renewable energy production facilities in the country: the Woodlawn site in New South Wales produces energy for 30,000 households using biogas from Sydney's organic waste; the Ti Tree Bioenergy Facility in Queensland supplies 2,500 households with green electricity produced from biogas; the Earthpower plant in New South Wales, the first regional waste-to-energy facility (food only) in Australia, provides over 3,600 households with green electricity.

UNITED STATES VEOLIA WINS TWO RADIOACTIVE METAL WASTE TREATMENT CONTRACTS

The Idaho National Laboratory (INL), managed and run by Battelle Energy Alliance under the authority of the United States Department of Energy, has chosen Veolia's Nuclear Solutions activity to treat its radioactive metal waste. Both contracts signed with the INL involve the use of the GeoMelt® solution, a method for chemically converting radioactive metals into an inert oxide, while immobilizing radionuclides in a durable vitrified waste form.



VEOLIA AND UNILEVER
IN A NEW PLASTICS ECONOMY LOOP

At the end of October, Veolia and Unilever signed a collaboration agreement on sustainable packaging. The two companies will combine their know-how with a view to boosting a circular plastics economy in several regions of the world. Starting with India and Indonesia, two countries swamped by plastic pollution, where Veolia and Unilever will implement used packaging collection solutions, reinforce their recycling capacities and develop new business models and methods.

VEOLIA
AT THE HEART OF THE NEW ALLIANCE
TO END PLASTIC WASTE

Launched on January 16, 2019 in London (United Kingdom), the Alliance to End Plastic Waste (AEPW) wants to stem the scourge of plastic waste in the environment, starting with the oceans. Some thirty companies, involved in the plastics and consumer goods value chain in North and South America, Europe, Asia, Africa and the Middle East, have come together in this new coalition, which has committed to donating over one billion dollars — with the aim of reaching 1.5 billion dollars — over a five-year period, to increase and disseminate solutions to reduce and manage plastic waste.

A key goal for Veolia, as a founding member:

“Tackling plastic waste in the environment and developing a circular economy requires the participation of all the actors in the value chain and the long-term commitment of companies, governments and communities. No country, company or community can solve this problem alone,” stated Antoine Frérot, CEO of Veolia and Vice-President of the AEPW.

Telex

COP24 briefing in Cracow on October 22, 2018: Antoine Frérot, Veolia’s CEO, shared his vision of the megalopolises of the future along with the Group’s commitment to climate change action.

Antoine Frérot and the President of the French National Natural History Museum (MNHN), Bruno David, signed a framework agreement in November to consolidate and deepen the long-standing collaboration between Veolia and the MNHN to promote biodiversity.

London’s South Quay Plaza building complex, which is home to the UK’s highest residential tower, will use Veolia’s latest heat and power cogeneration technologies to produce low-carbon energy.

Veolia and two French research institutes — INRA (French National Institute for Agricultural Research) and IRSTEA (National Research Institute of Science and Technology for Environment and Agriculture) — signed a five-year framework agreement in November concerning the use of composts from the circular economy to recover the agronomic potential of soils.



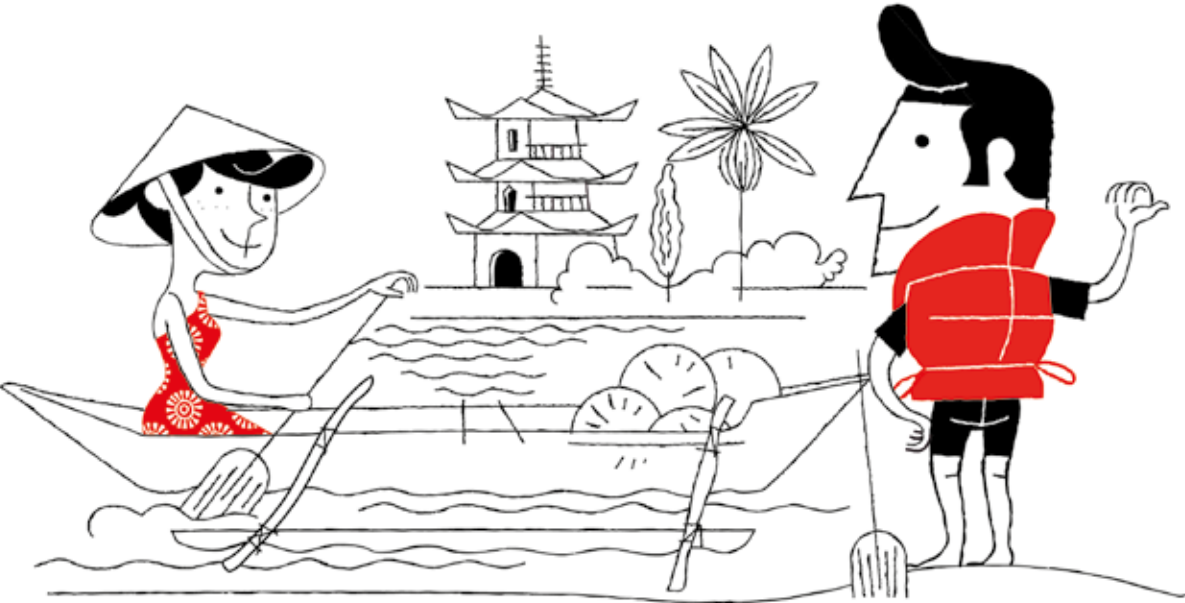
UNITED KINGDOM
AIR QUALITY
DESERVES A
TECHNOLOGICAL
REVOLUTION

Devised collectively by Eminox, Veolia and Westminster City Council, a technology tested on garbage trucks’ tailpipes in this downtown London area has led to a 99% drop in their nitrogen dioxide emission levels, which are lower than new vehicles in line with the Euro 6 pollution standard. The solution, which combines a diesel particle filter with selective catalytic reduction and Amminex ASDS™ technology, is an industry first. Enabling older diesel vehicles to meet the Euro 6 standard allows them to travel in the ULEZs (Ultra Low Emission Zones) introduced by Transport for London, Greater London’s public transport regulatory body.

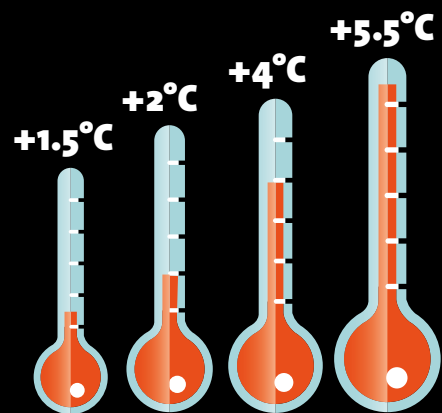
MARCH 22, 2019
WORLD WATER DAY

LEAVING NO ONE BEHIND

ALLOWING EVERYONE — RESIDENTS, IMMIGRANTS, REFUGEES, THE STATELESS — EVERYWHERE TO BENEFIT FROM DEVELOPMENT AND ACHIEVE THE FULL REALIZATION OF HUMAN RIGHTS, WITHOUT DISCRIMINATION ON THE BASIS OF GENDER, AGE, RACE, LANGUAGE, RELIGION, OPINIONS, DISABILITY, ETC.



[HTTPS://WWW.UNWATER.ORG/WHAT-WE-DO/INSPIRE-ACTION](https://www.unwater.org/what-we-do/inspire-action)



Source: IPCC, special report, October 2018 = scenario of +1.5°C compared to the pre-industrial era, between 2030 and 2052 Source: IPCC, 5th report, 2015 = scenarios of +2°C, +4°C and +5.5°C compared to the pre-industrial era, looking to 2100

The 4 forecasts for the planet

While the United Nations 24th Climate Change Conference (COP24) concluded on December 16, 2018 with an agreement on a technical guide – the Paris Rulebook – essential for implementing 2015's agreement, the 195 signatory States (plus the European Union) have not met their greenhouse gas reduction targets. Yes, the international community has definitively adopted the 1.5°C goal and now has a method for measuring, checking and reporting on the progress made by GHG reduction policies. However, the commitments made by the States to date would lead to warming of 3.3°C in 2100. This reflects a real lack of political will to promote both emissions mitigation and adaptation in countries affected by global warming.

BY 2100... IF WE DO NOT TAKE ACTION

HALF A DEGREE MAKES ALL THE DIFFERENCE!

Rising sea levels, the frequency and intensity of heat waves, the violence of deadly hurricanes, floods and scorching heat... All around the world, the number of extreme events due to climate change is increasing. The impacts are already visible at 1°C warming, the average threshold reached worldwide in 2017 compared to the pre-industrial era. These climate events affect the lives of billions of people, especially the most vulnerable. In the fight against climate change, every tenth of a degree counts.

At 1.5°C warming, the consequences on populations and ecosystems worsen.

At 2°C, the impacts would be dramatic on our ability to feed ourselves and on our health, and could even become irreversible.

Beyond 3°C, the situation would become critical: mass extinction of animal and plant species, heightened food insecurity and massive population movements.

MITIGATION AND ADAPTATION MEASURES

The IPCC's October 2018 report highlights:

stabilizing global warming at 1.5°C – one of the goals of the Paris agreement – remains possible but requires profound and rapid changes in our societies. The latter therefore have ten years to reduce their human-induced carbon dioxide (CO₂) emissions by about 45% compared to 2010 levels! And they must achieve zero net emissions by 2050.

It is therefore time to accelerate the pace of implementation regarding two key measures: mitigation and adaptation. The first makes it possible to stabilize or even reduce GHG concentrations in the atmosphere through anthropogenic intervention. The solutions developed include CO₂ capture and storage, methanization, and energy efficiency. The second targets the ability of a natural or human system to adjust to climate change, in order to control any consequences thereof or deal with the repercussions of negative impacts that cannot be avoided. It may involve restoring ecosystems, managing biodiversity, sustainably managing water, etc.

TIME FOR ACTION

The Climate Summit organized by the UN in New York on September 23, 2019 will be crucial in raising States' ambitions. Likewise, COP25 in Chile in December must ratify these new commitments, settle the question of the global carbon market, and begin implementing the greenhouse gas global stocktake for 2023. Many industrial companies such as Veolia, major cities and organizations are unhesitatingly striving day after day to maintain the ambitious

climate targets. In its activities, Veolia is working to reduce greenhouse gas emissions and invent solutions to avoid them (cf. the topics addressed in this issue). Mitigation solutions based on the circular economy: waste recycling and recovery, renewable energy production, energy efficiency, and district heating. Adaptation and resilience solutions: water recycling in areas under water stress, sanitation control during rainy weather, etc.

WHAT AWAITS US AT +3°C



Heightened heat waves

Heat waves have tripled in frequency, accelerating in particular the phenomenon of urban heat islands where the thermometer can reach up to 50°C. Extreme hot or cold temperatures are all the more frequent as the average rise in land temperatures increases.

More frequent floods, storms and hurricanes

Average rainfall is increasing in wet regions, while dry regions are becoming even more parched. 800,000 Europeans are victims of river flooding each year. On the other hand, (subtropical) dry regions are becoming even more arid. Extreme weather episodes are becoming increasingly intense, endangering the survival of the most vulnerable populations.

Food and health crises

Falling crop yields and water reserves on a regional scale are increasing certain risks – food insecurity, heightened tensions linked to conflicts over the resource's use, etc. – especially for the most disadvantaged populations. Periods of extreme heat in urban environments lead to many deaths among the very young, the elderly and outdoor workers.

Rising sea levels and melting ice and permafrost

The sea level has risen by **98 centimeters**. One in ten people worldwide is affected. **85%** (in volume terms) of glaciers have disappeared. **81% of the permafrost** (ground that has permanently frozen) has melted, releasing enormous amounts of methane, a powerful greenhouse gas. 10,000 small islands have been erased from the map.

Loss of biodiversity

Corals have practically vanished under the effect of ocean acidification. The disappearance of these major stalwarts of the ocean food chain is leading to the disappearance of many other marine species. Climate change is accelerating changes in land ecosystems, causing the extinction of one in six species. And provoking the disappearance of the goods and services offered by nature.

Sources: IPCC Fifth Assessment Report; Potential impact of sea level on French islands worldwide, CNRS, 2013; Climate change, heading towards an increased flood risk in France and Europe? CEPRI

Winning the climate fight: mission possible?

Michał Kurtyka and Antoine Frérot debate the question.

14/15



Michał Kurtyka
Polish Secretary of State for
the Environment, President of
COP24



Antoine Frérot
CEO of Veolia

COP24, which came to an end on December 14, 2018 in Katowice, Poland, has given birth to the Katowice Rulebook. All the players — whether civil society, politicians or companies — are concerned in the fight against climate change, with interests that are sometimes difficult to reconcile. What role should everyone play and what kind of just transition should be sought, given the sense of environmental urgency? Michał Kurtyka, President of COP24 and Polish Secretary of State for the Environment, and Antoine Frérot, Veolia's CEO, debate the issue.

As President of COP24 in Katowice, what are your conclusions from the conference?

Michał Kurtyka: It was an extremely complex negotiation that was both very technical and very political. From this point of view, I think that COP24 in Katowice was a success. We laid down the rules for a global climate policy; we reached a consensus. These rules will come into effect in 2021 all over the globe, replacing the Kyoto Protocol, and this large-scale global framework will be reviewed every five years. Once implemented, they will oblige States to be transparent regarding climate change actions. Both developed and developing countries alike will gain from this. We are going to mutually induce one another to keep our promises and guarantee developing countries support in terms of funding, technology transfer, and administrative capacities.

There are many signs nowadays that the climate crisis is worsening. At the same time, certain experts, such as the IPCC, believe that it is still possible to change the climate situation. Personally, do you think that humanity is capable of winning the climate fight?

Antoine Frérot: There are battles where the stakes are so high that we must engage in them, even if the chances of success seem slim. The fight to limit climate change — and thus preserve the habitability of our planet — is obviously one such battle.

Despite the size of the task to be accomplished, it is possible to achieve a carbon-free economy within the timeframe required by the climate clock. But we must agree, collectively and individually, to do more. Everyone — i.e. States that define energy policies; cities that emit 75% of the planet's CO₂ emissions but can also influence lifestyles limiting them; companies that consume resources but invent low-carbon solutions; organizations that are highly involved in implementing projects on the ground; the inhabitants of Planet Earth who, through their personal decisions, vote for or against the climate dozens of times a day.

M. K.: At COP24, we unanimously adopted the Katowice Rulebook, a set of rules that are going to define the global climate policy for the years ahead. I see this as a sign of optimism, which shows that — beyond the trade wars that States are engaged in from day to day — we are able to address the climate question outside political frameworks. It is sometimes easy to fall into pessimism and tell ourselves “there's nothing we can do.” But that's not an option. I think that humanity has the time, intelligence and resources to meet the climate challenge. Will we be able to seize this opportunity? That will depend not only on the public authorities, but also companies, cities and regions, which are sending us many signals.

“I think that humanity has the time, intelligence and resources to meet the climate challenge.”

Michał Kurtyka

...

Portsmouth,
United Kingdom -
Waste-to-energy
facility.

... In its latest report, the IPCC recommends a significant reduction in anthropogenic CO₂ by 2030 of around 45% compared to 2010 levels. What role can companies in general play to achieve this target? What solutions is Veolia implementing to this end? **A. F.:** Companies play a decisive role because they innovate and can produce lower-carbon goods and services. In this respect, they have a powerful ripple effect on their suppliers, clients and consumers. It was companies, for instance, that were behind the drop in electricity storage costs, a crucial point in the energy transition's success. Veolia is playing its part by inventing processes for recycling end-of-life batteries, which saves rare resources and helps lower costs.

“We are not short on solutions. However, we are lacking the political will and economic incentives to spur the majority of players to replicate them on a wide scale.”

Antoine Frérot

A. F.: Companies such as Veolia already offer a variety of complementary solutions: energy efficiency; renewable energy; the circular economy that drastically reduces carbon emissions by turning waste into resources; capturing methane, which is a pollutant when it is released into the atmosphere but a source of green energy if it is converted into heat, etc. The widespread implementation of these solutions would lead to huge gains. Take waste energy recovery for instance. In Europe, only 1% of waste heat from factories and cities is reused; 99% is lost! We are not short on solutions. However, we are lacking the political will and economic incentives to spur the majority of players to replicate them on a wide scale.

Many global economies are based on coal. What solutions can be deployed to enable a transition to less polluting energy sources? **M. K.:** There is no miracle solution nowadays concerning the global energy equation. However, if we don't make every effort to find it, we will all lose out. Fossil fuel sources emit greenhouse gases and coal is incredibly polluting. It's up to each country to find alternative solutions to fossil fuels. In the case of Poland, for example, the government is thinking about its energy strategy for 2040. This strategy relies heavily on zero-emission sources: solar, wind and nuclear power. In particular, the project currently being discussed provides for significant growth in solar power, from 10,000 MW in 2030 to 20,000 MW in 2040.

A. F.: Our Group is playing an active role in the shift to renewables. In this respect, it has taken measures to switch its coal-powered energy production facilities in Central Europe and China to alternative fuels. In Karviná, in the Czech Republic, coal will shortly be replaced by solid recovered fuel and gas, which emit much less CO₂. At the same time, we have set an internal price per ton of CO₂, which is taken into account when determining our different investments.

The question of financing the energy and ecological transitions remains crucial. In your opinion, what measures should be implemented as a priority? **A. F.:** The main sticking point is concrete incentives to act. To spread low-carbon solutions all along the chain of economic actors, we have to set a CO₂ price. A robust, predictable and sufficiently high price so that cleaning up costs less than polluting by emitting carbon. When it comes to waste and wastewater, States apply the polluter pays principle or strict emissions caps. Strangely, they do this much less for greenhouse gases. At present, only 10% of CO₂ emissions are taxed at a sufficient price to limit warming to two degrees. We will never have a strong climate policy with weak regulatory mechanisms!



M. K.: We are already getting major fund managers on board in redirecting their strategic choices toward responsible investments, and that's great. However, micro-enterprise financing and crowdfunding must also be sought out. And we all have a role to play in this. Finally, there are also European funds. The European Commission recently announced the allocation of 25% of its funds to climate policy within the framework of its next budgetary stance. But what COP24 in Katowice showed and what Paris revealed is that we can't do it without civic dialogue, because social choices lie behind policy choices when it comes to the global climate, energy, food, etc.

On that topic, COP24 in Katowice placed the “just transition” concept at the heart of its debates. What exactly does this mean? **M. K.:** Just transition means establishing a dialogue and showing respect, and that everyone agrees with the decisions made. What direction do we want to take? In this context, policy can only reflect the social

“In the interests of the planet, each country must discern the decisive elements that contribute to the well-being not only of its citizens but also everyone else beyond its borders.”

Michał Kurtyka

consensus. In the interests of the planet, each country must discern the decisive elements that contribute to the well-being not only of its citizens but also everyone else beyond its borders. **A. F.:** This is a key issue. To be accepted, a transition must be just and seen as such. We will be unable to successfully achieve the energy transition if we neglect its social dimension! Responding to the climate emergency is a question of justice, first and foremost with regard to poor countries that are most affected by climate change, even though they are the least responsible for it. In developed countries, we must organize retraining for employees working in coal, the most polluting fossil fuel. There are over 100,000 such workers in Poland and over 70,000 in the United States. In the long term, most of these jobs will disappear. We will have to offset them, in particular by creating other jobs in clean energies: by 2030, 40 million people are predicted to be working in renewables, i.e. four times more than today. ■

In Australia, Henry relies on his teams to head up the Woodlawn ecosite. In Denmark, Leif is proud of Krüger A/S's role in Copenhagen's flood resilience.

Above and beyond

Meeting Veolia employees from all over the world.

18/19

Henry Gundry
Woodlawn Eco-Precinct
Manager
Tarago, New South Wales
Australia

Although he had once thought of becoming a forest ranger in a national park, Henry Gundry decided to give different expression to his passion for the environment: he is now the Woodlawn Eco-precinct Manager in Tarago. This site, which forms the hub of a network of interconnected green projects, hosts infrastructure designed and managed by Veolia. It receives waste from the city of Sydney and transforms it into a number of different resources: biogas for electrical generation and waste heat for aquaculture products. Attached to the facility is an agricultural enterprise where sheep and cattle are raised on Veolia's 15,000 acres of farmland.

Since his arrival in the Group in 2006, Henry has been both witness to and architect of the continued development of the Woodlawn site, which he has been managing since 2017. Initially tasked with ensuring operational environmental compliance, Henry gained experience, drawing on his understanding of sites' monitoring and compliance systems and drafting technical reports for governmental agencies.

As part of his new responsibilities, Henry communicates daily with his teams, who provide him with a detailed picture of the site's activities. Together, they review all the necessary aspects for the smooth running of the site, especially the production processes and safety. "The teams around me are a source of motivation. They help me meet new challenges in terms of innovation and achieve the targets we've set for ourselves," explains Henry. In all these everyday interactions, he prioritizes a direct and casual communication style "that lets you get the best from the people you work with."

This authenticity is also down to his local roots: "I live just four kilometers from my workplace and I also grew up in the area. It's a very important factor, because I'm seen as a real local leading the development of the Eco-Precinct for Veolia while having the surrounding local community's interests at heart."

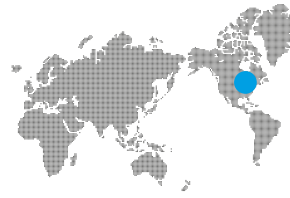
Attached to his local area, Henry is determined to do everything in his power to make Woodlawn an exemplary site. In particular, he mentions the gradual implementation of the aquaculture system, made possible by using the heat generated through biogas capture and electrical generation. This challenge was met with enthusiasm and crowned with success: "The Eco-Precinct's objectives and opportunities are constantly evolving, and that's precisely what I like best about my job," he emphasizes, keen to move Woodlawn even further in the direction of the circular economy. ■





Leif Bentsen
CEO, Krüger A/S
Copenhagen, Denmark

“Understand what we do better than ever, with the primary aim of saving the planet.”
More than a mere objective, this is the philosophy disseminated on a daily basis by Leif Bentsen in his position as CEO of Krüger A/S. Veolia’s Danish subsidiary counts five sites across the country. Specialized in many water-related activities (drinking water, treatment water, urban drainage and sanitation, wastewater treatment, soil decontamination and, more recently, land-based fish farming), it has developed a modeling and control tool to help the city of Copenhagen increase its flood resilience, by preventing wastewater from overflowing into the natural environment in the event of bad weather.
“In 2015, the United Nations set 17 goals to be reached to transform our planet through sustainable development. The sixth goal is to guarantee access to water and sanitation for all, and to ensure sustainable management of water resources. This is precisely the ambition we strive toward every day; what we have successfully achieved with the city of Copenhagen is one of our great sources of pride,” explains Leif Bentsen.
Having joined Krüger in 1991 after obtaining his engineering degree, he often goes to meet its clients. He is keen to discuss as often as possible with stakeholders in order to best meet their expectations and anticipate changes on the environment market.
A soccer and mountain biking enthusiast, Leif is a man of endurance. This trait allows him to sustain the pace of his many travels around the world to identify and set up new sustainable projects for Krüger and its clients. Always on the hunt for trends and innovations in the environment sector, he keeps a close eye on regulatory changes that often open up new markets.
When assessing the outcome of COP24, this hands-on man with a realistic and firmly optimistic approach states that, “while it’s still difficult to see concrete actions, we are going in the right direction, and the negotiations were done properly. The desire for acceleration is a legitimate one, but if we go too quickly, we run the risk of leaving certain countries behind. Things can move very quickly in Europe, because we have the decision-making levers, the investment, and the technology. We must therefore take advantage of them to do our utmost, while accepting that other regions of the world are not following the same rhythm.” ■



Lum berton^{USA}

From chickens to light bulbs... what if our poultry could produce energy?

In North Carolina, chicken droppings, which have traditionally been reused as fertilizer, have become extremely plentiful. Hence the idea of also making them a source of green energy!

Farming is the main economic activity in North Carolina. According to the state's Commissioner of Agriculture and Consumer Services, it brings in 84 billion dollars each year. In 2017, North Carolina even became the leading state for poultry and egg production in the United States, representing 4.8 billion dollars in revenue. However, poultry generates huge amounts of litter. Mat Ware, Vice President, Operations (Energy sector) for Veolia in North America, explains that when poultry farms were still few in number, all the used litter could be utilized as soil fertilizer. However, there are

so many henhouses nowadays that farming land is not enough to absorb the droppings. Professionals are also worried about the consequences of spreading this waste in overly large quantities, especially in terms of polluting the region's rivers, lakes and groundwater resources.

Biomass as a solution

Back in 2007, the North Carolina Utilities Commission decided to develop energy production using this waste and required a certain percentage of the energy sold ...



Issue at stake

► Treating and recovering chicken droppings, which have become extremely plentiful in North Carolina.

Objective

► Convert poultry litter into electricity.

Veolia solution

► Improve the litter recovery rate to make a biomass plant in North Carolina a model of its kind.

FRONTLINE

... by the local public services to come from poultry waste. Several poultry litter-fueled power plants were thus created, such as the Lumberton facility, a former coal-fired power station converted by Georgia Renewable Power (GRP) into a biomass plant, which treats poultry waste and recovers some of it, mixing it with wood chips to produce electricity. Since May 2017, Veolia has been running and managing the Lumberton site on behalf of GRP, supplying electricity to the Duke Energy grid. While the plant previously only recovered around 10% of the poultry waste – the rest of the energy coming from wood chip recovery – Veolia has succeeded in increasing the share of poultry waste recovered to over 30%. “We worked flat out to optimize the plant’s efficiency,” states Mat Ware. “The owners are planning to replace the boilers, which would allow us to reach 100% poultry waste recovered.” Nowadays, the plant treats up to 285,000 metric tons of poultry waste each year and produces 25 MW of energy per hour.

Sustainable energy

A contractual clause paired with a financial incentive encourages the facility to recover as much litter as possible. This is a beneficial challenge in more ways than one: first of all, the ash from the plant, which still contains the nutrients from the litter decomposition, can be used either as a green fertilizer or for land restoration. Then, the heat given off by

the recovery process is used to dry the wood chips destined for export that will power biomass plants in the United Kingdom, Europe and Asia. “These chips generally have a moisture content of 30%,” adds Mat Ware. “By drying them to lower this content to 6 or 7%, we obtain a better fuel while reducing the volume of water to be transported.” For Georgia Renewable Power, the partnership with Veolia has borne fruit, as Ciaran McManus, GRP’s Director of Assets and Operations, explains: “We are delighted to partner with Veolia in this pioneering



Mathew Ware, Vice President, Operations (Energy sector) for Veolia in North America

How Veolia is developing biomass in North America

“Energy production from poultry waste is a relatively new market in North Carolina. However, the favorable commercial and regulatory context and the amount of biomass available make it a promising one. Veolia is currently working with Georgia Renewable Power to

build two 65-MW plants in northern Georgia. In the United States, there are an increasing number of initiatives looking to abandon fossil fuels in favor of renewable energy. This has resulted in the rise of wind and solar technologies, as well as biomass, which also has an important role to

play. Other technologies such as methanization, which consists in recovering biological sources (i.e. food waste or sludge from wastewater treatment plants) into methane – natural gas – are developing. Veolia North America is becoming increasingly involved in this field. ”

project. Burning chicken droppings for fuel is highly complex and has certainly put the expertise and skills of both companies to the test. We really had to work together to ensure this project’s success.” Thanks to Veolia’s engagement and the visionary choice made by GRP to convert the facility, North Carolina has found a twofold solution to its problem: treating and recovering chicken droppings, as well as producing renewable electricity for individuals and industry. This collective effort has delivered a solution to everyone’s benefit. ■

In Morocco, the first carbon-neutral automotive plant in the world thanks to olive stones

Far from the United States, other countries are using original biomass fuels as an energy source. In Morocco, for instance, Veolia has joined forces with the car manufacturer Renault on its Dacia site in Tangier. Tariq Bensaid, Director of Operations for Veolia Industries in Morocco, explains how olive residues are used in the car manufacturing process. “Morocco is the fourth largest olive producer in the world. We therefore have a huge amount of olive stones and pulp from olive groves and oil mills. At the

automobile plant in Tangier, we power our biomass boilers with a mix made up of 80% olive residues and 20% ground wood pallets. In total, 23,000 metric tons of olive residues are treated each year by these biomass boilers to produce heat. We have two boilers with a capacity of 6 MW, which produce hot water at 90°C, and a 6.5-MW boiler for the production of superheated water at 220°C at 36 bar pressure. This heat supplies the hot water required for the manufacturing processes. The extra thermal energy is used in other

processes, such as operating the ovens for drying the car paint. This initiative has enabled the plant to obtain the European Union’s eco-label for its sustainable production methods. ■

KEY FIGURES

- **23,000 metric tons** of olive residues recovered in Tangier
- **76 GWh** of heat produced, used to manufacture cars at Renault’s Moroccan plant

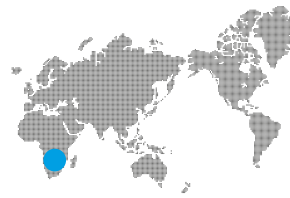


KEY FIGURES

- **285,000 metric tons** of poultry waste treated each year in North Carolina
- **25 MW** of energy produced per year, enough to power some **18,750 households** in the region



Windhoek



NAMIBIA

Recycled wastewater, a drinking water (re)source

Many metropolises around the world can barely meet their inhabitants' drinking water needs. Climate change is making the situation worse. What if recycling wastewater were the solution? This is the choice made by Windhoek – Namibia's capital – to guarantee a safe and sustainable drinking water supply.

Namibia is one of the most arid countries in the world; crossed by the Kalahari and Namib deserts and bordered to the west by the Atlantic Coast, rainfall is virtually nonexistent. Although it is located in a greener area, its capital Windhoek is under

constant water stress, with an average annual pluviometry of barely 300 mm, and aquifers that strong evaporation prevents from being refilled. To cope with this extreme situation, this African country introduced an unprecedented solution

back in 1968: recycling municipal wastewater for human consumption. Worldwide to date, this solution has only been deployed in Windhoek, Singapore and California's Orange County (United States).

"Multi-barrier" technology

The city of Windhoek's wastewater is treated in its Goreangab plant, which opened in 1968. Modernized in 2002-2003, it has since been run and managed by Windhoek Goreangab Operating Company (WINGOC), a consortium held 67% by Veolia and 33% by the WABAG group. During this modernization phase, several innovative technologies were put in place – biofiltration and granular activated carbon filtration, along with a "multi-barrier" ...



Issue at stake

► Increasing water resources in Windhoek – the capital of Namibia – one of the most arid cities in the world.

Objective

► Create new resources to secure Windhoek's drinking water supply.

Veolia solution

► Converting municipal wastewater into drinking water.

FRONTLINE

... process – to remove four main elements from wastewater (physical and organoleptic elements, macroelements, microbiological and disinfection by-products). The combination of technologies, chemicals and filters makes it possible to eliminate pollutants and solids in order to produce clean and perfectly drinkable water.

“Drinking water production from wastewater is based on the multi-barrier concept,” explains Thomas Honer, WINGOC’s General Manager. “Domestic effluents are treated using activated sludge. They are then transported to the Goreangab facility where they are converted into drinking water.” The water made fit for drinking is then mixed with other supply sources, such as reservoir water and underground water from aquifers.

A battery of controls

The drinking water produced by the Goreangab facility is constantly subject to quality controls, not only to ensure the safety of the sources but also to win the public’s trust. “Samples are analyzed in the laboratory every thirty minutes,” states Ludwig Narib, Strategic Executive for Infrastructure, Water and Technical Services for the city of Windhoek. In addition, there is a health risk management program linked to research projects. It includes advanced tests in terms of virology, parasites, toxicity, pesticides, algae toxins, etc., conducted by external laboratories. Last but not least, the plant has been entirely automated: “the quality of the water is continually tested thanks to automatic samplers that take samples that are then analyzed by an accredited laboratory. A final check performed by the city tests the end quality once the recycled water has been mixed with drinking water,” continues Ludwig Narib. All this effort has now paid off: the capital has been able to significantly increase its water resources. “At present,” says a delighted Ludwig Narib, “26% of the drinking water supplied to inhabitants comes from recycling wastewater.”

Combating water stress

Should Windhoek’s experience pave the way for many metropolises that are facing water shortages?

London and Tokyo are among the eight metropolises that are struggling the most to supply their residents with enough water. Just like Miami, Cairo, São Paulo, Beijing, Bangalore and Mexico, they are faced with climate or

OPUS®II: recovering process water to restore natural ecosystems

The oil and gas company PXP has chosen Veolia and its OPUS®II technique to treat the effluent from the Arroyo Grande oil field in San Luis Obispo County in California. Veolia had been chosen in 2013 to design, build and operate a produced water recovery facility. OPUS®II, an innovative proprietary technology, is used to produce high-quality water. Performance and price guarantees are provided over the contract’s twelve-year period. In addition to the advantage of being compact, Veolia’s facility allows the company to boost its oil production while helping restore

the local ecosystem. The treated water provides 25,000 barrels per day, which will be used in OTSG-type (superheated steam) steam generators for oil production, while 20,000 barrels per day are discharged into nature, helping augment rivers in a particularly arid environment.

This technology makes it possible to increase the crude oil production capacity, improve water management, and protect the environment. It proves the wealth of the product offerings from Veolia, which was able to count on several of its subsidiaries to tailor the offering to PXP’s needs. ■

infrastructure challenges and are among the cities most exposed to water stress. In the United Kingdom, for instance, London must deal with the convergence of two phenomena: relatively low rainfall, scarcely 600 mm per year on average (less than Paris and half that of New York), and a drop in water resources from rivers and the water table.

For the past 50 years, the solution implemented in Windhoek has proved that it is possible to

increase a city’s drinking water supply by recycling wastewater safely and responsibly. However, technology alone is not enough. Windhoek has successfully teamed it with a public awareness-raising and education campaign, a water usage control system to prevent it from being wasted, and efforts to eliminate leaks and reduce water consumption in public gardens. ■



Martine Vullierme, Deputy Director of Veolia’s Africa/Middle East zone, in charge of Operations

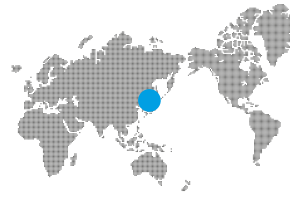
A solution to water stress

“ Veolia has been a stakeholder in this Windhoek project since 2003; at the time, a state-of-the-art “multi-barrier” technology was put in place. A host of physical filters along with bacterial and chemical treatments guarantee that the drinking water complies with World Health Organization standards. The water is therefore extremely clean. There are few facilities of this kind: Goreangab is both the oldest and the largest in the world. The standard solution consists in treating wastewater in treatment plants before discharging it into the natural environment (rivers or the sea). However, river water is often extracted and cleaned to be used as drinking water. In Windhoek, the process offers more direct water treatment.

Despite a shortage of water, other regions of the world are opposed to recycling wastewater largely due to cultural reasons or psychological obstacles. In Australia, for instance, a facility of this kind was suggested following a drought but never came to light because of opposition from the local community... and the return of the rain. However, many cities are suffering from water stress and it is an excellent source of drinking water. We must get used to this idea because water is a precious resource. Windhoek’s inhabitants have clearly understood this, which is why the city is planning to build an additional plant to treat and convert even greater quantities of wastewater into clean, safe drinking water. ”

KEY FIGURES

- **20,000 m³**: this is the volume of wastewater recycled each day by Veolia to supply Windhoek with drinking water.
- **26%** of Windhoek’s drinking water comes from the Goreangab plant.
- **1968**: creation of the Goreangab plant.
- **2003**: takeover of the plant’s running and maintenance by Veolia as part of a consortium.
- **2018**: 50th anniversary of Windhoek’s wastewater recycling facility.



CHINA Shandong

Hongda Chemical promotes energy efficiency

Shandong Hongda Chemical Co. Ltd, a major chemicals manufacturing company in the coastal province of Shandong, is the perfect illustration of China's industrial transformation in the light of climate change. Thanks to innovative solutions, Veolia has successfully transformed this group into a national energy efficiency champion.

For a long time,

Hongda Chemical concentrated its efforts on its core business – chemical production. At a time of strong economic growth and low coal prices, energy efficiency was far from being a priority for the company, as its General Manager Mr. Hongtao Wei admits. The performance of the plant's energy equipment was mediocre. However, the situation has changed. In 2017, ...

Issue at stake

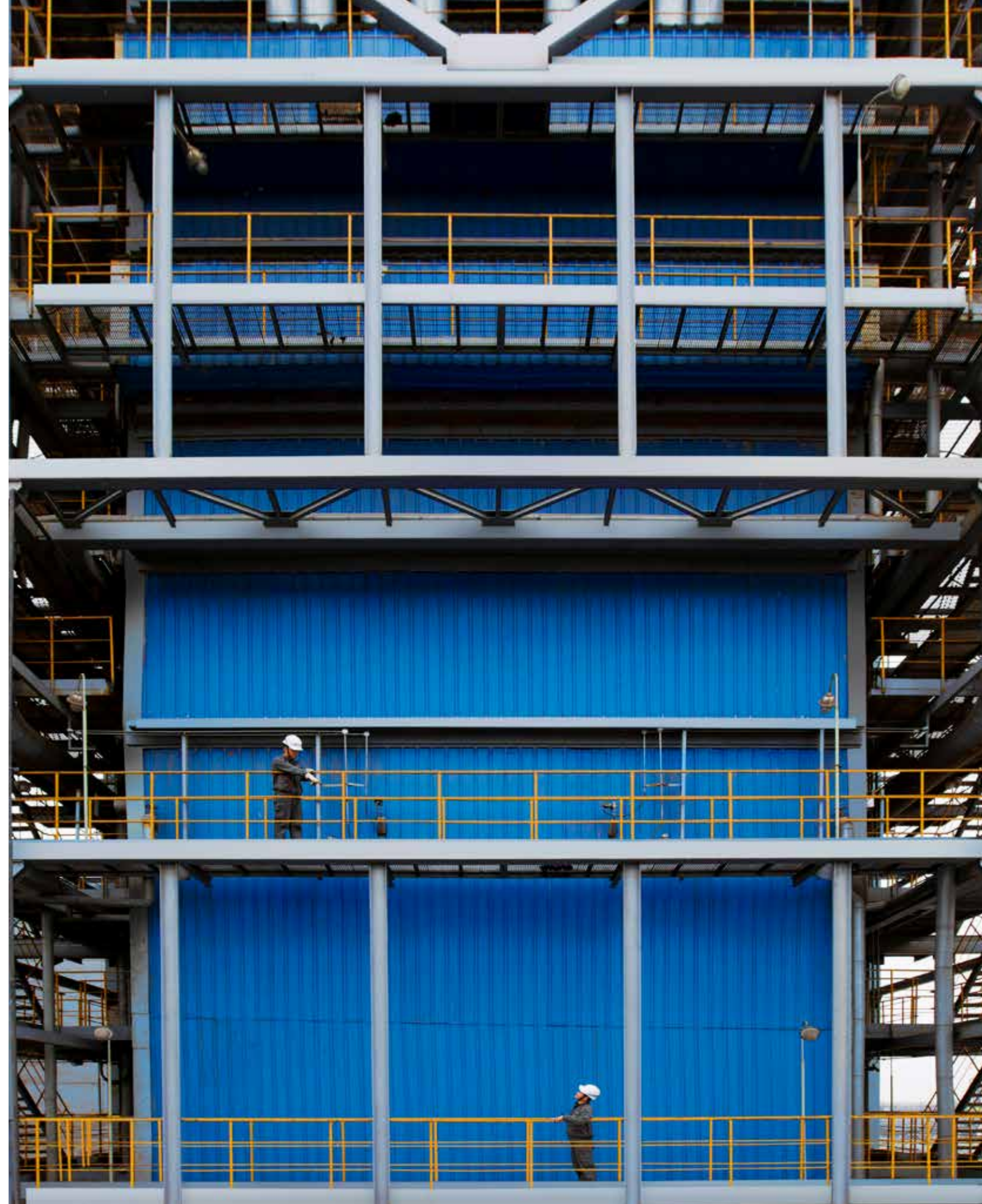
► A limited amount of time to reduce CO₂ emissions in China.

Objective

► Make energy efficiency a major lever in Hongda Chemical's energy transition.

Veolia solution

► 25,000 metric tons of CO₂ avoided each year for the manufacturer.





Olivier Chen, Vice-President, Business Development for Veolia's Industrial Energy and Energy Services sectors in China

Rewarding energy efficiency champions

In December 2017, China announced the launch of what will become the largest greenhouse gas emissions trading system (ETS) in the world. Unlike the initial European system (EU ETS) that set an emissions threshold according to past production values, the Chinese ETS is based on carbon intensity (calculated on the basis of a company's CO₂ emissions-to-output ratio) rather than the total volume of emissions. It will reward efficiency and performance in line with the sector's reference standards. Once the new program is established, it will initially apply solely to power plants (connected to the grid), before being expanded to sectors such as aluminum, cement, chemicals, paper, and ferrous

metals. Manufacturers will gain no advantage in "cheating" the system by putting off until tomorrow energy efficiency solutions that are already viable. Within the framework of the ETS, companies that release the fewest emissions per production unit will be financially rewarded. The energy efficiency gains made at the Hongda Chemical plant will be a major lever for the future national emissions trading scheme. "The energy system improvements implemented by Veolia will allow Hongda Chemical to obtain and then trade carbon credits on this market, bearing in mind that the price of transactions will undoubtedly continue to rise in the future," explains Olivier Chen. ■

••• Shandong's provincial authorities put in place draconian environmental standards that Hongda Chemical's cogeneration (CHP) facility was unable to meet. The government also required manufacturers with their own power plant, such as Hongda Chemical, to pay a tax on their greenhouse gas emissions.

A benchmark plant

Responsible for managing the basic services (heating, air conditioning, water, electricity) for many Chinese manufacturing companies at the time, Veolia provided Hongda Chemical with a solution: modernizing the plant's energy system and implementing two energy management contracts. The aim was not only to make the site compliant, but also to make it a real benchmark plant. The transformation of the two circulating fluidized bed (CFB) boilers with a steam production of 220 t/h was completed in March 2018; after the renovations, dust emissions fell by over 90%, while nitrogen oxide (NOx) and sulfur dioxide (SO₂) emissions were reduced by 80%, enabling the company to fully comply with the strictest environmental regulations. The energy efficiency of the entire plant has increased, rising from less than 60% to over 80%: this represents a considerable source of savings for Hongda Chemical, accompanied by a significant reduction in its greenhouse gas emissions (see key figures).

China: a leader in ambitious programs

Energy efficiency is increasingly appearing as a promising solution to combat climate change. According to Fatih Birol, Executive Director of the International Energy Agency (IEA), "energy efficiency policies could alone enable the world to achieve more than 40% of the emissions cuts needed to reach its climate goals without requiring new technology." On a global scale, China is gradually establishing itself as a leader in the field. Since 2000, ambitious incentive programs have been de-

veloped concerning both power plants and electrical appliances. Ultimately, the country has significantly streamlined its energy consumption, saving 1.2 gigatons of CO₂ — i.e. 12% unconsumed energy — in 2017. This represents almost all of Japan's annual emissions!

A booming market

Veolia is increasingly helping Chinese companies comply with environmental regulations. With the entry into effect of new energy efficiency standards for data centers, the Group was chosen by a Chinese publishing company to set up a chilled water facility in its big data hub and introduce a new eco-friendly approach. Another example is the north-east of China, where Veolia has been awarded a contract to construct, operate and maintain a biomass plant, set up an ecological alternative to coal, and run a project to power a plant using 80% renewable energy. These clients have joined the ranks of a new

generation of Chinese industrialists who are rethinking their production to participate in the global fight against climate change. "China will certainly be able to honor the commitments made in the Paris agreement," states Mr. Wei. "Our activities are a source of CO₂ emissions and we must continue our efforts to reduce the latter." ■

KEY FIGURES

- **232** metric tons of SO₂ avoided each year
- **572** metric tons of NOx avoided each year
- **25,000** metric tons of CO₂ avoided each year
- **104** metric tons of dust avoided each year
- **161** GWh of energy produced each year
- Energy efficiency has risen from **60 to 80%**





Bièvre

FRANCE

A flood prevention model to follow

In the Greater Paris region, SIAVB – the Bièvre Valley Intermunicipal Sanitation Authority – has been working for 70 years to control the capricious flows of this river, while guaranteeing the quality of its water.

With Veolia, the authority has put in place an automated flood management system, which has become a global benchmark in the fight against flooding. This project is all the more remarkable given that the Bièvre's river basin, covering a surface area of 130 km² located near a major metropolis, presents significant territorial disparities between highly urbanized zones and farming and natural areas.

Few Parisians know that the River Bièvre joins the Seine right at the heart of the capital, even though its source lies 36 kilometers from Paris. It snakes through the outer suburbs for 20 kilometers, before disappearing under the streets of Paris. This river, which runs underground in its downstream section, is nonetheless clearly

visible upstream in the Upper Bièvre Valley and comes under close and continuous surveillance. This is because, in "SIAVB's territory," the flows of this river and its tributaries – i.e. 38 kilometers of watercourses in total – are capricious and can cause considerable human and financial disasters in the event of heavy rainfall. In July 1982, in

less than a day, 7.5 million m³ of water flooded the valley causing significant damage. With only two existing basins along the course of the Bièvre, the storage and outlet capacities were completely inadequate at the time to cope with the volume of water discharged.

Toward remote management of the hydrographic network

After this episode, 17 water-holding basins and dikes were built, creating the current storage capacity of 800,000 m³. SIAVB's President, Thomas Joly (see boxed text p. 37), still remembers the 1982 flood, which was the trigger to putting in place an effective system to fight flooding: "Before these basins were created, our feet were in the water, and this could happen every 18 months. Floods are expensive for insurance companies and individuals who have to replace their furniture and repaint." An initial phase of the work was launched with Veolia in 1991 to remotely manage these basins, which are able to store or release volumes of water depending on the pluviometry. "However, all these static reservoirs are not enough to entirely dam the runoff from the Bièvre river basin in the light of increasingly violent and often ...



Issue at stake

► Improve the Bièvre Valley's resilience to flooding.

Objective

► Regulate the flow rate of the Bièvre River and its tributaries in real time via adaptation solutions.

Veolia solution

► Put in place an optimal system for remotely managing flooding in the Bièvre Valley on behalf of the local community.

... irregular rainfalls,” notes Bernard Willinger, in charge of managing the project at Veolia. The engineer continues, “We are in a valley that covers a great deal of land, with spatial constraints that no longer allow us to increase the storage capacities.” In 1993, SIAVB also entrusted Veolia with a maintenance and services contract to ensure monitoring and hydraulic management in real time under any circumstances. The Group then set up smart management of the entire hydrographic network: remotely managing the basins with “optimization of flow transfers from upstream to downstream.” In an initial stage, series of sensors were installed to remotely monitor and control the flow rates of the Bièvre and its tributaries, activating control gates at the exit of the storage basins. The runoff is modeled using satellite images, in order to plan response strategies to critical situations. SIAVB’s aim is to enable the Bièvre and its tributaries to swell if necessary in the expansion areas provided to this end, which are managed in concert with farmers and local authorities. This approach also guarantees the quality of the water and maintains biodiversity.

Disaster averted in 2016

As early as 1993, the whole system was managed thanks to a central computer, a world first at the time. “Veolia’s teams provide the local authority with a complete range of solutions for optimized flow transfer management, continuously and in real time, heading downstream,” states Bernard Willinger. “In times of flood, we can therefore regulate these watercourses on the point of overflowing, without them ever overflowing!”

KEY FIGURES

- **16** municipalities i.e. **200,000** inhabitants
- **3** departments
- **130 km²** (Bièvre river basin surface area concerned by the project)
- **20 km** south-west of Paris + **18 km** of tributaries under continuous surveillance
- **17 storage basins** with a capacity of 800,000 m³



It has been an undisputed success: thanks to the combined action of the authority and Veolia, the floods of May 2016 – 80 mm of continuous precipitation recorded in two days – did not cause any damage for local residents. On the contrary, during this same rainy episode, those living near another river in a neighboring valley that does not enjoy the same infrastructure, suffered an estimated 35 million euros’ worth of damage.

An open, adaptable system

The Bièvre Valley optimal flood management and prediction system run by Veolia is enriched each year by data collected on the ground. “It’s an open system,” states Bernard Willinger, “which allows us to offer tools that are constantly evolving, such as computer and mathematical models that decipher the impact of the rainfall forecast regarding the river basin in real time using RADAR imagery. This helps us better predict the rivers’ behavior faced with precipitation, and take into consideration the saturation of

soils, depending on whether they are located in an urbanized or rural area, obviously with different runoff percentages. We can consequently adapt our flow transfer management to lastingly protect residents, which is our priority.”

A model that has been exported... as far as Cambodia

The Bièvre’s automated flood management system has made a name for itself beyond the greater Paris region, both in France and abroad. Especially Cambodia, where we find a key World Heritage site: the valley of the Angkor temples, which are all located at the heart of an age-old network of canals, built in the 13th century at the height of the Khmer Empire, which had to be renovated to protect the site from flooding (see boxed text p. 35). The project was “entirely based on the experience gained in the Bièvre Valley,” underscores Thomas Joly. “We worked with the Veolia foundation to hold back the water around the temples to stabilize the land on which they are built.” ■



Thomas Joly, Mayor of Verrières-le-Buisson

Helping nature reassert itself to better protect communities

The Mayor of Verrières-le-Buisson, a small French town located some twenty kilometers from Paris, Thomas Joly is also the current President of the Bièvre Valley Intermunicipal Sanitation Authority (SIAVB). While SIAVB initially concentrated on wastewater treatment when it was founded in 1945, it has since distinguished itself by putting in place an exemplary hydraulic network management system in the Bièvre Valley.

“It was the flood of 1982, which caused several million francs’ worth of damage at the time, that raised the executive board’s awareness. They said that this had to stop. Since then, we have done the necessary to conserve and regulate water in the area (see main article). We are proud of the Authority, which drove this long-term project forward under Alain-Victor Marchand’s chairmanship. The latter even said that the Bièvre was the first river in France entirely under digital control! The Authority now brings together 16 municipalities and a 17th will most likely be added shortly. We now live in a region that is not only secure but pleasant for its inhabitants, where biodiversity has been

recovered thanks to this partnership with Veolia, which strives to optimize the volume of the basins by restoring the Bièvre. Today, we are making what may seem to be our weakness into our strength. We are restoring bends to our rivers, because a more sinuous pathway for our watercourses offers us more storage capacity. In a certain sense, we are helping nature reassert itself! Our experience also serves to assist other areas, such as the Angkor region in Cambodia. Over and above protecting the temples from flooding by storing water, we use this water now available for other purposes, such as irrigating rice fields, thereby helping provide food for Cambodians.”



Protecting the valley of the Angkor temples and its population from flooding: a humanitarian mission

In the Cambodian jungle, the capital of the former Khmer Empire rests on a vast network of canals and basins that has stopped working over the centuries. Since 2012, this hydraulic system – weakened by the floods of the past decades and climate change and located at the heart of an environment jeopardized by demographic pressure and mass tourism — has benefited from assistance from a Franco-Cambodian project: “Paagera” (Project to improve sanitation and water management in the Angkor region). Under the authority of Apsara (Authority for the protection of the site and development of the Angkor region) and supported by several partners*, Paagera relies on the expertise of water and sanitation players to harmonize the flows of water between the dry season and the rainy season.

SIAVB and Veolia’s experience in the Bièvre Valley provided an initial technical solution: a telemetry device deployed in 2014 now makes it possible to regulate Angkor’s hydraulic network. After an initial development phase, during which the hydraulic network flows were modeled and 20 first hydraulic measurement stations installed, a new phase began in 2018. It aims to set up the comprehensive remote management of water flows in three steps:

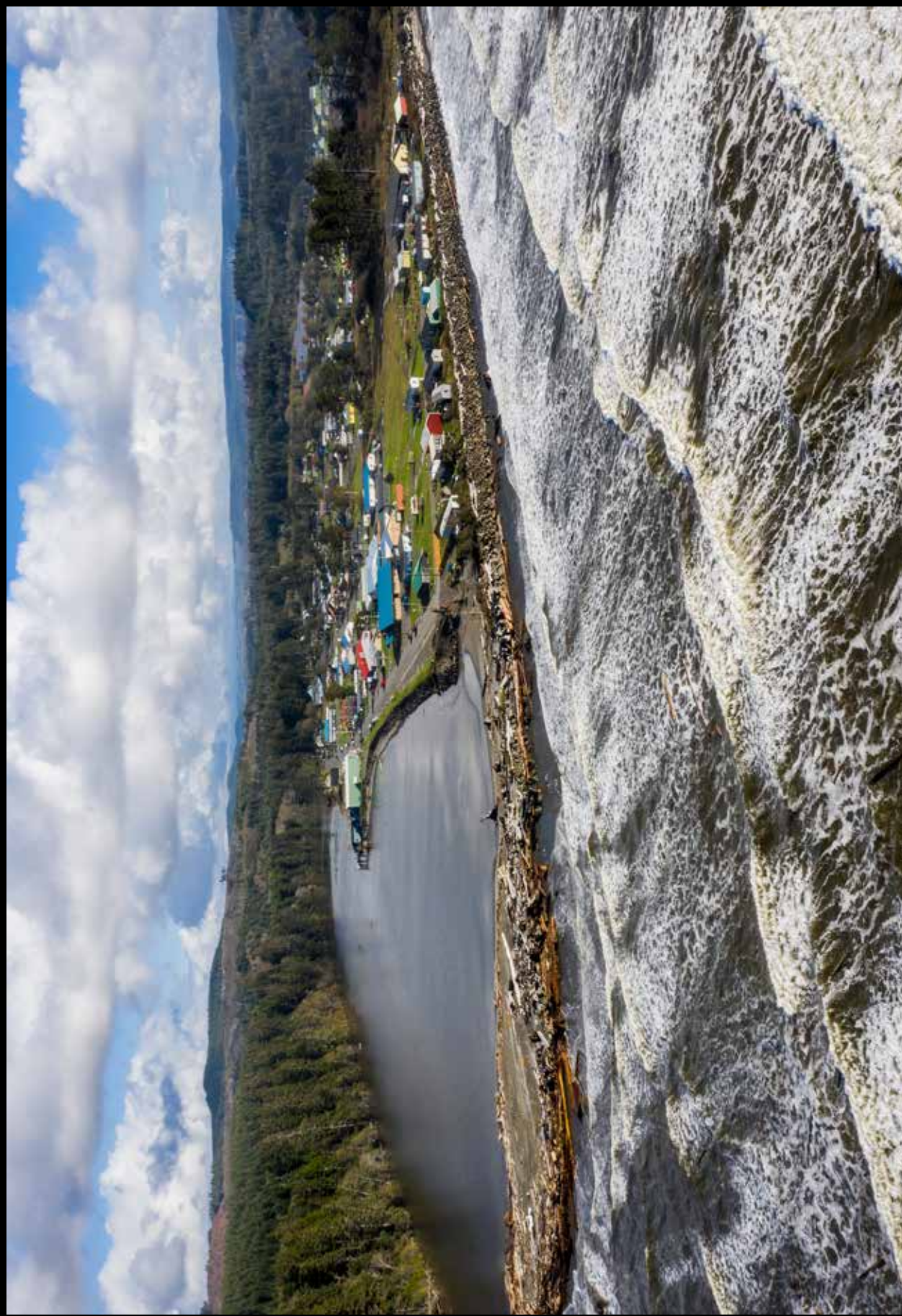
- creation of 22 real-time remote measurement sites;
- setting up of 10 gate automation sites;
- remote control and dynamic management of flows in the long term. ■

*Main partners: Veolia, the Veolia foundation, the Greater Paris public sanitation service SIAAP, SIAVB, the Friends of Angkor Association, APSARA.

In the face of rising water levels, an entire village is moving

In the north-west United States in the village of Taholah, Quinault Native Americans are getting ready to move many of their houses and public buildings to higher ground. Global warming is to blame: their village is threatened by rising water levels. As early as 2014, enormous waves burst their dike during a storm, flooding the houses closest to the Pacific Ocean. The dike has been repaired, but this is inevitably only a temporary solution.

Thanks to funds from the federal Administration for Native Americans, a plan to move the village 800 meters from its current location is underway. Two-thirds of residents and numerous public services (school, fire fighters, etc.) are concerned. For the Quinault people, climate change also has other impacts, particularly a drop in the quantities of salmon in the river that gave this Native American community its name. In the light of the upheavals to come, the inhabitants are getting organized.



Taholah is exposed to rising sea levels. In 2014, a major flood breached the defenses of the three-meter-high sea wall. A town planning scheme was therefore adopted in 2017 to build another village on a hill 800 meters away, at an altitude of 40 meters.

Kelsey Moldenke has been working on the Native Americans' relocation project for four years. The new toponymy will adopt the names of traditional plants in the Quinault language.



George Billie, native of Taholah, returned to the village to be with his family, attracted by the income generated by fishing. He has bought a fiberglass boat that cost 5,000 dollars and fishing nets at 250 dollars each.



Susanna Kalama, local development agency employee. "People think that disaster won't happen in their lifetime. But it'll come much sooner than they think," she fears.

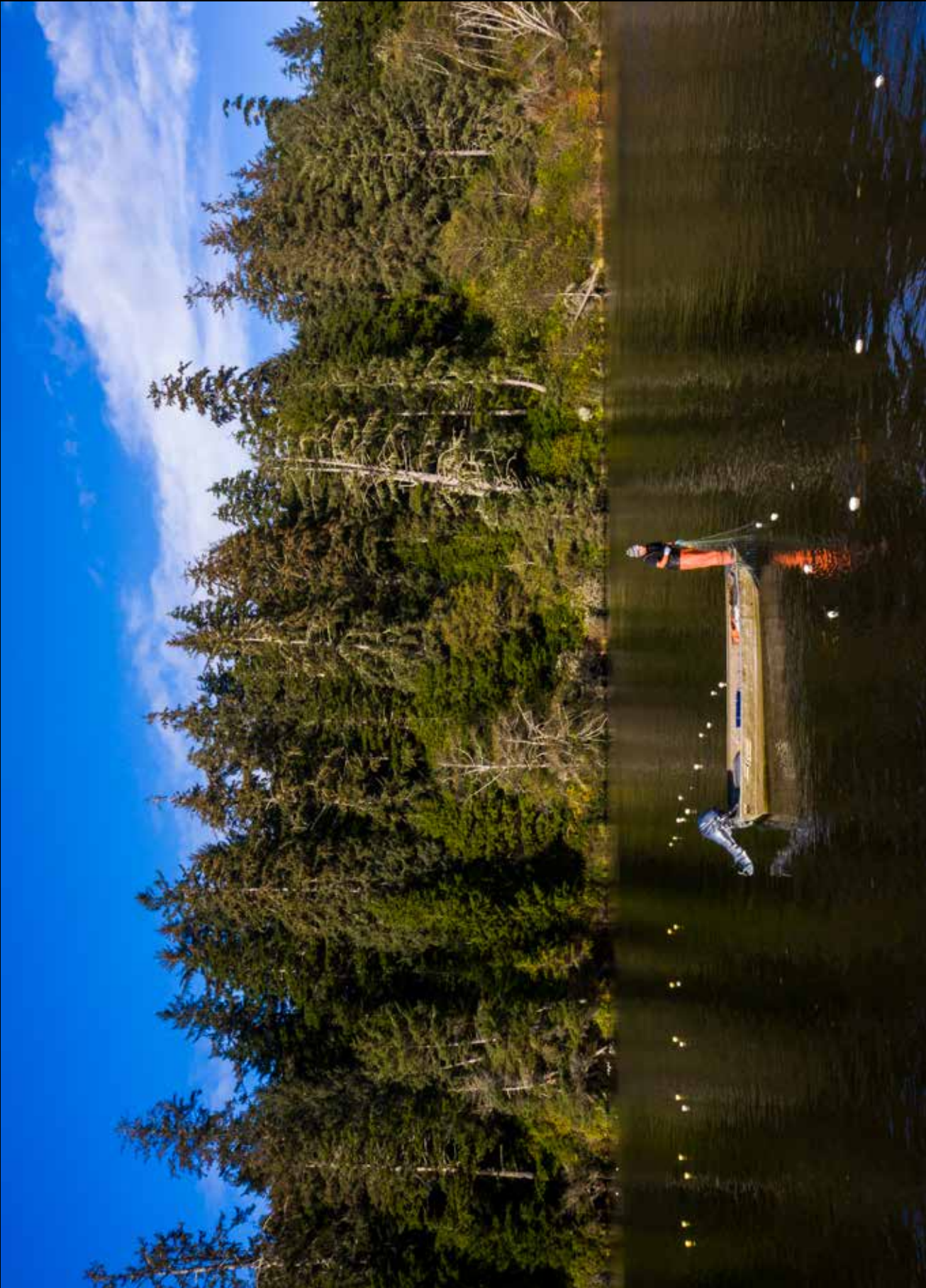


Joseph "Sunny" Davis is a fisherman and buyer at the tribal fishery. He also supplies markets in Portland (Oregon).



Douglas "Giles" Ellis was a fisherman. He has moved into his grandmother's old house located on the hill in the new urbanized area.

Between 1997 and 2009, the Quinault River dried up by 90%. The water is no longer as fresh and contains less oxygen. Salmon no longer come there.



For the first time in their history, the village inhabitants were unable to present the traditional blueback salmon this year during their ceremonies.

The attorney and President of the Quinault Indian Nation, Fawn Sharp, is behind initiative 1631, which looks to impose what would be the first carbon tax in the United States in 2020.



The fate of climate-displaced persons was included in the local referendum during the midterm elections on November 6, 2018. Tsunamis are Taholah residents' greatest fear.

David Hanson, an intimate portrait photographer

His love of people shines through his work. David Hanson mainly takes portraits, which he often enriches with brief interviews. He asks very simple questions about everyday life and describes himself as a handyman storyteller – documentary filmmaker, writer, photographer, director. His one aim is to tell the stories of the people he meets, often by chance.

He began to travel across the United States, taking several hundred portraits of Americans. These reports capture an intimate feel, prioritizing natural light. “I like listening to people, understanding how they live, and sharing their experience with the public,” he explains. “Especially when they don’t take center stage, when people don’t particularly pay them any attention, whereas their life is fascinating.” This report on Taholah was important to David Hanson who, like the Quinault community, lives near the Pacific Coast, in Oregon. “Their story deserves to be told,” he stresses. “It is important to go to a small fishing village like this one, which is regularly flooded due to rising water levels. What is happening to them allows you to really see the effects of climate change. My photos show the reality of the climate threat for these people.” For this report, David Hanson used a drone capable of flying several tens of meters above the sea and the village, showing just how close the houses are to the ocean.

Bio

David Hanson studied literature and geology at university, where he first took up photography. Although he has taken a few photography classes, for the most part he taught himself his trade in the nineties, printing and developing his photos in a dark room before the rise of digital photography. He worked in the media sector for a dozen years.



WHEN VEOLIA COMMITTS TO FIGHTING GLOBAL WARMING

Reducing its own greenhouse gas emissions, developing the circular economy, helping its clients make energy savings... Veolia is taking concrete action to limit climate change. The Group also helps local authorities and industries to adapt to the consequences of this change: greater water scarcity, extreme climate episodes, and flooding.

Everyone must play their part

in the fight against climate change, especially companies. "We implement solutions to help our clients lower their greenhouse gas emissions and thus limit their climate impact," states Patrick Labat, Veolia's Executive Vice-President, Northern Europe Zone. In concrete terms, Veolia helps combat climate changes via several levers of action. First

of all, by promoting a circular economy to limit the exploitation of resources and therefore reduce greenhouse gas (GHG) emissions. Secondly, by taking methane – the second GHG after CO₂ – into account. Finally, Veolia wants to see the emergence of a real carbon price, in order to put a price on pollution to promote low-carbon solutions. "We must ensure that recycled products

...

... are not in competition with virgin products depending on erratic oil prices,” explains Pierre Victoria, Veolia’s Director of Sustainable Development. “Putting a price on CO₂ emissions would lead to more stable prices, which would consequently make recycled products more acceptable, and allow us to organize recycling channels better.” Groupe SEB, Veolia and Eco-systèmes have therefore developed the first partnership creating a complete circular economy loop for small electrical appliances. The waste is collected by Eco-systèmes and then recovered by Veolia in the form of recycled raw materials, which are finally collected by SEB to produce new appliances sold in stores.

Acting in key sectors

Energy and waste management are two key sectors for action. “According to the International Energy Agency, energy needs are set to grow by 30% between 2017 and 2040,” says Patrick Labat. “Our energy-saving services are therefore crucial. We can act on energy efficiency, especially through cogeneration, which allows more energy to be produced from the same amount of primary energy. We can also improve heat distribution networks and even use them for energy storage to better match production to demand.” The best way is also to use the energy most available locally: Veolia produces energy from olive stones for a Renault plant

in Morocco (which makes it the first carbon-neutral car factory in the world), from coffee grounds for a soluble coffee production plant in the Netherlands, and even from poultry litter instead of the coal previously used to produce electricity in North Carolina (United States). In Pècs, Hungary, a boiler has switched from coal to a mix of gas and wood and (local) straw, which has drastically reduced its CO₂ emissions. In Basel, Switzerland, Novartis’ non-recyclable solvents

are recovered as energy: the heat recovered supplies a 100,000-m² shopping mall and a neighboring tertiary building, a perfect city-industry loop.

Capturing waste heat


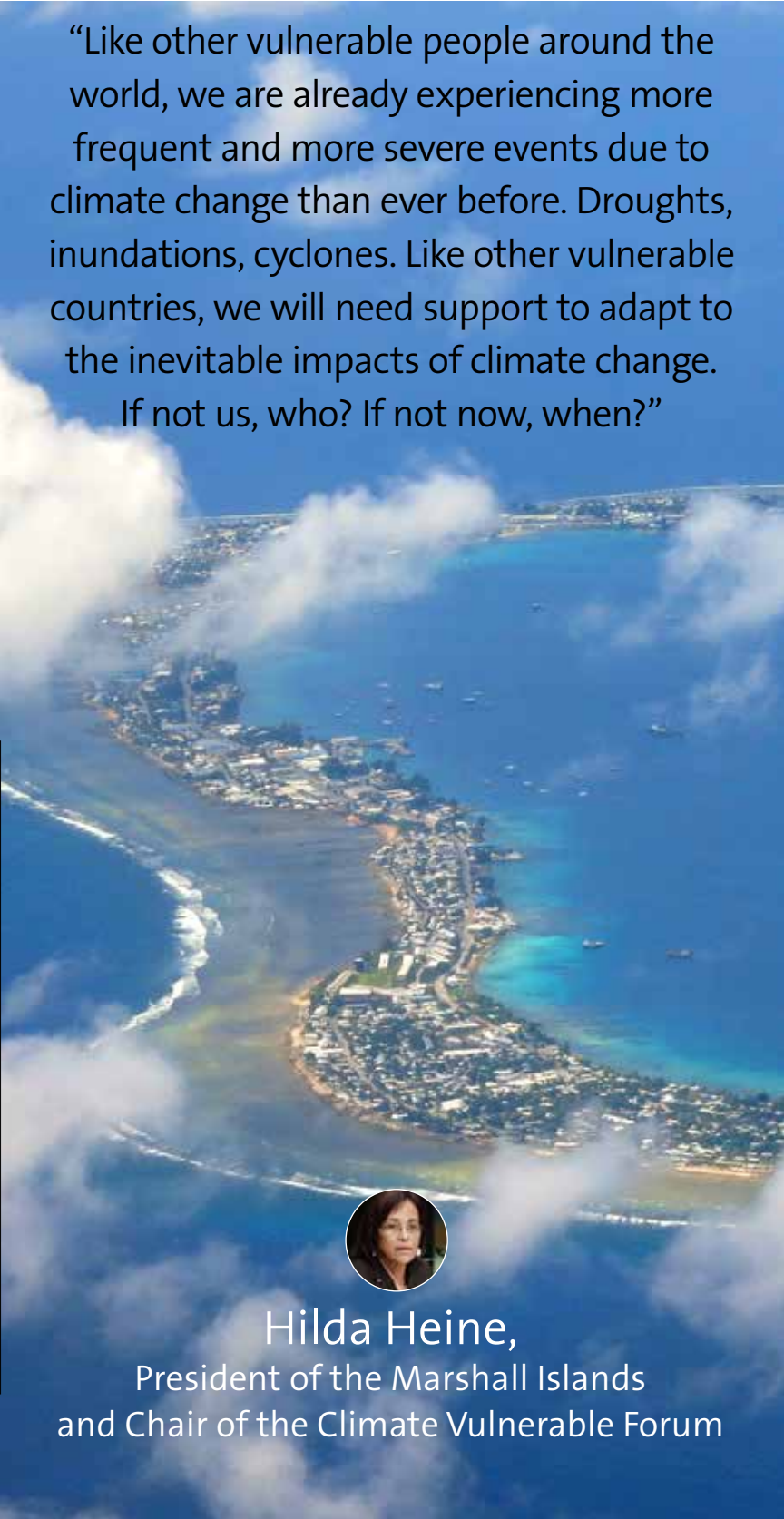
Recovering waste heat is another way to save energy and limit carbon emissions. Certain industries produce heat that they cannot consume.

However, it can be captured and used: Veolia does precisely this in Brunswick, Germany, where the heat generated by a data center powers the city’s district heating, and in Poznan, Poland, where the heat from the Volkswagen plant is reused to heat thirty municipal buildings. “By using waste heat, we make 100% energy savings, as this heat is lost otherwise,” points out Patrick Labat.

Taking energy saving even further means totally changing ...



“Like other vulnerable people around the world, we are already experiencing more frequent and more severe events due to climate change than ever before. Droughts, inundations, cyclones. Like other vulnerable countries, we will need support to adapt to the inevitable impacts of climate change. If not us, who? If not now, when?”



Hilda Heine,
President of the Marshall Islands
and Chair of the Climate Vulnerable Forum

Climate:
the time for
action is now!

The French paleoclimatologist Valérie Masson-Delmotte, co-chair of the IPCC’s working group on climate science, points out the reality of climate change and its effects: “We are currently at 1°C warming compared to the end of the 19th century, and the planet is warming up by about 0.2°C every ten years. By comparing what a world 1.5°C or 2°C warmer would be like, we see that there really are very clear benefits to stabilizing global warming at the lowest possible level.” Longer and more frequent heat waves, more intense torrential rain, the risk of yield loss for key cereal crops, rising sea levels... all aspects of the environment are concerned. “Holding back rising sea levels by 10 centimeters by 2100 means gaining time to adapt and preventing an extra ten million people from being exposed,” she advises. “Climate issues go hand in hand with development issues.” But the researcher remains optimistic. “We also show that stabilizing the climate is not impossible. It all depends on what we are going to do now. It’s striking to see that we are in a position to create economic development and improve everyone’s well-being, while reducing our reliance on fossil fuels and stopping the destruction of biodiversity.” The challenge is to halve CO₂ emissions between now and 2030, if we want to have a chance of stabilizing global warming at 1.5°C and being carbon neutral by 2050. We must also address methane, whose effect has been revised upward. “Our report shows many avenues for action and the importance of creating just transitions.”

** Source: France Culture, “De cause à effets” program, October 14, 2018*
IPCC report (www.ipcc.ch/report/sr15)

Taking avoided emissions into account

When a company like Veolia submits a report to extra-financial rating agencies, it must document the greenhouse gas emissions generated within its own scope. This is known as scope 1. But that's not all. The company must also declare the upstream and downstream emissions for its own activities (scope 2). Progress can be made in this area by working with suppliers and clients. Last but

not least, scope 3 concerns greenhouse gas emissions that are not directly linked to the products and services sold by the company, such as employee commuting. However, avoided emissions are not reported at any point. For example, manufacturing double glazing consumes more energy than producing single glazing, so it is reported as a polluting emission for the company that produces this double glazing. However,

these insulating products are good for the environment and even mandatory for any new construction. "We would like these avoided emissions to be taken into account during reporting," states Alice Peyrard, Veolia's Director, Climate Change Commitment. "We must, of course, discuss to decide what we report and to whom we attribute it, but this is an important consideration in valuing services working toward a low-carbon economy."

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••• how the company works. Rather than being a supplier, it must offer an energy-saving service. "In energy performance contracts, we make a commitment regarding the savings made by our client, with whom we share the profits achieved," explains Patrick Labat. "This motivates both parties and therefore encourages the client to change their habits and consume less." Accordingly, in Košice, Slovakia, Veolia has enabled schools to lower their energy consumption by 20%, supplementing its standard service provisions with a major awareness-raising campaign among pupils. With regard to methane capture, the best way is to recover the gas given off by landfills and use it to heat cities or industries or produce electricity. In Woodlawn, Australia, Veolia recovers the methane from Sydney residents' waste to power the region's heat and electricity network. In Plessis-Gassot near Paris, the methane produced by food waste powers the town's district heating. However, this involves incentivizing regulations

and the nearby presence of clients for this heat.

Working alongside cities and industry

In addition to actions implemented to limit climate change, it is also necessary to help cities and industry adapt to the consequences of this change. Within the framework of the 100 Resilient Cities partnership, Veolia and the reinsurer Swiss Re are supporting New Orleans (United States), the first city in the world to put in place a resilience strategy for its critical facilities. In Copenhagen, Denmark, the Group – via its subsidiary Krüger A/S in collaboration with the national meteorological institute – has developed a real-time management and control system for wastewater facilities to protect against flooding. Finally, Veolia promotes wastewater

reuse to limit water stress. In Durban, South Africa, municipal wastewater is treated by Veolia and reused by industry. An active player in the fight against climate change, Veolia must also be exemplary when it comes to its own CO₂ emissions. "When we own facilities, it is our responsibility to reduce our impacts as much as possible," observes Pierre Victoria. "When the responsibility is shared with a manufacturer, we must

foster a dialogue to agree on the greenhouse gas reduction process. Finally, when we buy a product, we are also responsible for the product's impact. We must therefore think about reducing this impact with our suppliers." What more can be done? Perhaps calculating avoided emissions (see above). Because everything that helps fight climate change should be encouraged. ■

KEY FIGURES

- **1.5°C:** is the global temperature rise that must not be exceeded if the impact of climate change is to be minimized. This is the finding of the IPCC's experts after analyzing over 6,000 scientific publications.
- **0 (zero)** net emissions by 2050: if we want to stabilize the climate at +1.5°C, we must emit less CO₂ than we take in by 2050.
- **5.5°C** hotter by 2100 if we do nothing to lower our greenhouse gas emissions. The consequences would be catastrophic.



Key figures

AfricWaste: the rise of the circular plastics economy in West Africa

Developing waste recycling channels by forging local partnerships with companies involved in the social and solidarity economy and organizations. This is the mission of the AfricWaste project, created by Veolia in the context of a partnership with the construction group PFO Africa. Tested in Abidjan (Côte d'Ivoire), the initiative looks to rely on the informal economy to set up a structured channel for collecting and recovering plastic waste, starting with PET bottles.

- **Up to 15 metric tons** of PET collected each month
- 100 CFA francs (€0.15):** purchase price of a kilo of PET plastic from informal collectors
- Project deadlines:**
 - phase 1: October 2017 – March 2018
 - phase 2: March to September 2018
 - phase 3: 2021, consolidation of the channel

In an effort to effectively implement new practices, the project's proponents have chosen to work with the informal collection system, a key link in the recycling chain in Côte d'Ivoire. "Informal collection works well – it's a clearly organized system. However, it is underoptimized, because people do not gain maximum benefit from their work," explains Martine Vullierme, Deputy Director of

Veolia's Africa/Middle East zone. During a first pilot phase deployed in Abidjan from October 2017 to March 2018, the AfricWaste project was tested at the Akouédo landfill: a collection and storage point where informal collectors can sell PET plastic bottles recovered from individuals and storekeepers. Following conclusive initial results, a second pilot phase was conducted between March

and September 2018 in the Treichville neighborhood to the south of the capital. A smartphone app was launched there: the user states the amount of waste they wish to have removed and their location; the waste can thus be retrieved by the nearest collector, who is then remunerated via phone payment. "The project arose from this idea: if waste is valuable, we can create a link between the people who

generate it, those who collect it, and Veolia that recycles it. This relationship is facilitated by phone payment, a service that incidentally originated in Africa," Martine Vullierme reminds us. The ultimate goal is to entrust the collection and sorting platforms to companies involved in the social and solidarity economy. These companies will supply the waste collected to Veolia, which will oversee its processing and recycling.

Heat islands: when water refreshes the city

Due to their high mineralization*, city centers experience greater temperature rises in summer, creating urban heat islands (UHI). This phenomenon can have heavy consequences, especially in terms of health, ranging up to an increased mortality rate for inhabitants.

In response, for the past several years Veolia has been developing diagnostic tools and innovative solutions to mitigate UHIs, based in particular on the use of non-potable water. Developing these solutions, which can be equally applied to a neighborhood or an agglomeration, requires experiments to be carried out on the ground.

In Lyon, France, Veolia devised a UHI characterization method in the Part-Dieu district, before testing a road humidification solution there. This method overlays two types of mapping: firstly, the city's exposure to UHIs, weighting several indicators (surface temperatures, presence of vegetation and water, etc.) correlated with in situ measures; and secondly, the sensitivity of populations in terms of health impact, using indicators such as population type (especially the elderly and children) and type of housing (precarious housing amplifies the health impact of UHIs). The aim of this mapping is to identify vulnerable areas to be treated as a priority.

In the wake of this mapping, Veolia joined forces with the Institute for Research on Urban Sciences and Techniques (IRSTV) to develop EVA (water, vegetation, albedo), a multi-criteria decision-

making tool for cooling solutions aimed at developers. EVA models cooling solutions and compares their impact on reducing UHIs and the water consumption that they involve. Two complementary approaches are prioritized when it comes to water solutions: humidification for roads, and evaporative pavements – which are more fragile due to their porosity – solely for pedestrian areas. In Nice in the south of France, Veolia uses a combination of cooling solutions that were studied as part of the creation of public spaces in the Var plain's multimodal transit hub (PEM). The end result has been the implementation of two cooling solutions: 250 m² of evaporative pavements at tramway stops and 300 m² of road humidification, all connected to the city's raw water distribution network. Ahead of the next series of measures scheduled for summer 2019, September 2018's campaign has already led to a perceived temperature drop of 5 to 6°C in the test area. ■

* **Mineralized surfaces** absorb heat during the day and release it back into the atmosphere at night.
Source: <http://www.otmed.fr/>

UHI: anticipate all the better to adapt

1 Diagnosis on the ground

• Temperature collections



3 Adaptation solutions developed by Veolia

Urban cooling systems recovering non-potable water – rainwater, mine water (seepage) – to help create cool islands: evaporative pavements, road humidification, water jets.



A **UHI** is a phenomenon triggered by the combination of heat waves, urban morphological parameters and factors linked to human (anthropogenic) activity. This leads to several negative impacts on the inhabitants and general living environment of cities, making them less attractive: heat stress, discomfort, and even a rise in morbidity and mortality.

2 Feasibility

• Studying critical hot spots



Veolia's climate change adaptation tools for cities

• Tools for diagnosis and designing cooling solutions such as EVA (water, vegetation, albedo) within the framework of short-, medium- and long-term action plans to reduce an area's vulnerability.

• Implementation of UHI mitigation solutions and monitoring of public and private urban projects (PLU).

Veolia pilot projects underway or completed

2011: microclimate simulation for the Saint-Augustin PEM in Nice (France)

2012: road humidification pilot scheme in Lyon (France)

2013: start-up of the EVA project with IRSTV in Lyon (La Part-Dieu district) (cf. article opposite)

2014: development of a health vulnerability diagnosis tool

2015: field tests of the vulnerability diagnosis tool in Lyon; EVA project results

2016: first commercial

deployment of the diagnosis and urban cooling solution design offerings

2018: start-up of the first urban cooling demonstrator based on evaporative pavements in Toulouse Montaudran Aerospace mixed development zone (unique in Europe)

2018: series of measures in the PEM in Nice over the summer

2019: pilot scheme underway in Milan (Italy)

Almost 30% of the global population is exposed to climate conditions exceeding a potentially deadly threshold for at least 20 days per year. By 2100, this figure is set to reach **48%** – in a scenario of drastically reduced greenhouse gas emissions – and **74%** in a scenario of increased emissions.

Source: Nature Climate Change, "Global risk of deadly heat," June 2017

By 2100, **two in three Europeans** will be affected by climate disasters. The number of annual deaths due to the latter will rise from 3,000 – observed from 1981 to 2010 – to 152,000 at the end of the century.

While floods and storms represent very serious threats for the European population, heat waves will be the deadliest climate events. They will cause no fewer than **99%** of the total deaths expected. In other words, 151,500 deaths (uncertainty bounds: between 80,000 and 239,000) by 2071.

Source: The Lancet Planetary Health, "Increasing risk over time of weather-related hazards to the European population: a data-driven prognostic study," August 2017

The urban heat island phenomenon in the United States concerns over **80%** of the population living in urban areas.

Source: Physical Review Letters, study March 2018



CO₂ sequestration in agricultural soils: a solution for tomorrow

Well-managed farming land can play a key role in reducing CO₂ emissions and formulating climate change action strategies. In the form of organic matter, it stores two to three times more carbon than the atmosphere*. Keeping soils in good condition therefore represents a considerable challenge!

To help farmers adopt responsible, more soil-friendly practices, Veolia has developed two complementary tools. The Soil Advisor™ app allows farmers to define the amendment and fertilization strategy best suited to their soils. This new tool, which is being deployed by SEDE (in France), helps them put in place an agroecological transition

that looks to limit chemical inputs and offset the greenhouse gas emissions produced by farming activities via carbon storage. Carbo Pro™ is a software program capable of predicting the amounts of carbon sequestered in the soil after applying organic products such as compost. These innovations, resulting from research

jointly conducted by Veolia and the French National Institute for Agricultural Research (INRA) for twenty years, maximize the potential of the “ecosystem services” provided by soils.

*according to the French Environment & Energy Management Agency (Ademe)

Thanks to the Soil Advisor™ app, farmers can tailor their amendment strategy to their soils and limit carbon emissions.

> The ecosystem services provided by soils

Living, healthy soil – the main carbon reservoir – provides many essential services for our societies:

- food production;
- material production (wood and fibers);
- water cycle regulation;
- air quality regulation;
- erosion regulation;
- biodiversity maintenance;
- natural risk regulation;
- climate regulation.

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WE'RE PITTING OLIVE STONES AGAINST CLIMATE CHANGE



Illustration: RUDE.

Resourcing the world

