



SOLID WASTE RECYCLING AND RECOVERY



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INTRODUCTION



HUMANITY HAS NEVER FACED AS **MANY** **CHALLENGES** AS IT DOES IN THE **21ST CENTURY**

We live on a planet we have not cared for properly.

And now we are paying the price. If the extreme weather events battering every continent are the most visible scars, other equally fearsome challenges need tackling during the coming two decades. With the clock now running on the climate emergency, recycling and recovering solid wastes into new resources plays an essential role in protecting public health and the environment, cutting greenhouse gas emissions, promoting regional resilience and preserving resources.

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In strictly practical terms, in 20 years' time there will be nine billion people on earth, all of them needing homes and food, and producing waste that will need processing; the rise of the global middle class and digital technologies will increase energy demand by 30%; the volume of waste produced is forecast to grow 70% by 2050; rampant urban spread will swallow farmlands that are already heavily degraded; proximity between untamed natural environments and urban spaces will increase the risk of new viruses being transmitted to humans; rising temperatures will make life ever harder in megacities, where population densities will continue to increase; the emergence of new pollutants in water, soil and air

will continue to cause more sickness and death; resource scarcity will cause major conflicts between users, destabilizing entire regions across the planet, and so on. These are just a few of the planetary challenges that Veolia seeks to help resolve.

***In 20 years'
time
there will be
nine billion
people on earth.***

Tackling these challenges is critical: they have shown us that our lifestyles are under threat and that we need to change and decarbonize them right now. Humanity cannot go on living in the same way. There is no turning back. Our world is different now, and we must adapt. Unless we act immediately, circumstances that seem exceptional today will become the norm tomorrow. We have to take stock and act collectively.

***The rise of the global middle-class
and digital technologies
will increase energy demand by 30%.***





01

— Introduction

BECAUSE ALTERNATIVE SOLUTIONS EXIST

Veolia's resolute commitment to ecological transformation means it can respond to the highly complex challenges shaping the world of tomorrow.

Veolia has adapted its activities — in water, energy and waste management — so it can better support its stakeholders as they undertake their own transformations. Veolia believes in joining forces, because nobody can tackle all these challenges alone, while also preserving natural resources and combating the climate emergency.

The following pages show how the Solid Waste Recycling and Recovery business line actively contributes to the vital ecological transition needed to build a more sustainable world, and how it leverages innovations to roll out new solutions for tomorrow.



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At Veolia, we are convinced that addressing increasing resource scarcity and the climate emergency while also setting out a sustainable model for future generations means our mission is to invent circular economic models that make it possible to reincorporate recycled resources, regenerate soils and produce renewable energies.

Veolia is present at every stage of recycling, and can offer solutions that give value to recycled materials, from eco-design to releasing products to the market, collection to sorting, traceability to the production of secondary raw materials that are returned to industrial manufacturing systems and processes.

In organic materials recovery, Veolia offers soil regeneration solutions based on producing organic soil improvers and biofertilizers as well as innovative bioconversion processes for animal feeds.

When it comes to energy recovery, Veolia offers local circular economy solutions that transform our energy production model, shifting from reliance on fossil fuels to the use of renewable energies.

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ALEXANDRE GUYON

Director, Solid Waste Recycling
and Recovery

VEOLIA SERVING THE PLANET

In 2018, the World Bank estimated that 2 billion metric tons of municipal solid waste is produced worldwide every year. Everybody on the planet generates an average of 0.74 kilograms of waste a day. But only 19% of this waste is currently recycled or composted.



MANAGING SOLID WASTE IS A UNIVERSAL CHALLENGE



The constant increase in the amount of waste is a result of greater consumption of goods and services, the planned obsolescence of certain products, the development of new technologies, and population growth. At the current pace, we will be generating 3.4 billion metric tons of waste every year by 2050.

The environmental consequences are extremely serious: because they can emit heavy metals or toxic gases, these solid wastes can cause water, ground and atmospheric pollution.

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02

— Veolia serving the planet

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This means that it is people with the most precarious living conditions who are also the most impacted by the increase in the amount of waste. In low-income countries, close to 90% of waste is burned or dumped in unregulated open-air tips. Local people scrape a living from sorting waste and are exposed to serious health risks.

And the situation is going to get worse. The amount of waste generated daily by people living in rich countries is forecast to rise 19% by 2050, with a 40% increase predicted in low- and middle-income countries. The same report states that, over the same period, there will be a threefold increase in the amount of waste generated in sub-Saharan Africa, and a twofold increase in south-east Asia, the Middle East and North Africa.

*In low-income countries,
**close to 90% of waste is burned
or dumped in unregulated
open-air tips.***



REINCORPORATING RECYCLED RAW MATERIALS AND DEVELOPING RECOVERY OF ORGANIC MATERIALS

Veolia helps to accelerate the recycling and recovery of waste, reduce waste volumes, protect the environment and preserve resources.

It designs solutions for recovering organic materials from waste to produce renewably sourced energy, for example, using biogas from methanization to produce biomethane or electricity and heat, or to provide innovative products to the farming industry such as organic fertilizers, as well as innovating to develop the bioconversion of organic waste to produce protein-rich animal feed concentrates.

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At Bardowick, in Germany

Based in the north of the country, this wet anaerobic digestion facility offers a recovery solution for nearby municipalities, retailers and food & beverage professionals.

Due to the large volume of waste to process, a facility able to process 40,000 metric tons a year was set up, along with depackaging units suited to the incoming waste streams.

Cogeneration is used to convert 600-800 normal cubic meters per hour of biogas, with high methane content, into electricity for the national grid. The digestate is used as liquid fertilizer in agriculture, in line with German regulations.

In Malaysia and in France

Veolia developed insect-based bioconversion in 2016 with two startups, Entofood and Mutatec: a solution that will transform organic by-products from food industry and agriculture refuse (either liquid or solid form) into proteins for animals feed via the production of insects. As a major industrial player, Veolia successfully set up its first full-scale bioconversion site in 2019 in Malaysia, and is currently building a second facility in France. Its international presence means Veolia can replicate and adapt its expertise in this field in different parts of the world.



In France

As part of efforts to maximize the recycling potential of WEEE, which is over 80% recyclable, a partnership was signed with Thales to manufacture environmentally friendly SIM cards using polystyrene recovered from end-of-life refrigerators.



Again in France

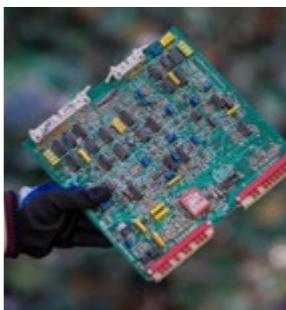
The SEB Group and Veolia have created the first complete circular economy loop for small domestic appliances: collected by an eco-body called Eco-systèmes, WEEE is then recovered by Veolia as recycled raw materials. The SEB Group then uses these materials to manufacture new appliances for sale.

02

— Veolia serving the planet

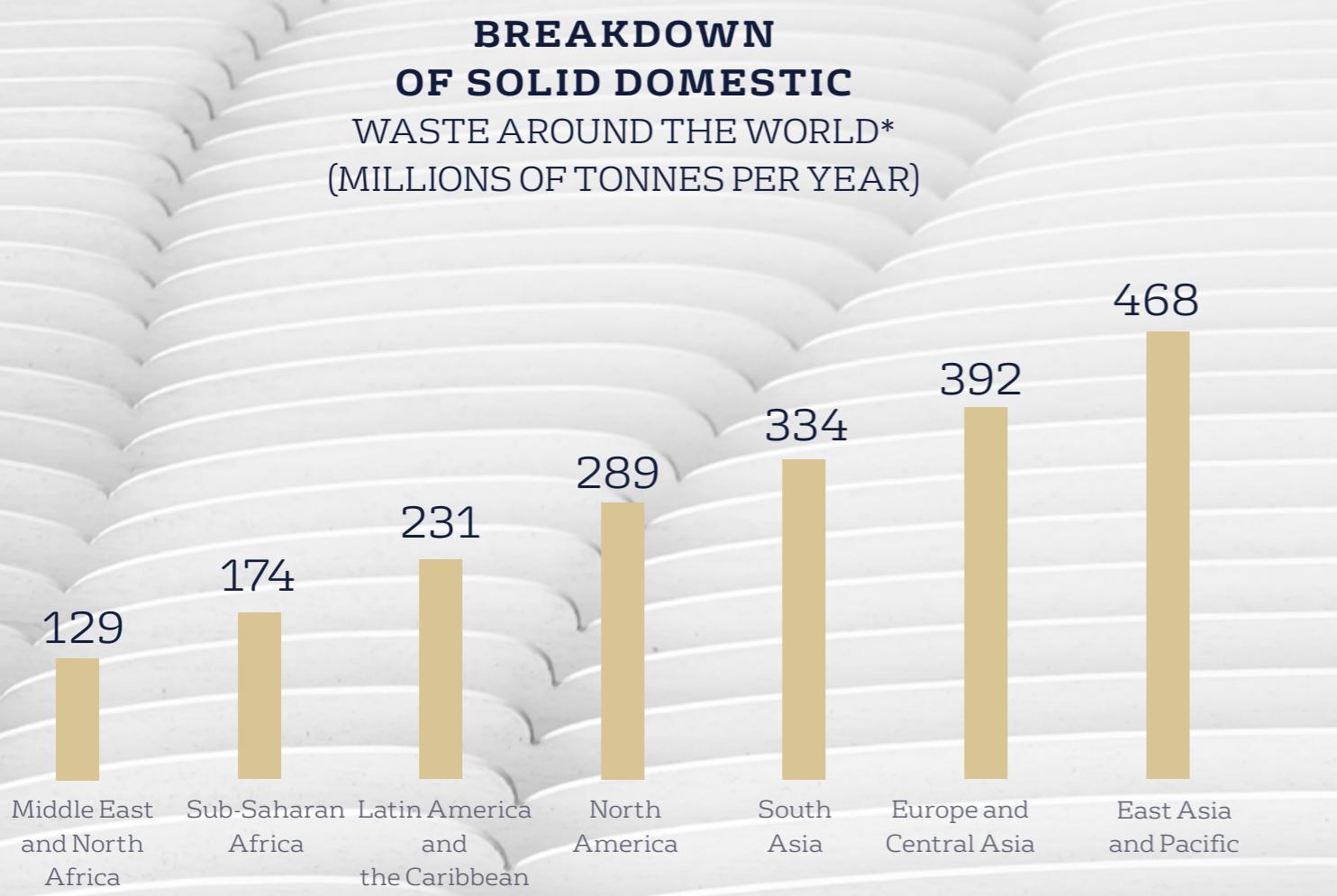
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Another response being actively investigated by the Group involves reincorporating recycled raw materials into industrial production processes. This is motivated by two certainties: that in the future these will be a go-to alternative to natural resources, and that they can help to protect national economic sovereignty in terms of supply. There are often major technological barriers to overcome. This is the case for some of the scarce and valuable metals that have become essential to our massively digital lifestyles. This is because breaking our dependency on fossil fuels simply creates a new dependency on these metals that are so vital to the growth of renewable energy and to the manufacture of digital devices.



Veolia is at the forefront of efforts to develop solutions for processing and recycling metals found in items such as waste from electrical and electronic equipment (WEEE). In 2019, 53.6 million metric tons of WEEE were generated worldwide, but only 17.4% was properly collected and recycled, according to The Global E-waste Monitor 2020. The remainder was buried or dumped, raising serious problems in terms of safety, health and environmental pollution. This waste, which contains plastics as well as ferrous metals, gold, silver, platinum, silicon and rare earth elements, all highly sought after in global markets, is also a major source of materials that can be recycled, and that are therefore resources.

In 2019, 53.6 million metric tons of WEEE were generated worldwide.

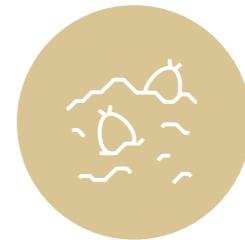


16%
of the global population (high-income countries)
generates **34%** of waste

* The World Bank - What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050



37%
of waste is buried at landfill sites



33%
is dumped in the open air



19%
is recycled or composted



11%
is incinerated

VEOLIA SERVING REGIONS AND INDUSTRIAL CLIENTS



The immediacy of the climate crisis is at the forefront of present-day preoccupations for everyone, from citizen-consumers to local authorities and industrial companies. The overarching nature of these concerns is driving the search for alternative solutions, made all the more urgent by the fact that pressure on resources will soon bring the system to its knees if no action is taken.



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— Veolia serving regions and industrial clients

Although it remains hard to give an exact timeframe, the movement of travel is unarguable. To head off what will soon become a reality, there is a near-universal call for societies to become more sober in the ways that they produce and consume, seeking to limit wastage and reduce waste volumes, to reuse, recycle and recover waste in circular economy loops. Veolia is adapting to reflect changes in its clients' business models. Around the world, day in day out, Veolia works with regional authorities and industrial companies to support their ecological transformation. The Group offers them a comprehensive range of tools designed to help cut their ecological footprints and preserve natural resources. The waste collected becomes new resources to use, whether as secondary raw materials, energy or biomass.

The waste collected becomes new resources to use.



WASTE COLLECTIONS IN DEVELOPING ECONOMIES

*In Latin America and South-East Asia,
Veolia actively supports national authorities
in the organization of household waste collections.*



The Group has a clear aim: to structure the activity to become part of a local circular economy loop, reducing the quantity of waste that otherwise would be scattered on streets and in the countryside. Veolia commits resources to raising awareness among local people so that they act of their own free will, for the greater benefit of local authorities. The Group also works with the informal sector to make working conditions safer, helping people cement their place as stakeholders in recycling and recovery. This vital role is a standout feature of Veolia's work in these parts of the world.



A photograph of a street in Colombia at dusk. A white waste collection truck with the number 4025 and the word 'FANALCA F25' is parked on the side of the road. Two workers in white uniforms and hats are standing near the truck. The street is lined with palm trees and power lines. The sky is a mix of blue and orange.

In Colombia

The informal sector generally deals with sorting at source and the collection of recyclable waste, providing a fundamental service to society that is protected by the constitution. Here, Veolia works to help establish inclusive solutions for the informal sector, contributing to establishing sustainable waste collection services and helping boost wellbeing and lasting development among local communities.



In the United Kingdom

Veolia manages 26 incineration and generation plants powered by solid recovered fuel (SRF) in the county of Hampshire, England. Bulky waste is processed to extract residual metals. The process also produces SRF used for on-site energy recovery. The result is that 94% of the county's waste no longer goes to landfill, the highest waste recovery rate in the country.

03

— Veolia serving regions and industrial clients

TRANSFORMING SOLID WASTE INTO ENERGY

Veolia is one of the leading global actors in the transformation of waste into energy.



The Group operates over 70 energy recovery facilities worldwide. This allows it to offer sustainable, locally generated energy to regions and industrial clients, helping to diversify their energy mix and limit use of landfill. With the emergence of innovative technologies for capturing CO₂, energy recovery from waste will be a key contributor to pathways to carbon neutrality for regions and industrial companies, and it will continue to play a role over the coming decades.

SUPPORTING INDUSTRIAL COMPANIES TO SHIFT TO ECO-DESIGN

Veolia's Solid Waste Recycling and Recovery business line works with industrial clients to help them to shift to circular production processes, particularly through reintroducing recycled raw materials into production lines. In this way, Veolia is present at every stage of a product's value chain, beginning with eco-design to make recycling easier. The core challenge always lies in identifying how to innovate to create the most efficient local circular economy loop so that an alternative resource can be produced, whose value exceeds that of the virgin material. This means that encouraging industrial companies to use secondary raw materials rather than fossil-derived materials makes perfect sense. It helps reduce carbon footprints, particularly for consumer goods.

Recycling bottles made from PET (polyethylene terephthalate) or PEHD (high-density polyethylene) is a great example.

In Indonesia

Veolia collects plastic bottles on behalf of Danone, sorts them and transforms them into high-quality granules that are then reinjected into local production lines: a true bottle-to-bottle project.



In Europe

Veolia works with Tetra Pak to make sure that, by 2025, 100% of the components of its used containers are recycled. Tetra Pak containers are technically sophisticated items and some of the component materials are hard to recycle. They comprise 75% card, 20% plastic and 5% aluminum. Although fiber and pulp are recycled by the paper industry to make paper (for toilet paper and kitchen paper) and card (for packaging, bags and boxes), Veolia has invented a specific recycling process to deal with the remaining mixture of plastic and aluminum (PolyAl). It is processed in specialist facilities that convert it into raw materials that can be used by the plastics industry.



03

— Veolia serving regions and industrial clients



In Toulouse, France

As part of efforts to reduce waste and promote reuse and the circular economy, Veolia supports a startup called Kippit that works on recycling and the battle against planned obsolescence. Veolia is helping Kippit develop its project to create household appliances that are ethical, sustainable, eco-designed and locally made from recycled, repairable, upgradeable and energy-efficient products.

INVENTING TOMORROW: CENTRAL TO EVERY VEOLIA INNOVATION

Veolia always pushes innovation to the maximum to support its industrial clients in their ecological transformation. In terms of waste recycling, the Group designs and develops solutions for tomorrow, pushing technical limits to extract the greatest possible volume of alternative resources that can substitute for virgin raw materials.



CHEMICAL RECYCLING OF PLASTICS

The diversity of plastic resins and the complexity of their composition pose difficulties for recycling, meaning there is a constant need to refine the technologies employed.

Having already developed mechanical solutions, Veolia is designing new chemical processes for tomorrow. These innovations, still at the pilot or research stages, include pyrolysis (heating plastic at high temperature to obtain a hydrocarbon product) and material separation, which is useful for packaging that contains multiple layers of different resins. The aim is to arrive at a monomer, the basic component, via a variety of different technologies.

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One solution is to use enzymes as organic catalysts to split the PET molecules so that material for recycling can be depolymerized. It can then be purified and repolymerized. In this way, plastic can be recycled infinitely. These techniques can also be used for colored plastics, which are harder to recycle using mechanical processes.

These are promising responses to the challenges of meeting exponential growth in the production of plastics and manufacturers' ever-growing needs for recycled materials, a need that is driven by consumer demand.

Veolia is innovating today so that tomorrow it can help produce a monomaterial plastic containing 100% recycled resins obtained from mechanical and chemical recycling.



In South Korea

In 2019, the Group merged with R&E to recycle waste artificial plastic marbles (35,000 metric tons a year) at three sites. R&E is the first company in the world to develop and deploy a patented technology that uses pyrolysis to produce methyl methacrylate (MMA) and aluminum oxide. The recovered MMA is then used as a raw material in the manufacture of acrylics and LED lights, and heat-resistant aluminum oxide is used in the manufacture of ceramics.

IMPACTFUL SOLUTION

PLASTICS RECYCLING



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9 BILLION

metric tons of plastics have been produced worldwide since 1950



9%

of plastics are recycled,
with another 12% incinerated



Plastics make up
80% of the waste found
in the seas

BACKGROUND

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cumulative 9 billion metric tons of plastics have been produced worldwide since 1950, mainly from oil. And global production is growing exponentially: 400 million metric tons in 2020, 600 million in 2030. The industry is dominated by China, followed by Europe and North America. There are considerable consequences for the environment, human health and biodiversity. All the more so as currently just 9% of plastics are recycled, with another 12% incinerated. This means that 7 billion metric tons have been dumped in the natural world, polluting seas and oceans, and finding its way into food chains. Remember that 80% of marine pollution comes from the world's continents, washed into the oceans by rivers and rainfall. And plastics make up 80% of the waste in the seas. At this rate, according to Veolia partner the Ellen MacArthur Foundation, there will be more plastic than fish in the ocean by 2050. This plastic waste is made up of packaging and single-use products such as plastic bottles, bags, drinking straws, cups, and now masks. The impact is all the greater because the plastic lifecycle poses two problems: not all plastic is recyclable, and not everything recyclable is recycled.

SOLUTION

By recycling plastics to recover value, Veolia is supporting the plastics industry as it undergoes a period of profound change.

Veolia's technology provides an alternative to the use of virgin material, in the form of a secondary raw material tailored precisely to manufacturers' needs, and offering all the same qualities as virgin resins. The Group can handle every stage in the process, from sorting waste to delivering recycled materials. Its innovative solutions promote the expansion of circular economy models that are vital to preserving our environment.

Central to its strategy is Veolia's firm focus on setting up a genuine plastics recycling industry, a commitment that gives it a major competitive advantage in the global market.

The expertise the Group has developed in this field means it can process several types of resins, including polyethylene (PE) used in packaging, construction, etc., and polypropylene (PP) used in the car industry, that can then be reused by its industrial clients.

Veolia recycled over 391,000 metric tons of plastic waste worldwide in 2020. With a strong presence in Asia and Europe, the Group aims to recycle 610,000 metric tons a year by 2023.

There are several stages in the plastic recycling solutions offered by Veolia:

- Collecting plastics and transporting waste to the recycling center
- Sorting to separate plastic, paper, card, metal, etc., before separating the different types of plastics
- Washing in hot water to remove impurities
- Grinding to turn the plastics into flakes
- Reformulation to achieve the product quality and technical specification required by the client
- Extrusion to regenerate the material prior to reinjection into industrial production cycles



IMPACTFUL EXAMPLE

In Spain, Veolia is offering a second life to plastic bottles, in another example of a bottle-to-bottle approach. The aim is threefold: meet new European targets for packaging material recovery (as of 2021, a percentage of recycled plastic must be incorporated into food-grade bottles sold in the EU: 25% for PET in 2025, and 30% for other plastic bottles in 2030); use a circular economy approach to help renew resources; and reduce national dependency on virgin raw materials.

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Against this background, in 2020 Veolia teamed up with the TorrePet factory — the first company in Spain or Portugal able to handle the complete bottle lifecycle — to improve waste management practices in Spain. In this way, Veolia recycles over 1 billion post-consumer bottles collected from all over the country into recycled polyethylene terephthalate (rPET), producing 20,000 metric tons a year of material of the highest food-grade quality.

*In Spain, Veolia recycles over **1 billion** post-consumer bottles collected from all over the country into recycled polyethylene terephthalate (rPET).*

05

— Impactful solution



The factory has an efficient process that uses the best available plastic recycling technologies to produce granules around 2 millimeters in size:

- optical sorting to separate transparent PET, colored PET and PEHD, with each variety processed on a separate line
- grinding bottles
- washing and purifying flakes
- extrusion, crystallization and solid state post-polymerization

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05

— Impactful solution

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These technologies, supported by rigorous inspection of inbound waste, have enabled Veolia to obtain Food Grade certification from the EFSA and the FDA, making possible the commercial sale of bottle-to-bottle recycled transparent PET.

Colored rPET is primarily reused by the textile industry, and PEHD by the construction sector.

Thanks to this comprehensive know-how, the Group is helping Spain meet environmental, economic and societal ambitions.

- Playing its part in cutting the country's carbon footprint via a fall in its greenhouse gas emissions: manufacturing a bottle from recycled PET emits 70% less CO₂ than using oil-derived virgin PET.
- Helping to boost Spain's competitive strength and cut its dependency on virgin raw materials and fossil fuels.
- The factory also contributes to the economic development Extremadura, one of Spain's least industrialized regions, by employing 120 mostly local staff who work 24 hours a day, 7 days a week to keep it operating.

*Manufacturing a bottle
from recycled PET
emits 70% less CO₂
than using
oil-derived virgin PET.*



IMPACTFUL SOLUTION

SOLID RECOVERED FUELS (SRF):
AN ALTERNATIVE TO FOSSIL FUELS



BACKGROUND



To adapt to the climate crisis, humanity needs to learn to live without fossil fuels, which are powerful emitters of greenhouse gases. The solutions making this possible exist, particularly shifting economic models from linear to circular. Massive implementation of waste recycling and energy recovery will deliver an enormous reduction in our environmental footprint.

As part of this, solid recovered fuels are a viable and sustainable alternative to fossil fuels such as coal and lignite, and a way of addressing the need to reduce volumes of waste sent to landfill. SRF are also a high-yield energy source for generating heat and electricity. The outlook is promising: currently, 30% of non-mineral and non-hazardous waste is buried, potentially almost 70 million metric tons a year for the production of SRF in Europe.

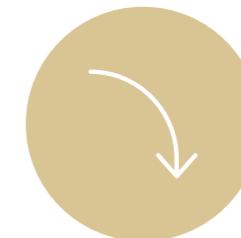
In France, a mandatory 50% reduction in landfill capacity by 2025 will produce an additional 8 million metric tons available as SRF. Initial arrangements already in place — prevention of waste production at source, new extended producer responsibility schemes, more comprehensive sorting guidelines for household packaging, ban on single-use plastics (drinking straws, swizzle sticks, etc.) — will at best reduce and recycle 1 million metric tons. In time this means there will be an additional 7 million metric tons of waste requiring a recycling or recovery solution that does not as yet exist. The development of low-carbon SRF, a market that is taking shape thanks to encouragement from the state, offers major potential.

With this in mind, Veolia is extending its capacity to produce SRF for local authorities wanting to develop urban heating networks, and for industrial clients, the cement industry in particular, wanting to improve their environmental performance by reducing the amount of fossil fuels in their energy mix.



30%

of non-mineral and non-hazardous waste is buried in Europe



50%

reduction in landfill capacity by 2025 in France



7 MILLION METRIC TONS OF ADDITIONAL WASTE

in France requiring a recycling or recovery solution



SOLUTION

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s a specialist in integrated waste management and long-term partner with local authorities, Veolia has created solutions for its municipal and industrial clients to produce and recover energy from SRF as part of local circular economy loops. Veolia can design, construct and operate facilities for the preparation and incineration of solid recovered fuels. SRF can be used on-site to generate heat or electricity for industrial applications, or in district heating networks. This alternative sustainable energy source offers multiple benefits: clients reduce their environmental footprint, diversify their energy mix and profit from an environmentally friendly alternative to landfill, generating savings.

Solid recovered fuels, also known as refuse derived fuels, are non-hazardous solid residues prepared from waste leftover after sorting, composting, etc., from solid household waste (residual household waste, outsize items), waste from commercial activities, from specific sectors managed by eco-bodies (furniture), and so on.

Their use requires an upstream preparatory phase that generally takes place directly at waste sorting and recovery sites. This is additional employment-generating activity at these sites. SRF preparation lines process the material at different stages: rough grinding, mechanical/air pressure sorting or by size (gratings), separation of ferrous metals, fine grinding depending on the end-user profile (cement industry for example).

IMPACTFUL EXAMPLE

Veolia works with Solvay, a global leader in chemicals and materials, to promote and implement its sustainability strategy. As part of this process, the Belgian company chose Veolia to replace the three coal-fired boilers at its plant in Dombasle-sur-Meurthe, in eastern France, with an SRF installation by 2024. The new facility is forecast to use 350,000 metric tons of SRF a year, cutting the site's fossil CO₂ emissions by 50% (250 metric kilotons of CO₂) and enabling Solvay to secure its supply of process steam at a price unaffected by variations in fossil fuel prices. This project also helps to cut the amount of waste going to landfill by growing the French market for SRF and energy recovery.



KEY ACTIVITY DATA

GLOBAL GEOGRAPHICAL AND INDUSTRIAL FOOTPRINT

685 processing facilities
operated worldwide



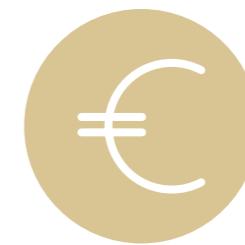
47 MILLION METRIC TONS
OF WASTE PROCESSED



40 MILLION PEOPLE
BENEFITTING FROM A COLLECTION
SERVICE



464,948 BUSINESS
CUSTOMERS



7 BILLION EUROS
REVENUE (2019)



MORE THAN 390,000 TONS
OF PLASTIC WASTE RECYCLED
WORLDWIDE BY 2020

Veolia Communications Department
September 2021

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