

INFRASTRUCTURE

## Self-Performing Office: The plan behind the megaproject

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INTERVIEW

## How to turn good ideas into better business

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3D PRINTING

# A SECOND LIFE FOR ART

# BUILDING THE FUTURE OF MUSEUMS



House of European History, Brussels  
European Museum of the Year Award 2019  
*Special Commendation*



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# 3D PRINTING, THE ART IS IN THE REPLICA

The flames that devastated Notre-Dame were as symbolic as the building itself, representing the fragility of our cultural heritage in the face of the paradox of time: architecture strives for endurance, but the longer it lasts, the greater the risk it will disappear, because catastrophes know how to wait for centuries: a war, an earthquake, dereliction, mass tourism or a fateful spark...

Just weeks before the fire, a piece of news confirmed that recovering our lost heritage might be more feasible than ever. Madrid's National Archaeological Museum unveiled a replica of the Romanesque Arch of San Pedro de las Dueñas, the first work in the world of a considerable size and complexity ever to be reproduced with additive 3D printing. Textures and details are replicated with such intricacy that only an expert eye can distinguish the copy from the original.

ACCIONA thus demonstrated that it can reproduce a small ornamental piece or even a building in a shorter period and at a much lower cost than would be required for any previous techniques, and showed its skill in various specialized areas, such as protecting masterpieces from weather conditions or from too many visits, increasing the circulation of replicas in exhibits and facilitating research with reproductions

that can be made available to any university. It also made a giant leap in the new museum paradigm—another of our business lines—in which the public not only touches art, but truly engages with it, as if journeying through time.

Once again, we are global pioneers of 3D applications, as we were three years ago in civil engineering. Belén Linares, Director of Energy Innovation, talks to us about this strategy of positioning ourselves at the forefront of technology, and about an open innovation model that can track down good ideas and quickly transform them into profitable products, from hybrid wind-solar power to biomass processing and logistical planning of megaprojects.

Our formula is to think big, given our multinational status, while continuing to innovate with the agility of a small startup. ■

“ Our formula is to think big, given our multinational status, while continuing to innovate with the agility of a small startup ”

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TRANSFORMING INNOVATION  
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Planning on a multinational scale, developing with the agility of a startup. Belén Linares, Director of Energy Innovation, analyzes a business model that can —quickly and cheaply— turn technology trends into profitable products.

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P. E. La Moraleja. 28108 Alcobendas.  
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Smart meters and carbon fiber pipes. Predictive maintenance to prevent even a drop of water from being lost.

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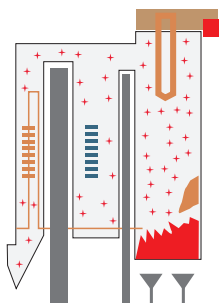
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the new  
Ribera  
del Duero



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First Spanish female Master of Wine  
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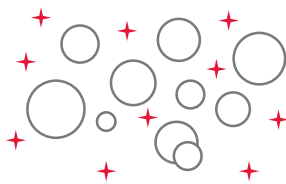
# COMPREHENSIVE, SMART AND SUSTAINABLE WATER MANAGEMENT



## UNIVERSAL ACCESS



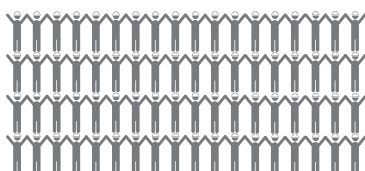
**IN 2018, ACCIONA CONTINUED TO STRENGTHEN ITS CONTRIBUTION TO TACKLING ONE OF HUMANITY'S GREATEST CHALLENGES:** ensuring that more and more millions of people around the world have access to water and sanitation



**ACCIONA** is an **expert** on the entire water cycle: from extraction, purification or desalination, transport and supply to the **treatment of wastewater** and its **return to the environment** in the same or a better state than it was in when extracted

IT MEETS THE WATER  
SUPPLY NEEDS OF A  
POPULATION EQUIVALENT  
OF OVER

**100 MILLION  
PEOPLE**



Last year its wastewater,  
drinking water and  
desalination plants  
produced or treated

**790 hm<sup>3</sup> of water**  
(790 billion liters)

OVER **1/3** OF THIS WATER  
IS PRODUCED IN WATER-  
SCARCE OR WATER-  
STRESSED AREAS

QUICK BRIEF

In the Middle East and  
North Africa alone, it desalinated

**204 hm<sup>3</sup>**  
Its reverse osmosis technology emits  
**6.4** times less greenhouse  
gases than thermal desalination

Around the world, the  
company has built:

**120**

drinking **water**  
**treatment plants** that  
supply **31 million** people

**80**

desalination **plants**  
that supply  
**22 million** people

**300**

wastewater **treatment**  
**plants** with a total  
capacity of **15 million m<sup>3</sup>**  
per day, serving  
**57 million** people

**ACCIONA CONTRIBUTES  
TO ACHIEVING 4 OF THE  
UN'S SUSTAINABLE  
DEVELOPMENT GOALS**

QUICK BRIEF









HISTORY

## THE TRENCH IN CALLE ARAGÓN

AN ICONIC STREET, A GROWING BARCELONA AND A CLAMOR IN THE PRESS: "COVER THE TRENCH, FOR HEAVEN'S SAKE!"

by Patricia Alcorta

In the late 1950s, Barcelona was overflowing once again. The Eixample was no longer wide enough, and the city's growth model was hotly debated in the local press. Aragon street was one of the most often cited streets, due to the accursed railroad trench—two kilometers long and 15 meters wide—that coal trains passed through night and day. Over the years it had become a sewer that collected soot, cigarette butts and the general unpleasantness associated with industry, and if there was one thing everyone agreed on it was the need to cover it for the sake of the area's residents and to enable connection with the rest of the city. Finally, the City Council green-lighted the project, and in one year, Entrecanales y Tàvora transformed it into a train tunnel with a concrete vault whose surface could support road traffic. However, since we all have a bit of an instructor, a town planner and a controversialist inside us, the debate continued. Some criticized the street—in the rather flowery prose of the era—for having become a major avenue that was kind to cars but hostile to pedestrians: "Now, it's a suburban knife that cuts Barcelona from end to end!" ■

# TAKEOVER BID TO ACQUIRE 100% OF MOSTOSTAL WARSZAWA

THE CORPORATION IS ONE OF POLAND'S LARGEST CONSTRUCTION COMPANIES.

The Siekierkowski Bridge, one of ACCIONA's biggest projects in Poland.



The takeover bid to acquire the remaining stake in the company involves the purchase of almost 10 million shares owned by minority shareholders. The price offered per share, €0.81, represents a 28.7% increase over the volume-weighted average price of the past six months. With the buyout, ACCIONA aims to achieve better integration of Mostostal Warszawa in the group

to strengthen its business and growth strategy. The relationship between the two companies is longstanding; ACCIONA has been the majority shareholder in the Polish construction firm since 1999. Founded over 70 years ago, Mostostal Warszawa develops projects in all key sectors of the Polish infrastructure market. It closed the 2018 financial year with revenue of 182 million euros.

## NEW RAILWAY CONTRACTS IN NORWAY AND AUSTRALIA

The joint venture of the Swiss company Implenia and ACCIONA has won the public tender to build the Sandbukta–Moss–Såstad line, which will consist of 10 kilometers of double-track railway, 5.5 kilometers of which will be underground. The contract is worth 650 million euros and is part of a national program to improve connections between Norway's main cities and decrease traffic in the area around Oslo.

In addition, the consortium formed by ACCIONA and Lend Lease has been selected to build two new railway stations and eliminate three level crossings in southeast Melbourne, the contract is worth 335 million euros. Over the last 18 months, ACCIONA has signed agreements for railway projects in Australia and New Zealand worth over 1 billion euros.







## USYA, THE THIRD PHOTOVOLTAIC PLANT IN CHILE

The Chilean market continues to add value to the group. ACCIONA has just begun its third photovoltaic plant in the country. Usya is the final stage of a plan to invest 600 million dollars in four renewable projects (two photovoltaic plants and two wind farms) with a capacity of almost

400 MW. Located in the region of Antofagasta, the 64-megawatt-peak (MWp) plant will generate enough power to meet the demand of 70,000 Chilean households, with 187,000 modules spread across 105 hectares. It will be operational by the middle of next year.



## Renewable energy in the airports on the Iberian Peninsula

ACCIONA has been awarded four of the seven lots in a tender called by AENA, to supply power to all of AENA's airports in the Iberian Peninsula, including Adolfo Suárez Madrid-Barajas Airport and Josep Tarradellas Barcelona-El Prat Airport. An estimated 728 gigawatt-hours (GWh) will be supplied (76% of the total tender award), preventing the emission of 460,000 tons of CO<sub>2</sub> by fossil fuel power plants. The energy supplied will be certified by the National Markets and Competition Commission (CNMC) as 100% renewable.



## FINANCIAL CLOSE FOR THE SHUQAIQ 3 DESALINATION PLANT

Funding of over 530 million euros was secured just three months after the contract was awarded to ACCIONA and its three partners (for design, funding, construction, operation and maintenance over a period of 20 years.) The agreement involves two Saudi banks and four international banks. The desalination plant will be built in Saudi Arabia and will be one of the largest in the world, able to supply drinking water to 1.8 million people.



## A 200 MILLION EURO WASTEWATER PLANT, THE FIRST PROJECT IN VIETNAM

With this project in Nhieu Loc-Thi Nghe, ACCIONA gains a foothold in one of the key economic regions in its expansion plan. The contract has been awarded to the consortium consisting of ACCIONA and VINCI Construction Grands Projets. It includes plant design, construction, operation and maintenance and will benefit over one million residents of Ho Chi Minh City. Vietnam's government is pursuing a policy of water infrastructure modernization.



# WIND ON THE BLADES

# SUN ON THE TOWER

AEOLUS AND HELIOS, UNITED. THE RESULT IS A HYBRID THAT BREAKS NEW GROUND IN SELF-CONSUMPTION AND EFFICIENCY: CARBON-BASED SOLAR PANELS ATTACHED TO WIND TURBINES. A TWO-IN-ONE RENEWABLE ENERGY SOURCE THAT'S UNIQUE IN THE WORLD.

by **Juan Pablo Zurdo**



The wind turbine in Breña wind farm in Albacete, Spain, where the new organic panels are being trialed.

**B1-1**  
Breña

SOME IDEAS ARE SO GOOD AND SO SIMPLE, THEY SEEM OBVIOUS. ONCE SOMEONE HAS THOUGHT OF THEM, OF COURSE. LIKE PUTTING CANDY ON A STICK OR BAND-AIDS FOR DARKER SKIN TONES.

Covering a wind turbine tower with solar panels has joined the ranks of this exclusive club. It seems like a Eureka idea, and it is, but it's more than that. When innovating, that light bulb moment requires a complex process of prior research and development, such as testing new materials for PV technology, one of ACCIONA's priorities.

The company has taken a promising up-and-comer with a bright future into its fold: the organic solar panel, made with carbon for the chemical reaction instead of silicon. Advantages: abundant raw material, manufacturing consumes little energy and panels are so malleable that they enable an ease of installation and maintenance that was previously inconceivable. "The technological improvement and production cost reduction curve is spectacular, which is usually a strong indicator of disruption," says Enrique Iriarte, the Project Manager.

After locating the technology with its trend tracking system, ACCIONA agreed a set of production and cost targets with its development partner, Ger-

man startup Heliatek, as well as an unprecedented format: panels that roll up like vinyl. The next step was to determine the panels' practical value for the business. Consideration was given to installing them on buildings, but when the sheets are barely one millimeter thick, when they're flexible, when they're suitable for curved surfaces and you can just stick them on with no need for heavy support structures... why not use them on a wind turbine tower? That's when the light bulb went off: the world's first organic wind-solar hybrid project.

#### PILOT PROJECT IN BREÑA

So far, it's been implemented in a single wind turbine in Breña wind farm in Albacete. Eight rows of panels are attached to the 80-meter-tall tower, covering 50 of these 80 meters. The project's primary differential value is clear to see: the major civil engineering project already constructed, i.e. the turbine towers, can be capitalized on to combine two infinite energy sources. Moreover, it can be done without high installation costs, essentially requiring only a telescopic crane, a light frame to attach the modules to and a roller to smooth them out to eliminate bubbles or folds.

The pilot project is already tackling the next goal: measuring the output, generation efficiency and deterioration of the panels, and using this data to move toward total self-consumption. A modern windmill is like a computer. It may look like it's off, but it continues to consume power. Even though the blades don't turn when it's too windy, the nacelle needs to rotate and seek the best angle

### FACT SHEET FOR A POTENTIALLY DISRUPTIVE TECHNOLOGY

Carbon-based panel model:  
HELIASOL 308-5986, BY HELIATEK

**1 mm**

thick  
with a per-unit  
surface area of

**5,986 X 308 MM**

Total no. of panels:

**120**

southeast/southwest-facing  
panels

Maximum  
output of

**9.36 KW**





in order to avoid damage to the structure. The machinery and auxiliary systems continue to operate at all times, to keep the lubricating oils at the right temperature, for instance, or to enable remote control of the components and sensors in all of ACCIONA's wind farms around the world.

Where does the energy come from when the turbine is stopped? From the grid. Now, with the organic panels attached to the tower, this energy can be produced in an autonomous hybrid system. Whether it will entirely or only partially cover consumption remains to be seen, but forecasts are optimistic given the scope for technological improvement. It's plausible that it may even generate a surplus that can be fed into the grid.

### TRIPLE HYBRID

After the measurement phase is completed, ACCIONA will develop management software to coordinate two sources that each fluctuate on their own depending on weather conditions. "Hybridizing isn't easy, harmonizing two generation systems and managing to do so with a simple application is an art form," explains Enrique Iriarte. In fact, this hybridization model is even more complex, since it's not double but triple: organic solar, wind and, in the future, storage via the installation of batteries that will power the machinery on windless nights.

It's possible that this one-of-a-kind wind turbine has already made energy transition history. It ushers in an emerging generation model that's sure to attract other companies, speed up scalable production and enable installation on objects or structures with moving, small or irregular surfaces, or surfaces that aren't strong enough to support conventional panels. It all began somewhere in La Mancha. ■

The lab in the startup where the panels are developed under contract with ACCIONA, thanks to its open innovation model.

## THE PROJECT SEEKS TO GENERATE POWER FOR SELF-CONSUMPTION BY EACH WIND TURBINE

### COMPETITIVE ADVANTAGES OF PIONEERING THIS TECHNOLOGY

- It's still expensive to produce panels, but the process consumes little energy and ACCIONA has secured special conditions from its partner.
- Panels are flexible enough to be used on moving parts such as wind turbine towers, whose upper portions oscillate up to one meter.
- Towers will continue to grow higher: this means more useful surface area for panels.
- Other wind-solar hybrids use ground-mounted panels, which require land and infrastructure to be readied.
- All of the materials are 100% recyclable, and maintenance is simpler and cheaper than with silicon.
- The company is a pioneer in their use all over the world: brand prestige, solid position in the sector.
- Forecasts for cost reduction and efficiency gains are very optimistic.
- It's one of the projects with the best investment-to-business opportunity ratios.



We are  
passionate about


**BELÉN LINARES CORELL**

DIRECTOR OF INNOVATION FOR ACCIONA'S ENERGY DIVISION

transforming

por **Juan Pablo Zurdo** fotos **Jacobo Medrano**

—  
innovation into  
products and  
businesses”

A portrait of Belén Linares, a woman with dark, wavy hair, smiling and looking slightly to her left. She is wearing a dark blue blazer over a light pink blouse. A decorative brooch is pinned to her blazer. A white text box with a thin black border is positioned to her right, containing a short biography. A thin black line connects the text box to her shoulder area.

Belén Linares has been the Director of Innovation in the Energy Division for the past three years.



ANTED: AN  
ENGINEER WITH AS  
MUCH ANALYTICAL  
INTELLIGENCE AS  
EMOTIONAL, CREATIVE  
AND PROACTIVE  
INTELLIGENCE, WITH  
A MIND AS OPEN AS  
THE WAY ACCIONA  
INNOVATES, WHO  
LIVES BY A MOTTO:  
“MAKE IT HAPPEN.”

This could be an ad for the sort of employee sought by ACCIONA Energy's Innovation Department, which helps drive alliances with universities, research centers and startups to transform good ideas into even better products. “It’s an arduous and, therefore, exciting journey” —says the department’s director, Belén Linares, an Aeronautical Engineer with an MSc in electrical power systems— from lab-based theory to real-market practice. It requires as much skill at managing people as it does technological skill: “We have to internalize our own company’s business goals as well as those of our partners, and motivate both parties in a well-balanced relationship.” It’s not just about innovating, it’s about innovating quickly, keeping cost and risk at reasonable levels and anticipating applications where no legislation exists, for dozens of projects at once and with enough flexibility that we still win even if a project never gets off the ground, thanks to an ability to learn that ensures the next one will be a success.

#### **“Innovation” is becoming a buzzword...**

That’s true, it’s used constantly to describe doing things differently from how you used to do them. And while that’s a valid use, it’s

too general. Our approach is open innovation that turns new technology into useful products, into specific applications for the market. We have a pivotal position in a network that includes universities, researchers and startups that all use very different languages and go at very different paces. We are engineers but we’re not developers. We track down innovations of interest to us in this global ecosystem and try to secure agreements to develop them with a view to very clear business goals. It’s extremely hard to transform a good idea into a good product that contributes to our EBITDA, and that’s why we find it so exciting.

#### **What sort of professional and personal traits does it require?**

Sometimes the biggest opportunities come from the smallest leads, and in innovation there are barriers everywhere. You wonder if something is too expensive, about the fact that it’s never been done before, if it’s too risky... We are engineers with specialized knowledge, but we also look for creativity and an open mind that doesn’t rule anything out. And, of course, the technological discretion to identify or discard possibilities so we’re not just fumbling in the dark. Big corporations usually become cumbersome. That’s why our goal is agility, taking the helm so we can make mistakes quickly and cheaply, learn and then get back behind that helm until we get it right. Our motto is “Make it happen”, but make it happen fast. Open innovation entails a mutually beneficial relationship with much smaller companies and it must be pursued with respect for them, avoiding being an invasive presence while getting them excited about the joint endeavor, with an overarching commercial and business vision. And you don’t learn all this in engineering, but by managing people and companies. We look for a mix of technical and human skills, of aptitude and attitude.

#### **In this model, what is the tracking process like?**

Innovation is not a divine or stochastic science; it’s not a crystal ball, nor does it spring from talent alone. It’s a process that, in our team, begins with the trend tracking system. It doesn’t work like trend labs, which investigate upon demand after receiving an order. Our system is proactive,



9

energy  
innovation  
projects: 5 in  
Spain and 4  
abroad

€26.6

million

The amount  
saved by  
improvements  
made to  
processes

## ON A PERSONAL LEVEL

### **An innovation you'd like to have patented...**

The iKnife intelligent surgical knife: an electrical current heats up tissue, enabling nearly bloodless incisions. It also detects chemicals in tissue to determine whether it contains malignant cells in real time.

### **A historical technological breakthrough...**

I'd definitely have to go with the printing press.

### **The human trait you most admire...**

I admire many, but especially honesty.

### **A human trait you're not so fond of...**

Selfishness.

### **A hobby that's an essential part of your life...**

Just one? Reading, which is why I chose the printing press. Another is golfing with a partner.

### **Your favorite book, movie and song...**

I think *Blade Runner 2049* is an amazing movie. Song: *El astronauta que vio a Elvis*, by Love of Lesbian, which is the last band I saw live.

### **A personal motto...**

The same one we have in ACCIONA's Innovation Department: "Make it happen."

it searches for all mentions of new technologies by universities and startups around the world. Then, it systematically uses parameters of quantity, relevance, simultaneous occurrences and patents to create a weekly summary and a detailed half-yearly report on the evolution of each trend. The aim is to substantiate strategic innovation decisions through data analysis, which is absolutely crucial. We are a machine that processes information with a view to ACCIONA's particular interests.

### **What are some of the main areas of interest?**

In PV solar, which is a fantastic breeding ground for innovation, I would point to automation, digitization, predictive maintenance and trials of



new materials like organic carbon-based panels, everything from automated cleaning machines to drone thermography and hybridization with wind, biomass or storage. We're also going to implement bifacial solar panel technology in some of the company's facilities. In wind power, we want to extend the life of farms with predictive, prescriptive, intelligent and ever more remote maintenance. Controlling energy over time is an obsession of ours: storage in both battery plants and emerging systems like converting electricity into hydrogen, which extends its life from a few hours to several months, enabling medium-term asset planning. And then there's the future distributed model, management of micronetworks with thousands of power gener-





Innovation can benefit the planet as a matter of common sense, as an ethical duty, and also because it's good business



## A SNAPSHOT OF ENERGY INNOVATION

### THE TEAM

The department has 13 staff members plus three or four support technicians who work a rotating basis. That's the inner core, but the team actually extends to encompass hundreds more people thanks to the support of ACCIONA's open innovation ecosystem. There are always 10 to 20 projects underway.

### THE ORGANIZATION

Two groups:

- **THINKERS:** They hunt for trends using the technology tracking and intelligence system, and define the major lines of work or focus areas (new materials, hybridization, storage, advanced sensors, hydraulic robotization, micronetworks, blockchain applications, etc.) They devise challenges and lead projects with startups.
- **DOERS:** The implementers. They bring technology projects and focus areas to fruition. They achieve results and attract media attention.

The two groups are structured based on the particular profile of each worker, although sometimes they trade places to gain an understanding of the complete innovation process.

### THE RELATIONSHIP

The team attracts startups that are the right fit for the business goals through active scouting and the INNOVATION platform, which underpins the company's startup system, and then enters into a balanced partnership with them. The relevant innovation is usually co-patented, and in exchange for accelerating these startups ACCIONA secures a privileged relationship with them with respect to potential competitors.

ation points that will be closer and closer to consumption points.

### What about other, perhaps a bit more modest, projects?

In our plan, these major trends exist alongside a focus on longer-term profitability and brand impact, and with other trends that may have less of an impact but can be swiftly monetized and help support the former trends. It's a model that keeps us focused on very diverse areas of business that move at very different speeds. These projects are less glamorous, but use advanced technologies to help business managers cut costs and increase efficiency on a day-to-day basis. For instance, satellite surveillance to fight fires, drones that inspect cracks in wind turbine blades, which are a machine-learning sensor-based tool that a wind farm only has to disconnect when a storm has already hit rather than hours in advance due to spotty weather forecasts, or the Max Power project, which increases wind turbine performance beyond theoretical limits... They improve operations on-site, and thus increase return on investment and profit.

### What will the electric power system of the future look like?

The change is going to be huge; we're already seeing it. We'll go from highly-regulated power generation and marketing to a much more decentralized system with self-generating units and self-consumption everywhere, that is to say, a model of energy as a service. There's no doubt that the law is rigid, it moves slower than the need for change. With small pilot schemes, however, innovation can show itself to be of practical value, demonstrating the return on investment to facilitate the adaptation of regulations to modern times. The aim is to set the trend for our future business, and I don't mean ACCIONA alone, but the entire sector. This challenge presupposes an even bigger one: the enormous social responsibility of decarbonizing the economy and fighting against climate change. Benefiting the planet as a matter of common sense, as an ethical duty and because it's good business. Could anything be more exciting than that? ■

# 3 D THE ART OF CLONING ART

by  
Ángel Luis Sucasas

Capitals printed in a water-resistant polymer used to reproduce details and textures. To the right, the entire arch in front of the National Archeological Museum (Madrid).



FOR NINE CENTURIES, THERE WAS ONLY ONE ROMANESQUE ARCH OF SAN PEDRO DE LAS DUEÑAS. SINCE APRIL, THERE ARE TWO. THE SECOND, AN EXACT REPLICA, IS THE FIRST ARCHITECTURAL MASTERPIECE REPRODUCED USING ADDITIVE 3D PRINTING, AN UNPRECEDENTED MEANS OF SAFEGUARDING OR REVIVING OUR COMMON HERITAGE.





# WE WANT TO BELIEVE THAT HISTORY ENDURES AND WILL WITHSTAND ANY UPHEAVAL. IN TRUTH, IT'S AS FRAGILE AS NATURE, AS FRAGILE AS THE ENDANGERED RHINOCEROS THAT MAY NEVER SEE 2020.

Most silent films were lost forever due to poor preservation of celluloid. Who knows how many masterpieces in the Library of Alexandria were lost to fire? Terrorist attacks in Palmyra destroyed the Buddha statues in the Bamiyan Valley and other World Heritage gems. And let's not forget the spire of Notre-Dame Cathedral in Paris, which was engulfed by flames.

With a forward-looking approach, however, the present offers technology that can act as an insurance policy against risk. 3D printing and new techniques that can capture reality down to the tiniest crack, such as photogrammetry, have a surprising role to play in preserving our artistic heritage. Their ability to create extremely detailed digital twins has negated the threat of permanent disappearance. 3D printing enables us to go far beyond the possibilities of any sort of virtual reproduction, recreating such masterpieces as if they were backup copies in the three-dimensional and textured world.

ACCIONA, a company that is leading the way in 3D printing of civil infrastructure like the pedestrian bridge in Alcobendas, Madrid, is also at the forefront of this new application, which combines the arts with technology in order to preserve the collective cultural memory. Last April the National Archeological Museum (MAN) in Madrid publicly unveiled the first 3D-printed work of art cre-

ated layer-by-layer in concrete via additive manufacturing: the Arch of San Pedro de la Dueñas (León, Spain). The original arch, from a canonical monastery, is held by the museum.

## A TANGIBLE DIFFERENCE

The copy made by ACCIONA is located in the garden at the museum's entrance. The fundamental difference between the two pieces doesn't lie in the virtually identical capital details or the feel of the limestone ashlar, columns or voussoirs. The difference is that the exact replica doesn't have a "Please Don't Touch" sign, that it could feasibly travel to exhibits in Spain and abroad, that it will enable more exhaustive physical examination and dissemination, and that, due to this, it ensures more fastidious preservation of its twin, which is nearly one thousand years old.

"It's a huge innovation for the cultural preservation and museum world, which is moving toward interaction with exhibited pieces. You can't touch an original. But you can touch this arch. Technology enables us to give a new life to pieces the public was once only able to see in books or visit in a specific, far-off museum, and of course it was unthinkable to get close to such masterpieces or even, at times, take photos of them," explains José María López-Galiacho, Director of ACCIONA Productions and Design (APD).

With printed art, several copies can be made. These can tour with traveling exhibits and facilitate academic study of the pieces with a view to restoration, archeology and history.



## THE ARCH AND ITS BACKUP COPY

**2.2**  
meters high and  
**3.3**  
meters wide

**Project**  
**Duration**  
**2 years**  
**Team**  
**10 people**

### PHASES

**1./**  
In-situ digitization  
via reality capture.

**2./**  
D-Shape 3D  
printing in concrete,  
over the course  
of three weeks  
at ACCIONA's  
premises in Torrejón  
de Ardoz (Madrid):  
one week for the  
arch, another for the  
columns and  
the last for the  
final details and  
assembly.

**Printing**  
**Technique**  
Additive, with  
material added  
layer by layer.





Technology also allows us to play around with dimensions, in the manner of a zoom, for analytical and educational purposes. We can't go back to the Renaissance and exhume Michelangelo so he can enlarge David's head. But with 3D printing, we can take details like an eye or an eyebrow and create 3D models for academic study.

## TWO MATERIALS

The arch has exemplified this. During the unveiling, attendees were able to feel its contours rather than merely posing for selfies. There's no need for that old velvet rope barrier, as the piece was printed in two different materials which give it resistance and a degree of malleability: a concrete structure combined with a water-resistant polymer for the most intricate elements, such as the carved figures and geometric decorations.

Why this particular arch and not another piece? "Because ACCIONA and the MAN wanted to tackle a major challenge —explains Andrés Carretero, the museum's Director— and, in addition to being of a very respectable size, this arch has very diverse elements, including a lot of areas with protrusions and

A piece at Madrid's National Archeological Museum (MAN) is captured with a high-resolution laser scanner. The digital reproduction of the piece can be shared by researchers all over the world.

## IMPACT ON THE APD WORLD

- 3D printing and photogrammetry allow **ACCIONA PRODUCTIONS AND DESIGN** to build a narrative for museums and exhibits with much greater appeal: a direct, creative and accessible experience enabling visitors to touch and handle pieces, enlarge them on-screen and access to complementary information based on their age and preferences.
- **APD** is scanning various pieces for the new **Grand Egyptian Museum**, to enable 3D digital models to be produced. One of the items being scanned —with reference to both scale and color— is Tutankhamun's outer burial chamber. This will allow a physical reproduction to be created and exhibited in the museum at a later date.
- 17 years ago, APD pioneered the use of full-scale recreations in the **Archeological Museum of Alicante**, complete with audiovisual resources to contextualize artifacts in their historical era. This innovative approach won it the **2004 European Museum of the Year Award**.



# THE SIZE OF THE ARCH AND ITS DETAILED DECORATIONS PUT THE CAPABILITIES OF 3D PRINTING TO THE TEST


indentations such as the capitals. Its complicated features enabled us to test the limits of 3D printing using an additive model.”

## CLONING


This sort of cloning is made possible by laser scanning, which can be used not only for subsequent printing but also as a stand-alone technique to create digital twins. In fact, 30 pieces from the MAN encompassing over one thousand years of art, from the 4th to the 15th century, have been scanned. Simply by pinching the screen to increase the focus, the smallest details become visible, from scratches on copper to the ocelli of insects in the wood of a Virgin Mary. “It’s as easy as having a cell phone on you and knowing how to take photos,” explains José Daniel García Espinel, Director of ACCIONA’s Innovation Advanced and Digital Innovation Hub. “Although we also use techniques like laser scanning to capture pieces with this level of precision.”

In terms of scale, the future is limitless. You can print small sculptures and decorative art pieces, intermediate spaces such as a cave with rock art, or a staggering scene of a city destroyed by natural disasters, war, the passage of time or a combination of all of the above. Perhaps Pompeii, a prime example of how the pressure of tourism and weather conditions can be as harmful over time as the eruption of Vesuvius in 79 AD.

This possibility is no joke for López-Galiacho: “Nothing is impossible if there’s someone to fund it. In such a scenario, we could set out to bring Pompeii back to life.” ■



ACCIONA printed this 3D replica of Madrid's statue of The Bear and the Strawberry Tree for the city of Guadalajara, Mexico. Below, concrete blocks used by printers.





## A HERITAGE ROUTE REBORN

**Arch of Triumph, Palmyra.** A 2nd century Roman arch destroyed by Islamic terrorists in 2015. It weighs 11 tons and stands 6 meters tall — two-thirds of the original size— and was created in Egyptian marble using a subtractive technique. A joint project between Harvard and Oxford universities and the Dubai Future Foundation.

**Pompeii Casts.** Printed replicas of the startling shapes left by some of Mount Vesuvius' victims, whose bodies were covered in volcanic matter and left behind natural casts upon decomposing. A joint project between the Italian company World's Advance Saving Project and the Special Superintendence for the Archeological Heritage of Pompeii, Herculaneum and Stabiae.

**Micro Rome.** Wrapped in gold leaf to give it some shine, this reproduction

of Imperial Rome printed by 12 Yale University students has traveled the world, offering an example of how ancient cities can be reproduced on a tiny scale: 1500 x 1300 x 90 millimeters. The project was inspired by Giovanni Battista Piranesi's maps.

**Nefertiti returns to the Nile.** In protest of what they view as Western appropriation of the historical heritage, two German artists scanned the bust of Nefertiti held by the Neues Museum in Berlin. They used this digital twin to create their own copies, which they sent to Egypt. The news made headlines around the world.

**Million Image Database.** This database aims to create a sort of open-source Wikipedia for the collective cultural memory: internet users upload photos of their trips for the purpose of building 3D digital twins of masterpieces all over the world.

THERE'S NO  
LIMIT ON SCALE;  
WE CAN EVEN  
REPRODUCE  
CITIES  
THAT HAVE  
DISAPPEARED



## ROGER MICHEL

Founder and Director of The Institute for Digital Archaeology (UK) and the Million Image Database project

“ 3D enables reconstruction at a reasonable cost and in a fraction of the time ”

### What will 3D printing and photogrammetry do for our heritage?

Several factors favor their rapid and widespread adoption. Chief among these is the fact that the technology is simple. A good handheld scanner costs just a few hundred euros, and good results can be achieved with a simple cell phone. This means that institutions of all sizes can play an important role, especially in conflict zones or areas

with restricted access. Even a single person, in the right place and time, can help. They also herald a new sort of interaction with antiquity; for the first time we can discover large- and small-scale archeology by touch.

### How might they be used in the wake of the fire at Notre-Dame?

Having high-quality 3D models will always make the task of rebuilding easier, in addition to enabling it to be done via 3D printing or sculpting, which could be used to recreate significant portions of the cathedral at a reasonable cost and in a fraction of the time needed for traditional techniques.

### Should a new international framework be created?

Yes, I firmly believe that UNESCO should get involved, given its credibility and the unequivocal authority it has to act on states' behalf. It should lead this initiative and develop international standards for repairing and rebuilding ruins and objects, a topic that's often debated within the organization.

### Could we take on the task of rebuilding cities?

There are few historical monuments that haven't required a prodigious amount of reconstruction work, so it would be a mistake to view reconstruction as a modern problem or even as something that's optional. That's not to say, by any means, that we should take on such a task without a clear overarching vision. Reconstructions of complete cities are feasible; what is less clear is whether the international community wants to move in that direction.

### How can we prevent digital copies from being lost over time?

The challenge is the durability of the existing digital formats and how best to organize the massive amounts of information being collected. Without an explanatory framework, this information is less useful and the proliferation of several different formats poses a risk to long-term preservation. That's why one of the key aims of the Million Image Database is to create a simple way to store images with sufficient contextual information.



# BIOMASS

## HARVESTING





ENERGY THAT'S DOUBLE GREEN: IT'S RENEWABLE AND FROM VEGETABLE SOURCES. BIOMASS PLANTS PROTECT FORESTS, BOOST THE RURAL ECONOMY AND MAKE BETTER USE OF RESOURCES AND THE RURAL POPULATION.

—  
by  
**Ángel Luis  
Sucasas**

# CLEAN ENERGY

# WHAT DO TARRAGONA AND TOLEDO, PORTUGAL AND CALIFORNIA AND GALICIA AND GREECE HAVE IN COMMON? MEGAFIRES THAT ARE BEYOND HUMAN FIRE-FIGHTING CAPABILITIES.

They all share a common origin: dense undergrowth that builds up due to lack of forest maintenance, becoming tinder over a giant fuel tank. Spanish forests frequently contain some 30 tons of such vegetation per hectare, three times the amount that fire-fighting resources can deal with. These conditions increase the speed of fire propagation and the size of the flames, which create their own microclimate in the area where the blaze is raging.

Transforming this biomass into an energy feedstock reduces the risk of megafires (known as “firestorms”) and that’s just one of the multiple benefits. The European Commission also considers biomass a strategic sector in order to “diversify Europe’s energy supply, create growth and jobs and lower greenhouse gas emissions.” The industry creates nearly 400,000 jobs in the EU,

To combat rural depopulation and keep forest areas clean, the conversion of biomass into energy will be an increasingly important activity in Spain and Europe.

and by next year the energy it produces will be double that produced in 2012. The Commission estimates that 8% of all energy consumed will come from biomass by 2050.

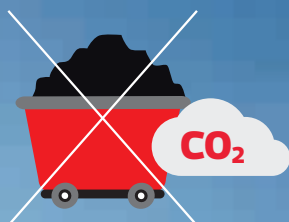
ACCIONA has been a pioneer of biomass as a renewable energy source since 2002 when it opened the Sangüesa plant (Navarra) whose use of cereal straw makes it a unique facility. Later on, it added the Briviesca (Burgos) and Miajadas (Cáceres) plants, and although the technology is mature, the company maximizes its performance with material processing and steam system innovations. In 2018, the three plants together generated energy equivalent to the consumption of 140,000 homes (428,000 megawatt hours.)

“Biomass has social and environmental benefits above and beyond those of other clean technologies. Its presence in every region means it meshes perfectly with ACCIONA’s goal of sustainable development,” explains Óscar Lumbreras, who manages biomass production in the company’s Energy division. “It must play a key role in the energy transition and the circular economy; it’s a manageable energy source that can fill the gap left by the large thermal power plants, such as coal-fired stations, and ensure constant generation for the system that’s independent of weather conditions.”



# SOCIAL AND ENVIRONMENTAL INVESTMENT

IN ADDITION TO PREVENTING FIRES AND FOSTERING ADEQUATE FOREST MAINTENANCE, WHICH WAS ONCE A PART OF RURAL CULTURE, BIOMASS OFFERS THE FOLLOWING BENEFITS:



## DECARBONIZATION

It's a carbon-neutral energy source. The amount of CO<sub>2</sub> generated by combustion is the same as that absorbed by biomass-producing plants as they grow. It avoids emissions that would have been generated by fossil fuel plants. In 2018 alone, ACCIONA's facilities prevented the release of **272,000 metric tons of CO<sub>2</sub> into the atmosphere.**



## CIRCULAR ECONOMY

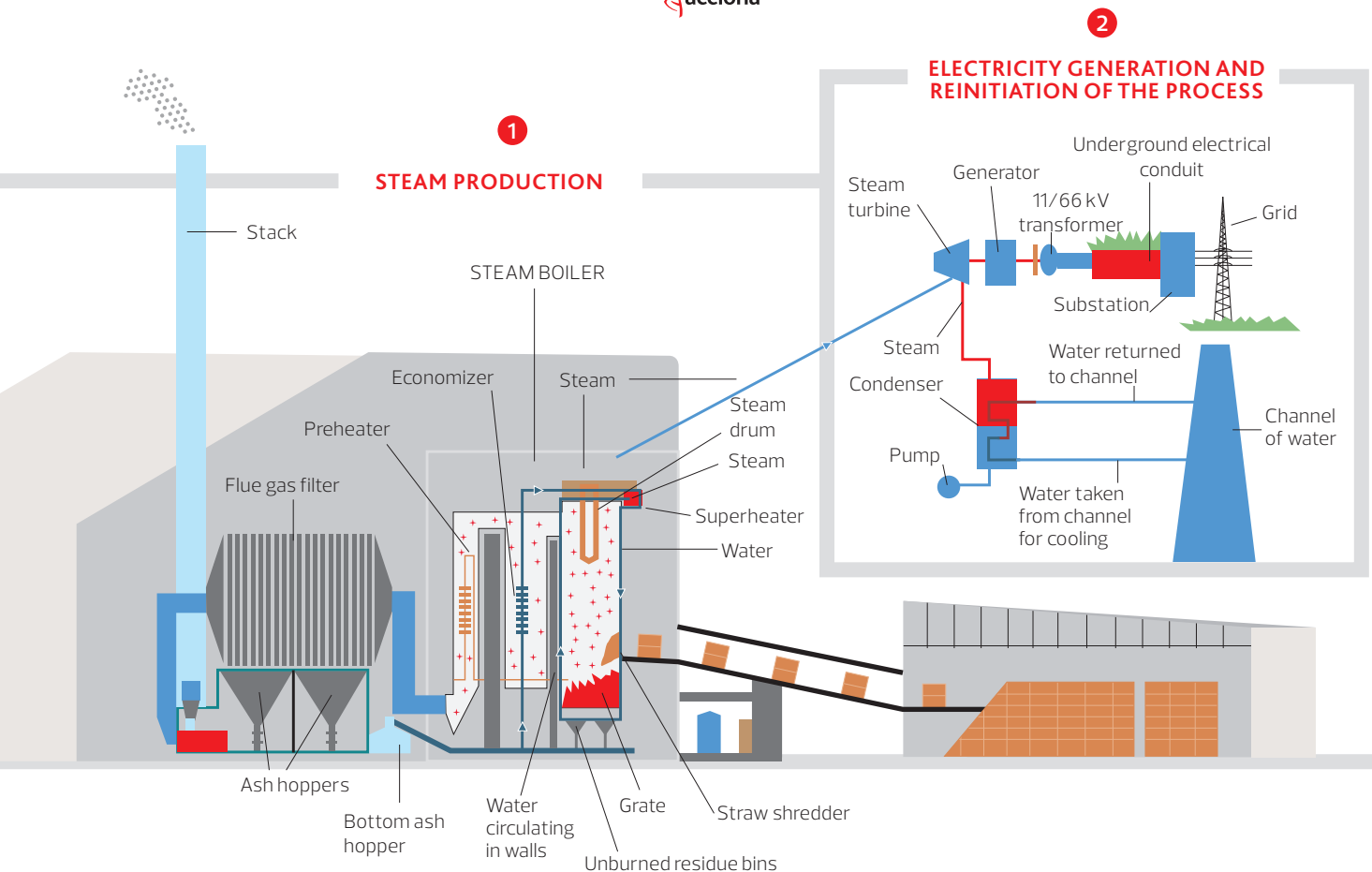
The purchase of biomass increases the value of agricultural and forest resources. In ACCIONA's case, **35% of revenue from the sale** of electricity returns to the local economy. Slag and ash left after combustion are reused in the production of fertilizers and aggregates or for the rehabilitation of degraded land.



## RURAL DEVELOPMENT

It stimulates a productive fabric of collection, processing and logistics that's deeply embedded in each region. Recurring and sustained revenue enables companies to plan for the medium- and long-term, make investments, keep their structures stable and diversify with other activities linked to their settings. At Sangüesa, **50 companies** supply straw obtained from some **800 farmers.**

Quality employment: ACCIONA's biomass plants create **326 jobs per year** (study based on the renewable facility socio-economic impact methodology developed with Ernst & Young): 74 plant workers, 109 direct jobs associated with transport, 91 indirect jobs created by purchases and 52 induced jobs.



## FROM (LIVING) PLANTS TO (POWER) PLANTS

**HARVESTING.** Transformation into energy —bioelectricity or bioheat— begins with collecting and compacting the plant material. Three types of biomass:

**1.** Herbaceous biomass is cereal straw (wheat, barley, oats, corn, etc.) It's easy to pack and is supplied twice a year. It has a very low, uniform moisture content of roughly 15%, ensuring a high calorific value. It produces a considerable amount of ash (6%), which leads to corrosion problems.

**2.** Woody biomass comes from agrarian pruning (vine shoots, olive trees, etc.) and forest biomass (pine, eucalyptus, oak, holm oak, etc.) After being gathered from crops and forests, it is shredded or

chipped. It is collected all year round, produces little ash (less than 2%) and its main disadvantage is that it has a lower calorific value.

**3.** Industrial biomass is used as a supplementary material. It comes from processes like oil extraction (olive pomace,) paper production (bark and sawdust) and from the food industry (dried fruit peels, rice, etc.)

**LOGISTICS.** Compacted feedstock is unloaded from trucks into a storage facility using overhead cranes. The storage facility is designed to prevent potential supply shortages.

**FEEDING.** Conveyor belts from the storage facility to

the boiler. They are equipped with moisture and weight measurement systems that allow constant adjustment of the amount of energy going in. With straw, the bale twine is cut first so that the material enters the boiler loose.

### STEAM GENERATION.

Combustion turns water flowing through the boiler's walls into steam. A system of tubes channels the steam back inside until it reaches the desired temperature and pressure (520° and 90 bar.) Combustion gases heat the air needed to facilitate this process and pre-heat the water headed into the boiler.

### CONVERSION INTO

**ELECTRICITY.** Exiting steam is fed into a turbine; it hits the rotor blades and makes them spin at

5,400 revolutions per minute. The turbine is connected to a generator, to which it transfers its rotary motion (1,500 revolutions per minute.) This is where kinetic energy from motion is transformed into electrical power.

### CYCLICAL PROCESS.

Steam exiting the turbine is cooled in a condenser as it flows countercurrent to cooling water, and it returns to its liquid state. It returns to the boiler to begin the process all over again.

Collection of ash and slag. Gases leaving the boiler contain particles that are captured in a large fabric filter to prevent their emission into the atmosphere, and slag produced during combustion is collected from the bottom of the boiler.



## BIOMASS TIMES THREE

1

### SANGÜESA PLANT

- Located in one of Spain's top grain-producing regions.
- Thermal generation from burning cereal straw.
- 17 years with no biomass shortages.



2

### BRIVIESCA PLANT

- Operational since 2010 and located in one of Spain's main grain-producing regions.
- Pioneering cooling technology that uses wastewater from the WWTP in the area.
- Thermal generation using herbaceous biomass.



3

### MIAJADAS PLANT

- Developed with the support of the EU. Joint R&D project with companies and technology centers in Spain, Finland and Denmark.
- Operational since 2010.
- Thermal generation using mixed herbaceous and woody biomass. This maximizes its flexibility in terms of adapting to yearly supply circumstances.




# SELF PERFORMING OFFICE

## THE SUPER-INFRASTRUCTURE MASTER PLAN


by **Miguel Ángel Bargueño**



IF YOU CAN DO IT WITH YOUR OWN PEOPLE, MORE EFFICIENTLY AND AT A LOWER COST, WHY OUTSOURCE? THE SELF-PERFORMING OFFICE (SPO) MODEL PLANS EVERY LAST DETAIL OF THE HUMAN AND MATERIAL RESOURCES NEEDED FOR MEGAPROJECTS. NO ONE ELSE IN THE SECTOR PUTS IT TO SUCH GOOD USE.



HAT GIGANTIC DAM OR THAT IMMENSE BRIDGE OVER THE SEA AREN'T SUPPORTED SOLELY BY THEIR PHYSICAL FOUNDATIONS. THEY'RE BUILT ON SOMETHING MORE SOLID: A PLAN.



Concrete being poured on one of the support towers of the Cebu–Cordova Bridge, one of the biggest civil engineering works ever undertaken in the Philippines. The SPO advised on the purchase of equipment to make concrete without outsourcing, on the selection of aggregate quarries, on erecting cranes and on doing formwork with the aid of ACCIONA's specialized surveyors.

The main structure of the Cebu–Cordova Bridge is suspended 650 meters above the water and connected to almost nine more kilometers of highway in a road network of strategic importance for the Philippines. The bridge will act as a broadband connection that joins two of the country's main islands: Cebu, which has a dense industrial zone, and Mactan, home to the country's second busiest international airport.

There are already bridges: two, to be precise, but activity and population growth in the area has rendered them obsolete. Massive traffic jams put the brakes on the economy, entailing a tremendous waste of hours and energy that undermines the quality of life of the population and the thousands of commuters who travel to their jobs each day.

New infrastructure that can cope with this volume of traffic, which has been rising for decades, has become a pressing need. When it is delivered in 2021 it will have an immediate stimulatory effect on the local economy. The Spanish Chamber of Commerce in the Philippines chose the bridge for its Project of the Year award.



## OUR OWN BEAM LAUNCHER

### Problem

The channel that separates the island of Cebu from Cordova, in Mactan, is extremely challenging, with slopes of over 6%. It's almost impossible for the cranes needed to erect the bridge to reach the area, and using conventional beam launchers (the specialized machine employed for this key task), with cables and winches, would pose serious risks and jeopardize the operation.

### Solution

The SPO has developed its own innovative beam launcher, unique in the sector, which works with a rack and pinion (a mechanism similar to that used in mountain trains.) It enables total handling control on these slopes and circumvents the risks. In addition to designing and manufacturing the machine, the SPO will provide its own technician to operate it. The launcher will be operational by the fall, and will install 585 beams.

The Support Department and its SPO foster economies of scale and know-how synergies. Each project capitalizes on previous experience with viaducts, tunnels, dykes, road surfaces and materials, among other things.

“We are proud to be contributing to the country’s development,” explains Fernando Fajardo, Head of ACCIONA’s infrastructure business in the Asia-Pacific region, “and we are applying all of our technical expertise and extensive bridge design and construction know-how to make the process as efficient and profitable as possible.”

## COORDINATION

How can it be achieved when the project faces so many logistical, engineering and planning challenges and requires mobilizing thousands of workers and millions of tons of material and machinery? Moreover, it has to be coordinated between ACCIONA’s headquarters, the Specialized Business Unit (SBU) regional construction teams and the project team.

The company manages to do it via the Project Execution and Construction Equipment Management Support Department. This department provides support to every single megaproject, from the time the foundation stone is first laid: scientific planning based on the Self-Performing Office model. “Our aim is to undertake key projects with our own machinery, our own staff and the value of our





own experience,” explains Roberto Carballo, who manages the Support Department, created in 2018 as a continuation of the previous Workshops and Machinery Department. This same philosophy has thus also been applied in earlier projects.

The new department is organized with a view to achieving better planning, minimizing risk and cost, controlling quality and pressure on the market and improving competitiveness. The SPO is thus involved in projects that entail greater risk or cost, or where deadlines are crucial.

It conducts design, definition and cost assessment studies for necessary equipment and facilities, for production, assembly and disassembly options, for transport factors and in relation to construction procedures and strategic personnel assignment. And it does so in a flexible manner, tailored to the characteristics of each project, to the social and business culture of each country and to the partners involved.

## ORGANIZATION

The SPO’s activities are as diverse as the projects themselves. They are divided into specialized areas: earth moving, tunnel structures and auxiliary resources, and maritime works. It has a machinery department that coordinates all of the depots and the use, acquisition, supply and maintenance of equipment. Moreover, the central workshops also contain the bulk of the company’s metal structure and special operations equipment. “We develop and manufacture our own equipment for projects involving bridges and metal structures here, with ACCIONA technology,” says Roberto Carballo.

“The ability to build special parts in our workshops and develop our own machinery means we can overcome the most complex construction challenges safely, efficiently and on time,” adds Julio Ruiz Cabrero, Project Director for Cebu Link Joint Venture and Head of Operations and Bridges for the SBU.

The SPO model isn’t one of our own innovations, but the scope of its application is. According to Roberto Carballo, “other construction companies tend to do the opposite, subcontracting equipment and staff to handle it. That’s where our differential value lies; we use our hundred years of experience to benefit our most demanding customers.” ■



The bridge is just one part of the project. It connects to another 8.5 kilometers of roads and infrastructure.



## OTHER PROJECTS INVOLVING THE SPO

- Site C Hydro Dam (Canada)
- Quito Subway (Ecuador)
- Folle Line Railway Tunnels (Norway)
- Pan-American Highway (Panama)
- Puhoi-Warkworth Motorway (New Zealand)
- E6 Ranheim-Værnes Highway (Norway)

WATER  
THAT  
DOESN'T



SLIP  
THROUGH  
YOUR  
FINGERS

SMART METERS AND CARBON FIBER PIPES. THE LATEST TECHNOLOGY TO PREVENT WATER IN THE NETWORK FROM BEING WASTED AND TO FULFIL AN OBLIGATION: EFFICIENT MANAGEMENT OF (SCARCE) WATER RESOURCES.

by **Javier de la Cruz**

The UN has made integrated and efficient water management a priority on the path to sustainable development of the planet.

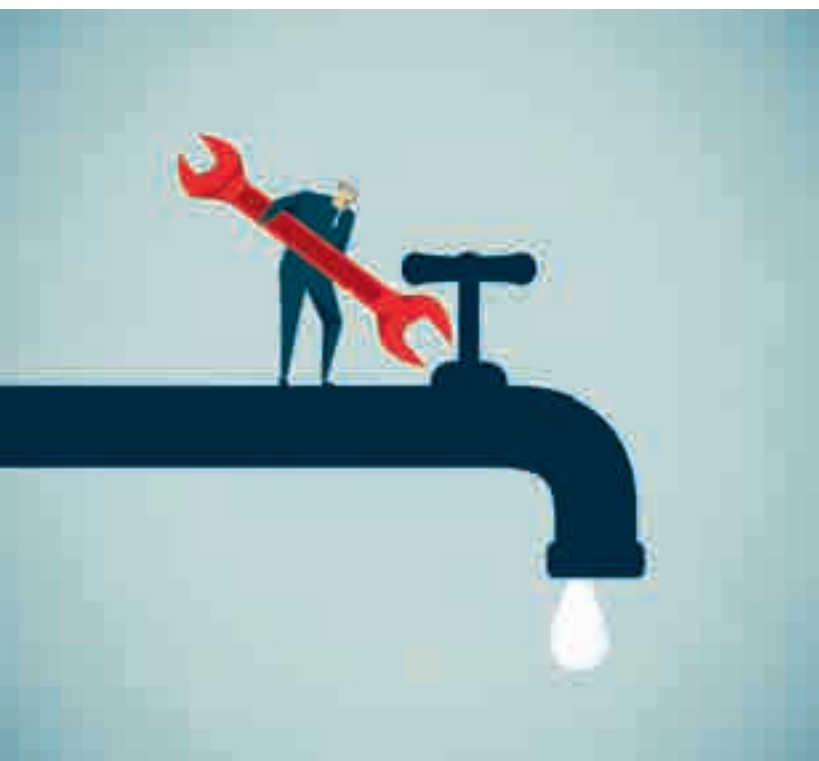
**D**ROP BY DROP, A DAM RESERVOIR CAN DRY UP, CONSUMPTION CAN RISE AND THE PROFITABILITY OF INVESTING IN WATER NETWORKS CAN FALL. AND DROP BY DROP, THE WORLD IS HYDRATED.

Wasted water is measured in cubic hectometers, but also in terms of ethical duty. Every drop represents all water, as the vital resource it is, and caring for it is an imperative set out in the UN's Sustainable Development Goals: universal access to quality water and sanitation, integrated water resource management at all levels and water-use efficiency.

ACCIONA was contributing to achieving these SDGs long before they were set, and has received international recognition on a number of occasions as the company with the best complete water management approach. It works to maintain this status by developing the network, introducing small and continual innovations like the 1,200 state-of-the-art smart meters installed in Zafra, Badajoz, where it manages the water supply.

"They are very important, due to both early detection of a possible fault or consumption anomaly





and for enabling users' bills to be calculated based on the service actually provided. This project will serve as a pilot scheme, so that we can optimize and replicate it in the rest of Zafra and other places," says Miguel Leiva, Head of the city's complete water cycle management service.

## RESOURCES DOWN THE DRAIN

In terms of loss, all of these drops add up to some shocking numbers. According to the National Statistics Institute (INE), 4,290 cubic hectometers of water was supplied to Spain's urban public networks in 2016; over 700 hm<sup>3</sup> was lost due to bursts, leaks and faults, in addition to almost 390 hm<sup>3</sup> lost due to inaccurate measurements, fraud and unauthorized and unmeasured consumption. Not only does leakage drain resources and money, it also results in inaccurate infrastructure sizing.

We turn on a tap at home. We turn on a sprinkler or open a valve on industrial premises. The flow always seems constant; faults often remain undetectable or are inaccessible in that maze of hidden

# NOT ONLY DOES LEAKAGE WASTE WATER AND MONEY, IT ALSO PLAYS HAVOC WITH MANAGEMENT OF THE NETWORK

pipes. Zafra's smart meters are helping to change this paradigm: "They take and record readings every hour: 24 readings a day," explains Miguel Leiva. "With this data we can calculate the volume consumed every hour and chart the consumption distribution for each user."

The meters use a remote reading system, sending information by radio to data hubs, which in turn send it to the central software for analysis. This measurement and detailed breakdown of the data enables almost minute-by-minute detection of leaks or undesired consumption, so that the problem can be addressed. In-depth analysis revealing atypical usage or billing for a household rings

## PLANET WATER

The scarcity of this resource affects over  
**40%**  
 OF THE WORLD'S POPULATION.  
 This percentage is set to rise.

More than  
**1.7**  
 BILLION PEOPLE  
 live in river basins where  
 water consumption exceeds  
 water recharge

**70%**  
 OF WATER  
 extracted from rivers, lakes and  
 aquifers  
 is used for watering

Floods and other  
 water-related phenomena  
 are responsible for  
**70%**  
 OF ALL DEATHS CAUSED BY  
 NATURAL DISASTERS

Source: UN, Sustainable Development Goal 6.

alarm bells. The supply manager and, ultimately, the government, will have optimal control of the network and greater predictive maintenance capabilities. “Network knowledge is the key, and it’s directly linked to efficient management of that network,” concludes Leiva.

## PREVENTIVE HEALTHCARE

The second breakthrough in efficient technology. Canal de Isabel II is the main water supply and sewerage network in the eastern part of the city of Madrid, and one of the capital’s largest distribution pipelines. The company has launched a new repair system for this network that consists of stuffing new carbon fiber pipes into old, deteriorated pipelines.

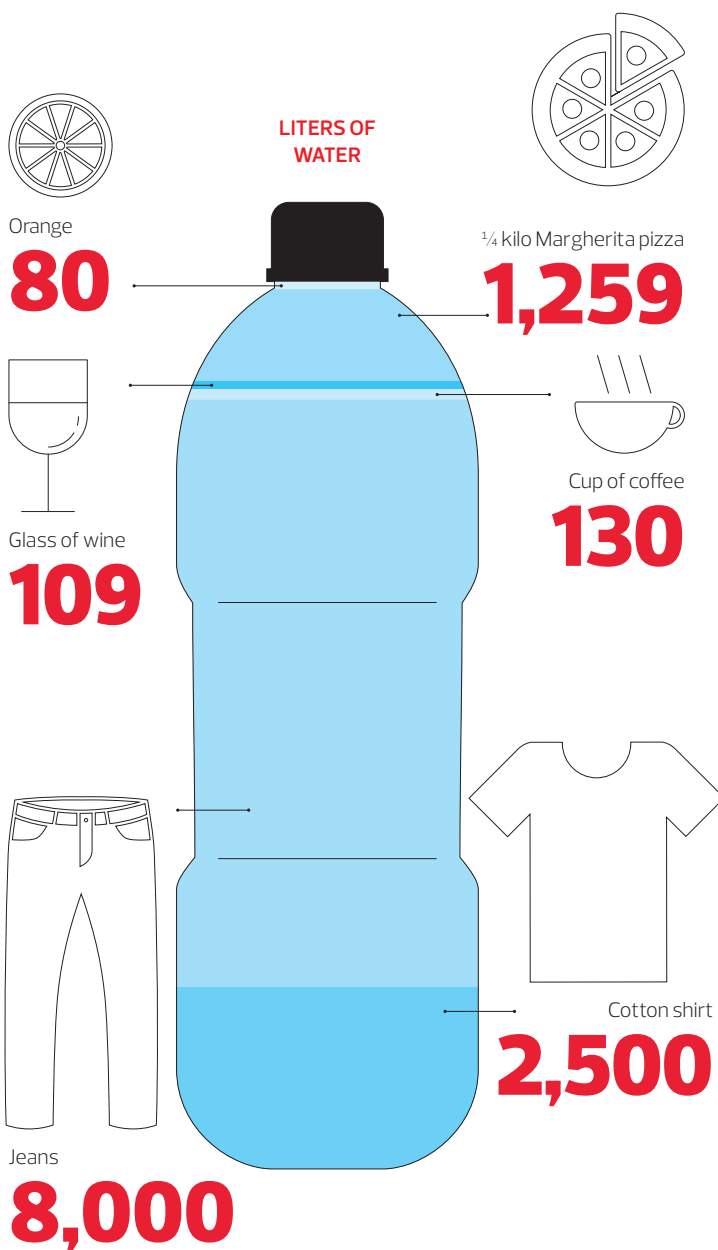
The technique is applied directly (like surgery through a catheter) and eliminates the need to remove the old metal pipe, which serves as an outer casing that reinforces the new one, although the latter is able to function on its own. The rationale behind this method is in line with one of ACCIONA’s water management priorities: preventive maintenance (not only in its water business, but in all of its pursuits) via continual review to locate points indicative of faults and to perform repairs before they require intervention that’s much more complex. And more expensive.

With carbon fiber pipes, the supply system can be renovated without having to dig trenches or remove debris. There’s no need to stop traffic, put up barriers or use heavy machinery such as pneumatic drills, and it saves residents from noise, dust and welding gases. It also avoids having to cut off water, as repair times are halved.

The carbon structure of the new pipes is specifically designed to carry water, and they are an improvement over the old materials in terms of resistance to pressure and loads, deterioration and durability, with an estimated useful life of 40 years. So far, the company has used the technique in nine sections, and it may also do so in other parts of the Canal network where it is renovating and repairing the water supply and reclaimed water system: part of the city of Madrid and four large municipalities: Alcobendas, San Sebastián de los Reyes, Tres Cantos and San Agustín de Guadalix. ■

## THE WATER FOOTPRINT OF THE THINGS YOU DRINK, EAT AND WEAR

Volume of water consumed, evaporated or polluted to produce everyday things like:



Source: Water Footprint Network



# THIS BUILDING HELPS YOU GET THE FULL (UNIVERSITY) EXPERIENCE

RESIDENCES, FACULTIES AND ENTIRE CAMPUSES. THE MANAGEMENT OF UNIVERSITY SERVICES IS A GREAT STUDY COMPANION; IT BROADENS THE EDUCATIONAL EXPERIENCE, MAKING IT A FULL LIFE EXPERIENCE RATHER THAN JUST AN ACADEMIC ONE.

by  
**Javier de la Cruz**

“I just don’t have a good place to study.” It’s a sentence that’s been uttered countless times. Sometimes as a true justification, sometimes as an excuse for poor grades. But there’s a reason people say it: good performance requires a conducive environment. Anyone who’s been a university student knows that the campus offers a full life experience that goes beyond the curriculum: the cultural setting, sports that energize our ideas, social relationships, contact with other cultures, getting enough rest to keep the pressure from getting to you...

ACCIONA bases its comprehensive university infrastructure management on this premise. Education is a humanist activity that draws on specialized resources, which means the personal relationship factor is as important as academic performance. “We were granted the first con-



cession for a university residence in Spain in 1996, and since then that trust has been based on a solid relationship with the educational community and students; we have a clear picture of their everyday needs,” explains Antonio Pérez de Arenaza, Director of the University Residences unit in ACCIONA’s Concessions division.

In addition to this relationship, there’s the benefit of continuity over time. The contract to run the residences is for half a century, and long-term planning allows adjustments to be made as educational needs and social values evolve. For example, technology resources (IT rooms and quality, full-access Wi-Fi,) healthy habits (sports facilities and balanced cafeteria meals,) comfort (green areas, services, furniture, bedrooms, study rooms and common areas designed for both relaxation and concentration,) security (balance between free movement for students, surveillance by security staff and caretakers and open communication with parents) and sustainable management of the entire complex.

### SUPPORT FROM THE GROUP

The goal of contributing to decarbonization is a priority across the board, from building construction and renovation projects to energy and natural resource efficiency. It draws on the synergies provided by the group, not only with respect to energy, services and infrastructure but also financing capacity, major contract management and corporate responsibility.

This support is also evident in large-scale projects like that of the University of San Luis Potosí in Mexico, whose campus ACCIONA designed, built, provided the principal and the equipment for and managed. It still runs and maintains multiple services, including cleaning, gardening, catering, security, auxiliary services and administrative management.

The most recent large-scale contract was for the expansion of the University of Barcelona’s Faculty of Law. It opened in February 2018 after extensive remodeling that distributed the administrative offices, departments, classrooms and parking lot extension across five



### NOTES ON COMPREHENSIVE MANAGEMENT

ACCIONA’s Campus brand manages five residences in Spain: Albacete, Cádiz, Castellón, Lleida and Murcia, located very close to the relevant faculties. They offer 1,200 spots in total and have hosted over 80,000 students from more than 35 countries. Their motto: “University life starts here.”

In the University of San Luis del Potosí in Mexico (pictured), it constructed four academic buildings that can hold over 5,000 students.

The expansion of the University of Barcelona’s Faculty of Law, undertaken in partnership with Sorigué, is one of the company’s biggest contracts. It had a budget of 44 million euros and includes 35 classrooms and 160 offices, among other facilities.

floors, laid out around central courtyards. The contract for management of the building is also for 50 years.

According to Pérez de Arenaza, projects of this significance free universities from the complex task of managing their services, enabling them to focus exclusively on academic excellence. “They also enable us to apply all of our knowledge. They are about buildings, of course, but first and foremost they are about the community of people who need them and give them meaning.” ■

# # INVEST IN

A JOINT APPEAL FROM FOUR FILM, SPORTS AND JOURNALISM SUPERSTARS WORRIED ABOUT CLIMATE CHANGE: "JOIN US, AND INVEST IN THE PLANET."



## MARC GASOL

Barcelona, 1985. The press sang his praises when he won the 2019 NBA Finals with the Toronto Raptors. With Spain's national team, Marc has also been a world champion, a two-time European champion and a two-time Olympic silver medalist. His current coach, Nick Nurse, says he loves discussing any topic with him and admires his concern and the empathy he shows through his support for the NGO Proactiva Open Arms and for the environment. His children, Julia (2014) and Luca (2017), have further cemented this commitment.

**"WHEN YOU HAVE CHILDREN, YOU START TO THINK ABOUT THEIR FUTURE AND YOU REFLECT ON WHAT WE'RE DOING TO LEAVE BEHIND A PLANET FOR THEM THAT'S THE SAME, IF NOT BETTER, THAN THE ONE WE FOUND."**



## KARLA SOUZA

Mexico City, 1985. She studied theater in Paris, Moscow and London while handing out advertising material in the street, working as a waitress and overcoming crises, like when she lost her voice for months. She began on the telenovela circuit, but it was in the movie industry that her sense of comedy and romance truly shone. Not only has she starred in three of her country's biggest blockbusters, she has also found success in the USA. It's always been clear to her that helping others and personal growth come first. That explains her activism, whether for causes like the Time's Up movement against sexual harassment or offering aid to victims of natural disasters.

**"WATER IS LIFE, WHICH IS WHY FOR YEARS I'VE BEEN COMMITTED TO CARING FOR AND PROTECTING OUR OCEANS. I ALSO HELP INSTALL SOLAR PANELS TO PROVIDE CLEAN AND SUSTAINABLE ENERGY."**

# THE PLANET

THEY ARE AMBASSADORS FOR ACCIONA'S MESSAGE OF SUSTAINABILITY IN COUNTRIES OF STRATEGIC IMPORTANCE: AUSTRALIA, CHILE, MEXICO, THE UNITED STATES AND SPAIN.



## AMARO GÓMEZ-PABLOS

He was born in Madrid in 1967, but has lived in Chile for the past three decades and is one of the country's most popular TV presenters. He won the King of Spain International Journalism Award for his report on Guantánamo and the CIA's secret prisons, and Chilean audiences chose his coverage of the 2010 earthquake the best in the country. He has also covered wars in the Balkans, Afghanistan and Iraq and traveled around the world as a reporter for CNN. All of this experience has led to a firm conviction: the environment and the planet's health are the most important headlines in his life.

**"I AM ACTIVELY COMMITTED TO THE ENVIRONMENT. MASS PRODUCTION OF PLASTIC AND CO<sub>2</sub> EMISSIONS WORRY ME. THAT'S WHY I HELP RAISE AWARENESS OF CLIMATE CHANGE AND I SUPPORT RENEWABLE ENERGY."**



## DAVID POCOCK

He's a fighter, and not just as a member of Australia's national rugby team. Born in Zimbabwe in 1988, he arrived in Australia after his family was forced to leave the farm where they worked. Even more of an activist than he is an athlete ("There are things in life more important than chasing a ball"), he married his best friend but they decided not to register the union until gay marriage had been legalized in the country. He chained himself up for 10 hours in front of a coal mine, and his support for clean and sustainable energy has remained constant.

**"I'M WORRIED ABOUT THE PLANET, DEFORESTATION OF HABITATS, THE FUTURE. FOR YEARS I'VE SUPPORTED INITIATIVES TO CONSERVE AND PROTECT THE ENVIRONMENT AND DEVELOP LOCAL COMMUNITIES."**





# CREDITWORTHY SUSTAINABILITY

THE BEST RECOGNITION FOR A PROJECT IS THE LOAN THAT MAKES IT A REALITY.  
THE CHALLENGES OF A FINANCIAL TREND LINKED TO THE ENERGY TRANSITION.

by  
**Denisse Cepeda**

Green funding is here to stay and is set for growth, as it combines two necessities: economic development and compliance with international agreements aimed at combating climate change. It is driving the transition to a sustainable economy, inasmuch as sustainability is becoming better and better business.

The funding is delivered through loans offered to companies by financial institutions to facilitate their path toward less polluting activities and to incentivize decarbonization. “There is a

Experts believe that special lines of credit for sustainable projects are a basic tool in the energy transition.

growing demand for green assets among investors and companies with a clear sustainability strategy, and the market is already proving that it can meet this demand. We believe that sustainability is a key credit factor for a company,” says Roberto Cabrera, ACCIONA’s Finance Director. This opportunity for internal transformation is mutual, open to companies but also to banks, as they are developing a new business line right when their sector is restructuring and becoming increasingly open to competition.

Some experts are demanding that green loans not only reward clean initiatives but also dissuade and penalize dirty investment, especially that associated with fossil fuels. According to Joaquín Mollinedo, General Director of Institutional Relations at ACCIONA, the growth of this financial trend is a response to expectations associated with new social values that go beyond economic interests: “Society is fully aware of the harmful effects of global warming, and governments already have tools with which to act.”

After the bond boom, green loans began to gain ground in 2017 for renewable energy and Corporate Social Responsibility projects as well as businesses with environmental benefits. They have stringent criteria, including certification by independent external auditors who evaluate companies’ environmental, social and corporate governance performance.

### A COMMON LANGUAGE

Where, though, should we set the bar for whether or not a project is classed as sustainable? It’s an endless debate, because we still lack common standards. Each auditor sets their own. In view of this, the European Commission has called for —in as many as three proposed regulations— greater transparency and uniformity of assessment criteria, to prevent projects fraudulently disguised as green from slipping through the cracks.

Governments and the market must agree on a common language for debt issuances and potential investors, with the aim of cataloging risk and implementing a solid classification system. According to the Bank of Spain, that single language, even if limited and imperfect, may be necessary for markets to reach critical mass. The European Securities and Markets Authority (ESMA) has already launched an initiative to encourage credit rating agencies to disclose their sustainability assessment criteria. But regulatory efforts must go further and move

## TRUST IN (AND FROM) GREEN FUNDING

Backed by the assurance of its 2018 results, with 70% of its EBITDA coming from sustainable activities, ACCIONA recently signed three green loans.

1. A 5-year syndicated loan (various banks) for

**675**

**million euros**

that can be extended for two one-year periods, to cover debt maturing in 2019 and 2020. If ACCIONA improves its ESG rating, the interest rate can be lowered.

2. A loan in Chile that’s groundbreaking in Latin America:

**30**

**million dollars**

granted by Santander Bank and subject to the same sustainability terms as the above loan.

3. The first Green Letter of Credit in the European market:

**129**

**million dollars**

signed with Caixabank, to be used to supply photovoltaic panels to the Puerto Libertad plant in Mexico, one of the largest solar plants on the planet.

faster. According to Ricardo Pedraz, a sustainable finance expert from AFI (Analistas Financieros Internacionales,) most countries still lack “specific legislation that directly links financing to energy transition.” The absence of such legislation can become a stumbling block when swift energy transition is vital.

In places where specific laws have been passed, for instance France, “they have been a tremendous driving force,” says Pedraz. ■



# THE SUN SHINES AT NIGHT IN NGÄBE-BUGLÉ

THE LIGHT AT HOME PROJECT ENABLES TWO OF PANAMA'S INDIGENOUS PEOPLES TO GENERATE THEIR OWN SOLAR POWER.

by **Patricia Alcorta**

The two peoples are the Ngäbe and the Buglé, who give the comarca indígena, or indigenous territory, in western Panama its name. They share these lands in the foothills of the central cordillera as well as numerous traditions and a lack of material resources. They also share the Light at Home project, run by [acciona.org](http://acciona.org), The Energy & Water Foundation, which was launched in the Isthmus of Panama in 2018 after it got off the ground in Cajamarca and the Amazon (Peru) and the state of Oaxaca (Mexico). Before

this, it had to receive the green light from the indigenous council.

More than 400 traditional homes made of wood, adobe and zinc sheets now feature a technological counterpart: a modern solar panel (the most visible part of the "third-generation solar home system," its official name) which gives them access to basic electricity services for the first time. This means quality light that improves children's studies and enables women to make their plant-fiber

bags at night, in addition to reducing the amount of oil-lamp smoke that families are breathing in. Now they can use and recharge small appliances and electronic devices such as cell phones and tablets.

It isn't charity. The families pay an affordable fee for the service, which improves their quality of life and the local economy, made up of small businesses. This year the project has set its sights twice as high: it aims to reach another 850 Ngäbe and Buglé homes.





We know how the story begins,  
but the ending has yet to be written



To find out more, visit  
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