

HOW IT WORKS

The circular economy, a sustainable business

CLEAN ENERGY

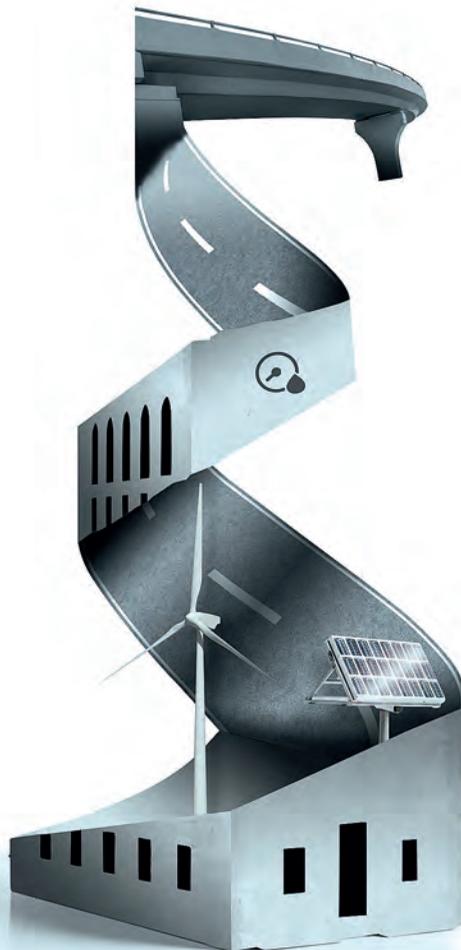
A solar megaproject for renewable Egypt



acciona

N.67 NOVEMBER 2017

INNOVATION CREATIVE POWER



ART and SUSTAINABILITY

ACCIONA and the Thyssen-Bornemisza National Museum are joining efforts to present **Art and Sustainability**. A journey through the museum's permanent collection to explore the historical relationship between man and sustainability through its masterpieces of painting.

Discover more at:
www.sustainabilityandart.com



INNOVATING INNOVATION

The time comes when a disruptive solution is simply not enough; nor is inventing a revolutionary material, or developing a laboratory specifically for creative ideas. The actual concept of innovation, as it is applied by and for the company, also needs to be innovated. A framework, a model, a vision that focuses each and every move.

This is what we are busy with now. Our General Director of Technology and Innovation, Arantza Ezpeleta, explains it. Her definition of innovation includes qualities which, by no coincidence, are more human than technological: humility, self-criticism, non-conformism, resilience, flexibility, adaptability, lateral thinking, and open-mindedness. A multinational business will naturally face challenges as diverse as the complexity of markets and global clients. It cannot permit itself to become inward-looking.

This is the way in which we innovate innovation: stimulating in-house talent through talent from outside, and vice-versa. And this is the model of open innovation (and collective intelligence) we use in our project Innovation #Startups, linked to the best startups possible in terms of concrete challenges in any aspect of the business. We are pioneers in Europe because we work shoulder-to-shoulder with them - on an informal level, with no hierarchical difference between the multinational and the technological SME.

The Internet of Things, artificial intelligence, machine learning and big data are being used to develop concrete that can resist corrosion, drones for analyzing tunnels and predictive software for desalination plants and wind turbines. It is possible that solutions such as these will also soon be applied to photovoltaic plants, like the three being constructed by ACCIONA in Egypt, a reference for sustainable economy in the MENA region. Or, one could point to the hopeful model of a circular economy as described in the section, How It Works.

Take our subway projects, where we also have a century of innovation experience. Then look at how we promote equality so that today's girls can become the STEM professionals of tomorrow. And there's the human adventure of taking microenergy projects to the Amazon. Innovation is everywhere, even in one-off, more modest services, which nevertheless use innovative processes, such as keeping the streets clean over Christmas. ■

“Stimulating home talent with talent from outside, and vice versa”



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Innovation,
an open and
transversal vision.

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MEXICO**

ACCIONA is building a wind farm and photovoltaic complex that will make Mexico home to the company's second biggest renewable energy park in ownership.

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FOR THE
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The year is 1959. Madrid residents look on curiously as dump trucks and road rollers carpet the Gran Vía with tarmac.

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**"WE WANT AN ACTIVE
ROLE IN CHANGING
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Non-conformism, lateral thinking, flexibility, an open outlook... The innovation model, digital transformation and its future in the words of Arantza Ezpeleta, ACCIONA's Director General of Technology and Innovation.



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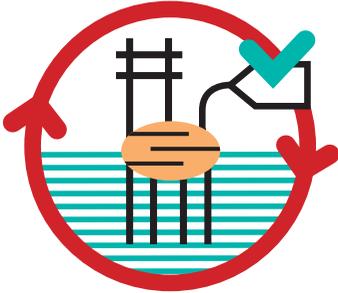
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HOW IT WORKS THE CIRCULAR ECONOMY

From the irresponsible squandering of resources and energy to smart reuse. The circular economy, a perfectly rounded business.

TECHNOLOGICAL INNOVATION I'MNOVATION # STARTUPS

One great multinational. Eight small startups. Nine projects developing specific solutions for challenges in each line of business. A pioneering innovation model for Spain and Europe.

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CLEAN ENERGY SOLAR COMPLEX IN EGYPT

Three major photovoltaic complexes, promoted by ACCIONA, are driving a strategic goal in Egypt and the MENA region: to replace oil and gas with renewable energy.



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METROS FROM THE MADRID METRO TO SUBWAYS ACROSS THE WORLD

The Madrid Metro is a pioneering centenarian, an example of innovation for many others, from Quito to Dubai and Hong Kong to Warsaw, thanks to ACCIONA's global reach and specialization.

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Special cleaning services prevent Xmas from drowning in trash.

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ANNIVERSARY

Bodegas Palacio celebrates a century-old wine on which it has built its reputation for excellence: Glorioso.

GLORIOSO

— BODEGAS PALACIO —

RIOJA

SELECCIÓN ESPECIAL

Our homage to a century producing fine wines
in the Rioja Alavesa

100 YEARS...

In the spring of 1917, a great story started to be written
in Bodegas Palacio. A story of the faithful expression of the essence
of the Rioja Alavesa, undertaken with transformational vision,
yet without abandoning our own identity.

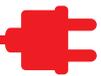




RENEWABLE DEPLOYMENT IN MEXICO



ACCIONA ENERGY



FROM TAMAUlipAS TO SONORA



Work is progressing on El Cortijo wind farm (Tamaulipas), one of five owned by ACCIONA Energy in Mexico.

THE FACILITY IS THE RESULT OF THE FIRST AUCTION OF LONG-TERM ELECTRICAL ENERGY DUE TO THE COUNTRY'S ENERGY REFORM.

ACCIONA

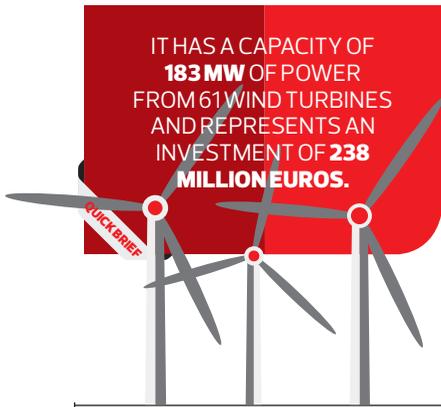
obtained

585.5 GWh

in the auction, to be covered by production at

EL CORTIJO

IT HAS A CAPACITY OF **183 MW** OF POWER FROM 61 WIND TURBINES AND REPRESENTS AN INVESTMENT OF **238 MILLION EUROS.**



The electricity distributed will be equivalent to consumption by

381,000 HOMES

and avoid the atmospheric emission of

400,000

TONNES

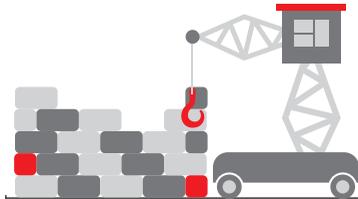
of CO₂ annually

CONSTRUCTION, OPERATION AND OTHER ACTIVITIES ASSOCIATED WITH THE WIND FARM WILL CONTRIBUTE close to

253

MILLION DOLLARS

to Mexico's GDP during its working life



Work will begin on building the photovoltaic complex, **Puerto Libertad (Sonora)**, in November of 2017. This facility will have a nominal capacity of

404 MWp

(317.5 nominal) and be 50%-owned by ACCIONA along with Mexican company **Tuto Energy.**



The project arose partly from the second, long-term electricity auction, at which

ACCIONA
OBTAINED

578.3 GWh

The plant, despite its size, is to be built in just

14 MONTHS

When both facilities are up and running at the end of 2018, ACCIONA Energy will have 1,144 MW of renewable energy in ownership in Mexico, comprising

65% WIND

and

35% SOLAR

AS A RESULT, **MEXICO** WILL HOST THE **SECOND MOST RENEWABLE ENERGY CAPACITY OWNED BY ACCIONA, AFTER SPAIN.**



 **acciona**

HISTORY

A CARPET MADE OF TAR

1959 AND MADRID'S GRAN VÍA IS COVERED WITH TAR, GIVING IT A FASHIONABLE LOOK

by Patricia Alcorta

Back then it was known as José Antonio Avenue. Even further back, it was named after the Soviet Union! Between political extremes, however, it continued to be known by many as Gran Vía. The city's main artery reflected Madrid's cannibalistic nature, as 17 streets and several squares were demolished to build this finest of thoroughfares. Cubiertas y Tejados paved it in 1959. It was a time when the old guard was about to retire and some workers still wore berets. Tar was then a primitive material compared to today's surfaces - able to repair themselves and generate energy. To the erstwhile residents of Madrid, though, the new road seemed like a carpet upon which wheels rolled as freely as balls, minus the rattling of the flagstones. ■



ORDINARY NET PROFIT GROWS 35.2%

RESULTS FOR THE FIRST THREE QUARTERS OF 2017

157 MILLION
EUROS
ORDINARY
NET
PROFIT

BILLING
5,333
million euros

+23.3%
compared with the
previous year

EBITDA
907
million euros

+7.9%

Main reasons for the good results are an increase in Infrastructure income, the positive evolution of business generation and an important reduction in financing costs due to the change in the company's finance structuring.

The headline figures in the income statement have risen: revenues up 23.3% (5,333 million euros) and EBITDA 7.9%

(907 million). Net profit fell year-on-year by 33.3%, however, due to the impact of extraordinary costs on the 2016 results. As of 30 September, net financial debt sat at 5,695 billion (+11%), due to the effect of negative circulating capital and maintenance of a high investment rhythm. Net investment rose to 656 million euros.

'THE SPIRIT OF PAINTING' AT THE PRADO MUSEUM

ACCIONA is sponsoring the exhibition, 'The Spirit of Painting', by Chinese artist Cai Guo-Qiang, including a number of works created in situ, in which he uses his renowned gunpowder technique and which is also inspired by El Greco and other masters in the Madrid picture gallery. The exhibition will remain open until 4 March and includes the screening of a documentary by Isabel Coixet.



ACQUISITION OF THE BIGGEST HANDLING COMPANY AT SANTIAGO DE CHILE AIRPORT

ACCIONA recently acquired 100% of Andes Airport Services, the principal company providing support services at the Chilean capital's international airport. The agreement guarantees personnel will be kept on and long-term service contracts honored. ACCIONA is thus reinforcing its position in the South American handling sector, with Chile as a growth platform. ACCIONA already provides services in six of the country's airports.

IN THE TOP 30 MOST SUSTAINABLE COMPANIES IN THE WORLD

We've done it again! ACCIONA scored maximums in the annual ranking by international organization CPD (827 institutional investors with 100 billion dollars in holdings) in management related to climate change and management of water resources. Only 27 companies out of the 3,000 analyzed by CPD worldwide obtained these double maximums, and ACCIONA is the only utility included in this small group. The company has become a regular in the CPD ranking, this being the seventh consecutive year it has scored maximum

points for climate (along with another 111 companies), and the second for water (along with 72 others). The two lists form an exclusive club. The ranking recognizes ACCIONA in part due to the fact that 72% of Ebitda and 42% of global sales in 2016 came from green economy activities as set out by the United Nations Environment Programme (UNEP); also for being the first carbon-neutral utility company, according to the Dow Jones Sustainability Index, and for having reduced its water consumption in operations by 7% last year.



SALE OF TRASMEDITERRANEA TO THE NAVIERA ARMAS GROUP

The operation will be completed in 2018, prior to approval by the Spanish authorities, in response to ACCIONA's strategy of adjusting and reinforcing its business model, which focuses on sustainable infrastructure and renewable energies. The sale implies a total value for the company of 419 million euros, although it may, in the end, reach 435 million based on the Ebitda results of the combined Group. For ACCIONA Chairman José Manuel Entrecanales, the operation occurred "at the best possible moment for the recuperation of the maritime transport sector, following a process improving the company's operational efficiency, and with a Spanish buyer from the sector who knows the market well - which will undoubtedly contribute to reinforcing Trasmediterranea's competitive position."



CONSTRUCTION OF ONE OF THE LARGEST PHOTOVOLTAIC PLANTS IN AUSTRALIA

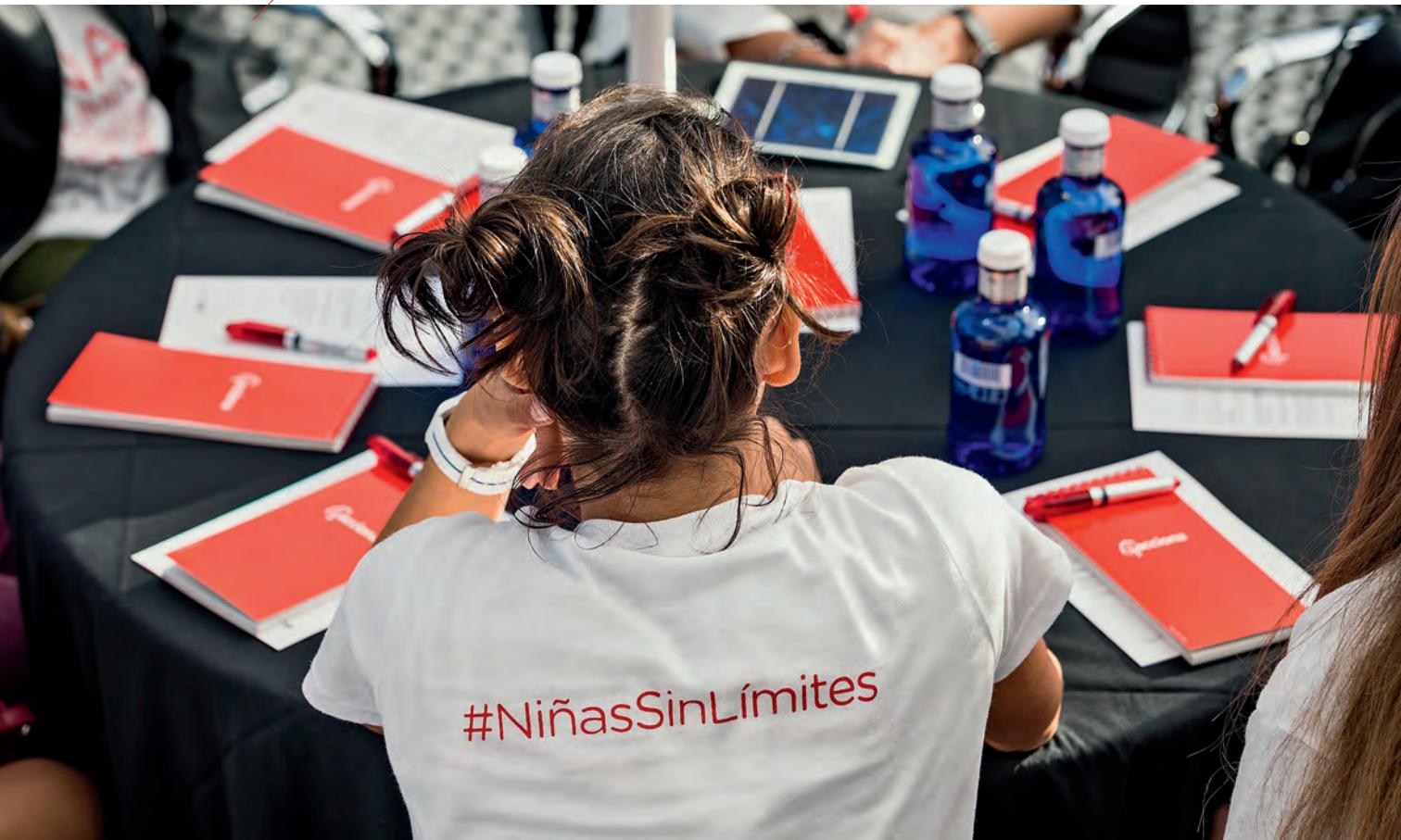
The consortium formed by ACCIONA Industrial and Gransolar (which is leading) is constructing the Lilyvale Solar Farm photovoltaic plant, close to Lilyvale, 50 kilometers northeast of Emerald, in the state of Queensland. With 100 Mwac of power, it will be one of the largest in Australia and a turnkey project for the client (Fotowatio Renewable Ventures, FRV), expected for the end of 2018. The installation will administer clean energy to some 45,000 homes and each year will prevent of 175,000 tons of atmospheric CO₂ emissions.



...AND THE GREENEST ELECTRICITY



For the third consecutive year, ACCIONA has once again taken the top spot as the company with the greenest electricity generation in the world, according to the New Energy Top 100 Green Utilities ranking, published annually in Energy Intelligence, an independent consultant specializing in the energy markets. The ranking (now in its sixth year) combines the valuation of the companies' CO₂ emission indexes along with their renewable capacity. ACCIONA remains the first operator to work exclusively with renewable technology (pure player) and to hold the world leadership in the classification developed by the consulting firm. The 100 companies which make up the list represent close to 55% of the electricity generation capacity for the planet.



INSPIRING GIRLS: GIRLS WITHOUT LIMITS

THE MINISTER WHO WANTED TO PLAY RUGBY, A MEMBER OF THE ELITE GROUP 47 AIR SQUADRON, THE BEST SPANISH HIGH JUMPER OF ALL TIME... WOMEN WHO INSPIRE GIRLS TO EXCEED GENDER STEREOTYPES.

by
Beatriz Portinari

“Do you want to know the secret of a successful military mission? Mutual confidence in the team and never letting fear paralyze you. This applies to any job or situation. If my companions sense my fear, the mission won’t go well. For this reason you always need to trust others, not let the fear of failing slow you down. You always need to give it your best shot.” María del Pilar Mañas commands the Madrid Operative Air Circulation Squadron, the first woman to hold this post in the history of the Spanish Air Force addresses a special audience. Not military people, not even adults, but a group of girls aged 12–13 sit around her, eyes as big as saucers.

“As a woman, was it not harder to get promoted? Is it difficult to command men?” asks one of them. “Not at all; they never treated me differently. In the forces, if you make the effort you can achieve the same. You may take more or less time to do so, but, as difficult a challenge as it may be, it’s only a matter of time before you accomplish it,” replies



Commander Mañas. What the girls don't realize is that they're listening to a former member of the elite Mix Group 47, which participates in missions involving intelligence, aerial vigilance, electronic warfare and tele-detection.

At another table, Olympic athlete Carlota Castrejana is talking about the dedication required to be a professional athlete, how it feels to win medals, and the merits of high-level competition. She is the greatest Spanish high-jumper of all time, as well as a professional basketball player. She currently serves as General Director for Sports for the Community of Madrid.

STEM CAREERS

This gathering was made possible through the Inspiring Girls project, funded and set up by attorney Miriam González Durántez in the UK four years ago. It consists of connecting successful women from diverse specializations with young girls in order to help them overcome the insecurity associated with age, or with stereotypes in general. The message is that they should not avoid studying a particular field just because it seems too masculine, nor should they be held up from rising to the top at work. Inspiring Girls employs the speed networking model; roundtables with direct, personal testimonies such as those given by the seven inspiring speakers gathered in Madrid at the beginning of October. The project, promoted in Spain by ACCIONA, has been extended to Italy, Serbia and Zambia.

According to a recent study at John Hopkins University in Baltimore, US, gender expectations are established between 10 and 14 years of age, although correction of these roles ought to begin long before that. An analysis recently published by the OECD, *The Search for Gender Equality: An Uphill Battle* points out that young girls continue to reject STEM (Science, Technology, Engineering and Math) disciplines, and that only five out of every 100 girls aspire to work in engineering or information technology. In pre-schools, boys draw themselves as surgeons, bombers or fighter pilots. Inspiring Girls seeks to effect a change in that mentality by putting forward positive examples - military women, bombers and sur-



WE ONLY ASK THAT YOU GO BACK TO SCHOOL

This is the slogan for the campaign ACCIONA is participating in, calling on its employees to act as mentors in educational centers for one hour a year. Here they will explain their professional work to 12-14-year-old girls, what challenges they've overcome and how they developed their careers.

IN NUMBERS

Just **5** out of every **100** girls in OECD countries aspire to work in **engineering** or **information technology**.

Over **25,000** volunteers in the UK have motivated nearly **500,000** girls in **three** years.

geons - personifying the message. "Only recently, the female president of a pharmaceutical firm gave me an example from within her own home. Her adolescent daughter had told her she wanted to try rugby, and Mom's first reaction was to remark: 'But that's a boys' sport!'", recounted Marta Pérez Dorao, president of Inspiring Girls Spain. "And this, a woman presiding over a multinational company!"

Interestingly, another of the meeting's participants, Isabel García Tejerina, said she too wanted to try out for rugby as a student. Now she is Spain's Agriculture and Environment Minister. "I invite you to come and see my Ministry, so you can have a look at the hallways on the first floor. There, we have portraits of all the previous ministers since the 19th century. Lots of moustaches, lots of uniforms, only men... until Loyola de Palacio was appointed in 1996. She said something that has inspired me ever since: 'The only battle you will ever lose for sure, is the one you never fight.'" ■



VIDEO
<http://acciona.sa/Me1r30gub7V>

Arantza Ezpeleta joined ACCIONA in 1998, and, among other positions, has served as Director General of the International Area.



We want

an active part

ARANTZA EZPELETA PURAS

DIRECTOR GENERAL FOR TECHNOLOGY AND INNOVATION, ACCIONA

in changing

by **Juan Pablo Zurdo** photos **Jacobo Medrano**

the

world”

SELF-CRITICISM, NON-CONFORMITY, RESILIENCE, FLEXIBILITY, FAMILIARITY WITH SURROUNDINGS. LATERAL THINKING ...

Are these qualities which define people or technologies? Both, in fact. The concept of innovation described by Arantza Ezpeleta bases technological intelligence on human intelligence, including emotional intelligence. People's attitudes determine the aptitude of machines. Telecommunications engineering has directed the development of international business. Since 2016, so has a key department in the Group's transversal, sustainable and competitive strategy: technology and Innovation. Humility is yet another of the virtues found in this model of open innovation; no matter how much talent may have accumulated within the Group, looking outwards supplements its own vision with that of others, in order to comprehend the truth of global challenges. "We live in a unique time. Many traditional businesses are forced to reinvent themselves through technology and digital innovation in order to keep up with the market. At ACCIONA we want an active role in changing the world."

Innovation, a word so overused that it runs the risk of losing any significance. How do you define it?

Innovating means opening new roads, breaking down barriers, imagining and implementing new ways of being and creating. Innovate in order to obtain the best results and be the most competitive. It's a no-brainer that, in order to be different, you have to do things differently.

What does an innovative mind (or business) have that others do not?

Self-criticism: the ability to recognize one's own mistakes in order to face up to them and improve. The capacity to ask oneself questions, and actually, to question everything one does. Agility in applying solutions to the challenges one faces. Resilience, flexibility, adapting to an environment which is constantly changing. Lateral thinking in order to transfer results which appear to be completely unrelated to one's activities. The ability to look beyond, openness, an awareness of one's surroundings. This means experimenting, trying out, and fully internalizing a solid culture of innovation constructed by all employees, in order to share knowledge, practices and lessons learned. An environment of constant critical analysis of current abilities, and spaces and time which spark creativity.

Name an historic solution of which you would say, "that is pure innovation"...

Only one? You're really making it difficult for me. There are so many that I admire, but I'll limit myself to the field of information technologies: the first algorithm designed specifically for a computer. Ada Lovelace, a brilliant mathematician in the 19th century and the daughter of the poet Lord Byron, managed to do it. She's considered a programming pioneer because of her algorithm for calculating Bernouille numbers in an analytic machine.

Emotional intelligence: how does one maintain creative freshness when the innovation obsession sometimes prevents us from viewing challenges with proper perspective?

Innovative people are sensitive to their surroundings and to others. They are empathetic, expressive, have a great capacity for imagining scenarios and possibilities. Emotions affect the creative process and teamwork. Acknowledging and knowing how to take advantage of them encourages collaboration and interrelations. In this company, innovation is an ongoing process, with people as its principal motor. This is why we promote an environment which boosts ideas without losing sight of what we can see outside.

Is the startup accelerator I'mnovation like that?

It is important to open the company up to inno-



2016

ACCIONA's innovative yield is once again above the European average.

3.2

times the innovative intensity ratio for sales, which translated into

193.9
million €.

The Company has a management system which monitors all innovative activity and metrics for the evaluation of processes and results.

vative business models, attract external talent and groundbreaking technology, in order to strengthen our knowledge, increase results, become more competitive... That is what Innovation is, an ecosystem which allows us to resolve big challenges – now and in the future. It reinforces a new productive model based on good, openly-innovative, technological ideas.

As for general strategy, is that also permeable?

Apart from the collaborations with startups, in the long and short term we will be launching initiatives which will involve our employees, suppliers and other talents abroad in society in general. We are working on a number of lines simultaneously: a new model based on digital areas for detecting and getting the most out of new technologies, making our employees digitally competent, an innovative plan with transversal programs at all levels of business. There are further, specific projects such as cybersecurity, intellectual property protection, and new labor profiles in digital areas.

If it's important to look outward, does your experience in European and global business development help in adapting ideas from other models?

It's been valuable in understanding that business models are not always equal in each market, and you need to be able to adapt your product by employing creative solutions. Only businesses that can achieve this will succeed. I've taught myself that flexibility and the capacity to reinvent oneself are fundamental. You can learn a great deal from the companies who manage to do that.



DIGITAL TRANSFORMATION IN SPAIN

Digital transformation is one of the thorniest challenges in Spanish competitiveness. Arantza Ezpeleta believes the digitization of processes and decision-making will need to move ahead within the fabric of the business. "Within our own ecosystem and management chain, the benefits of Industry 4.0 could come to a halt if the 'partners' do not adopt their own digital transformation." Things are advancing, but at the moment, for the most part, basic digital use is the norm. "There is a certain mistrust of the most advanced technologies; only a handful innovative companies use them."

WEAK SPOTS:

- The classic resistance to change.
- In Spain, investment in R&D is 1.2% of GDP. In Germany, it's 3%. The European average is 2%.
- The level of technical competence within the businesses, and goods and services suppliers, could improve significantly.
- Only 38% of companies have a formalized digital strategy.



Artificial intelligence and robotics will revolutionize not only the economy but also the way in which we relate to the world



MORE PERSONAL

The most innovative person you have known, and who has been a model for you...

My mother. She has been a pioneer in her field, anatomic pathology.

The innovation you would have liked to have signed off...

Any of those which have improved people's lives.

The other profession you could practice...

Medicine. I've always enjoyed research, questioning things, and medicine is wonderful for that. I find it fascinating to understand how something as complex as a human being works.

The movie you would like to have starred in...

Lots of them. A recent one, *Hidden Figures*, tells the story of the first female mathematicians at NASA.

Characteristics you most admire in others...

Honesty and humility.

A characteristic you admire somewhat less...

Falseness.

The energy to run a department in a multinational company, as well as a family, comes from...

The passion for what you do. Life is full of challenges and the need to confront them, be able to overcome them, is precisely what gives me the strength to excel at what I do.

There is another definition which states that the future of innovation is, simply, the future. What ACCIONA technologies are, or will be, strategic?

The convergence of technologies and business. To give an example, the groundbreaking work being done vis-à-vis Internet connectivity and energy. Hybridization of desalination plants with renewable resources, or the development of digital infrastructures in mobiles, in smart cities... these are some of the innovation fields which we are addressing in the short term.

What are the most leading-edge?

Groundbreaking implies that various technologies evolve and when they finally come together, the result surpasses all expectations. The Internet of Things, large-scale 3D printing, Big Data & Analytics, and Mixed Reality, will, in a short period of time, change the manner in which we do business. In the medium and long term, artificial intelligence and robotics will revolutionize not only the economy, but the our way of actually relating to the world.

Is there any particular one which currently amazes you?

There are many! The 3D printer revolutionizes traditional construction systems and allows engineers to create complex structural elements and architects to design bio-mimetic geometries which reproduce the forms in nature... Our technicians are already printing machine replacement parts on an immediate basis, in situ. In fact, we are pioneers. It was a year ago that we inaugurated the first large-scale pedestrian bridge printed in 3D. It was a milestone, because until then no applications existed for this technology in civil engineering.

Which do you think will contribute the most to our well-being?

I suspect that robotics will be one of those which will best develop human creativity and reduce workplace risks. Though their focus is different from our own business, technologies applied to health or food will be able to help personal and social well-being in ways which we haven't even imagined. Some of the emerging technologies will be able to increase our society's resilience as it faces the great challenges of the future. ■



I'M INNOVATION

INCORPORATING GROUNDBREAKING TALENT INTO THE COMPANY FROM OUTSIDE. THE QUEST FOR THE SPECIAL ONE. THE PROJECT THAT WILL MAKE THE DIFFERENCE. THE FIRST VENTURE OF ITS KIND. EIGHT STARTUPS SAT DOWN WITH ACCIONA, DISCUSSING ANYTHING FROM TUNNEL-SCANNING DRONES TO 3D-PRINTED HOMES AND CONCRETE THAT NEVER CORRODES... INNOVATION AT EVERY LEVEL OF THE BUSINESS.

Startups

by
Francis Pachá

photos
Jacobo Medrano

Previous page,
from left to right,
clockwise:
Javier Cerrudo,
Alberto Casas,
Pilar Górriz,
Alejandro Zarzuela,
Carlos Egea and
Ulises Wnsell.
This page:
Telmo Pérez.

Meeting of the eight startups and those responsible for business and innovation at ACCIONA to get the projects underway.

OBJECTIVE: ATTRACT KNOWLEDGE BY WEAVING A WEB OF INNOVATION AROUND THE COMPANY WITH A NEW WAY OF RELATING TO PROSPECTIVE PARTNERS.

Methodology: Innovation #Startups, the first ecosystem specifically designed for infrastructure and renewable energy startups (created by and for ACCIONA) in Spain, pioneers in Europe. “We had two options: to look for startups based on the large trends like the Internet of Things or big data, or to ask each business for their main technological challenges and who would participate in the selection of startups with the best solutions for each need,” explains Telmo Pérez, ACCIONA’s Director of Corporate Innovation and manager of this project. They went for the latter in a call for 100 startups in four countries.

Each of the eight chosen startups will develop a pilot project over three months. They meet with the area manager and define precise objectives as well as the targets of the process. “If the ACCIONA-startup team is comfortable and generates value in the solution, a long-term commercial agreement may be signed; a partnership relation, or we may become stockholders in the startup in order to develop new lines of business,” said Telmo Pérez. This relationship of equals tears down barriers. “Great companies tend to consider startups as mere providers and they aren’t. It is also unusual for us to act as business angels (investors in startups). They can provide us with the groundbreaking technology we need, and we can offer access to an environment in which they can try out their solutions,” he adds. “Furthermore, we offer them a specific purchasing process. For this we are grateful to the Legal department and the Purchasing department for their participation in the program,” chips in Francisco Javier González Báez, manager of Open Innovation at ACCIONA. “It may be necessary to put the money up front in order to finance these ideas, rather than the usual paying in 90 days. This is another example of a change in the work philosophy”. “When the first call is completed in January, the second will be launched. The idea is to string together two per year and open them to more and more countries,” he adds.



Francisco Javier
González Báez,
Manager of Open
Innovation at
ACCIONA.



1



2



3



4





THE CHOSEN EIGHT

01

BE MORE 3D

3D PRINTER PIONEERS

- Vicente, Joaquín, José Guillermo and José Luis, engineers. They are between 27 and 30 years old, live in Valencia and decided to open their own business in 3D printing in plastic.

- “We immediately realized that construction is a passion of ours. In one year, we designed, constructed and patented the first 3D printer in Spain, but in concrete,” explains Vicente Ramirez, CEO. “We want to show how well we do this. That faced with something so complex, we already have the know-how that a multinational needs.”

- This challenge will allow ACCIONA to employ other 3D printer techniques such as Contour Crafting, and broaden the field of application through Infrastructure and Innovation.

Product Owner: Carlos Egea, Manager of Advanced and Digital Innovation Hub for ACCIONA S.A.

“The technique of Contour Crafting used by Be More 3D extends the field of 3D printer technology application for ACCIONA.”



02

ARTELNICS

DATA ANALYSIS, WATER PLANT PROPHETS

- A multidisciplinary startup, although, not by chance, many of its managers are physicists. “We develop data analysis tools based on artificial intelligence for a range of areas applied to company conversions. The neuronal webs generate stronger productive models,” explains Roberto López, CEO of a company with three years under its belt and a branch in Salamanca.

- The pilot is a tool which gathers data, both internally and externally, from a water plant, in order to model its functioning and simulate hypothetical scenarios. For example, anticipating a week ahead how the output at a desalination plant will affect a specific algae concentration in the water captured.

Product Owner: Alejandro Beivide, Automatization and Control Department Chief, ACCIONA Water.

“Our challenge is to integrate the artificial intelligence into the workplace.”

Alejandro Zarzuela. Technical and Innovation Director, ACCIONA Water.

What we appreciate with Artelnic is their knowledge of machine learning, which links up complementarily with our teams, with good results.



03

MYTRA

FROM CONVENTIONALS TO 4.0 PLANTS

- Is it possible to update the technology of a water treatment or desalination plant which has been up and running for a quarter of a century? Actually, yes, if the plant’s lifecycle and specific use are adapted through the Internet of Things and augmented reality. “We come from a lifetime in water plants and have always tried to learn, from the bottom up, all that is needed to adapt to the reality of water through new 4.0 technologies,” says Carlos Jiménez, Technical Director of Mytra (Madrid).

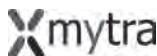
- The pilot, which he has developed with his partner Iván Martín, “selects plants which lack modern technology, have a 25-year vision, and analyze what they need in order to incorporate it. The objective is to define how a process with these characteristics can be standardized in the development of ACCIONA’s plants. It is a matter of designing the most realistic model possible, capable of generating added value for all. It is the fastest way to take off.”

Product Owner: Alejandro Beivide, Head of Automation and Control for ACCIONA Water.

“The work we do today will help us with tomorrow’s technology.”

Alejandro Zarzuela: Technical and Innovation Director for ACCIONA Water.

“Mytra provides significant knowledge of new cloud technologies, and are experienced in their field”.



04

KINEO MOBILITY ANALYTICS

GUESSING HOW AND WHY THE MASS (OF VEHICLES) MOVE

- Miguel, Manuel, Luis and Ricardo are specialists in big data, modeling and system simulation. Along with Luis Willumsen, an expert in planning reference and transport models, they founded Kineo Mobility Analytics. “We focus on geo-localized data analysis, from mobile devices (telephones, credit cards, public transport) in order to obtain mobility patterns in different sectors,” explains Miguel Picornell, Technical Director.

- The pilot will be applied principally in transport and highway concessions. “The information and its analysis offer a map of displacement patterns in the population: origin and destiny of the trips, recurrence of trajectories, purpose, incidents... ACCIONA Infrastructures can improve management, whether through new tariff policies to optimize income or proposing new civil works or managing traffic more efficiently.”

Product Owner: Ulises Wensell, Manager for Study of Demand and Traffic for ACCIONA Concessions.

“Kineo is an independent analysis platform which, without belonging to any single mobile phone operator, maintains a strategic relationship with Orange in Spain and other operators in other countries. We are looking for a richer way, using predictive analysis, to describe the selection of routes by the users of our concessions.”



5



6



7



8





05

GOITECHNOLOGY AND ILLUSION
IN THE NEW LOGISTICS

• At 24-years-old, Yaiza Canosa is the CEO and founder of this Madrid business, along with two partners, Alberto and Alfredo. "GOI means package in Vietnamese, but also refers to those boxes which, in a move for example, contain something of great sentimental value," she explains. "We are the first logistics operators to specialize in large-size deliveries. We turn the logistics on its head. Here, the client chooses exactly when they want it to arrive, is able to trace the exact position of the order in real time, and can request that the transporter warn them half an hour ahead."

• Their pilot is a tool "which optimizes the whole logistics process in the food sector through an algorithm based on machine learning and artificial intelligence." It will be applied to the last-mile logistics carried out by ACCIONA Services, in order to augment productivity and reduce operational costs at the 50 physical sales points, from now until the end of January 2018.

Product Owner: Javier Cerrudo, Manager of Facility Management and Innovation at Facility Services.

"We are well suited to one another; GOI provide the know-how and technology, and ACCIONA their framework and ability to penetrate the market with large businesses."

Emilio Arce: Director General of ACCIONA Facility Services.

"With GOI, we also note the effort and above all the dream to change things. We can apply cognitive intelligence to service and become more productive."



06

HEMAVDRONES: FASTER TUNNELS,
SMARTER WIND TURBINES

• Xavi, Álex, David, Pau, Toni, Fernando and Carlos shared a challenge: for drones to fly for much longer. They have not been able to patent their innovation because legislation prevents flying at the necessary altitude. Nonetheless, the experiment had served to digitalize the use of these apparatuses in various industries.

• "We collect the information from the drones, upload it and process in the cloud; we add value and present it in digital layers of information," explains Carlos Ferraz.

• They are the only startup participating in two pilots. One calculates volumes and advance sections when constructing tunnels, in order to increase security and reduce the obligatory stop time following each detonation. The other develops an automated wind turbine inspection system with drones, based on collecting data which will reduce generator failure and stoppage.

Product Owner: Jorge Gómez Hoyos, Group Head for Underground Works at ACCIONA Construction.

"HEMAV will contribute, in a pioneering manner, to digitizing and optimizing our tunnel construction processes."

Product Owner: Roberto del Campo Arzoz, Innovation Project Manager for ACCIONA Energy.

"They have their own digital processing platform for aerial data in the cloud, in order to generate and visualize predictive and analytical reports in the Energy sector."



07

SMARTIVETHE ALGORITHM WHICH
KNOWS EVERYTHING ABOUT
EVERY TURBINE

• Four years ago, Jordi, Ramón and David founded this software startup based on IoT, big data and machine learning, for diagnostics and control in wind turbines. "We created a system which analyzes the wind turbine's and generator's historical data, in order to develop a predictive motor capable of knowing when something was about to fail."

• We concentrate a lot on the mechanical parts, but we extend it to the electric as well," explains David Amoros, CTO of the company.

• "We are able to generate specific motors for a specific turbine system, as each of them could have a certain age, condition or different development."

Product Owner: Gunther Auer, Engineer in the R&D Department at ACCIONA Energy.

"Their broad experience in the wind sector, particularly in Operations and Maintenance, makes them ideal partners to develop solutions which focus on our needs. They add value to the objectives of prolonging the useful life of our installations and reducing Operations and Maintenance costs."

Alberto Casas: Responsible for Optimization of Assets in Wind Production for ACCIONA Energy.

"They combine experience in big data with deep knowledge of wind maintenance. This allows them to apply large-volume information analysis techniques without losing sight of the business objectives."



08

SMALLMATEKNANOTECHNOLOGY EXTENDING
THE LIFE OF CONCRETE

• Federico Maia and Nuno Nogueira present Smallmatek from Aveiro (Portugal).

• They develop intelligent additives capable of locking in, transporting and freeing active composites (corrosion inhibitors) in a controlled manner. These additives (nano-structured materials) can be incorporated into coatings and mixes of reinforced concrete in order to make them longer-lasting and resistant to corrosion in aggressive environments.

• They work by simulating the durability of the new materials in order to predict their efficiency.

Product Owner: José Cubillo Capuz, Group Chief for Advanced Materials at ACCIONA Construction.

"The Champlain Bridge, which provides access to the Island of Montreal, was constructed in 1962, and corrosion has forced them to build another one. Such cases mean that administrations in Canada, Australia, Norway or Sweden are beginning to demand 120-year infrastructure durability in their contracts. Smallmatek has experience in maritime and aeronautical sectors, and is one of the largest startups facing this challenge."

Pilar Górriz, Area Head for Technological Center Media at ACCIONA Construction.

"According to our experts, the Smallmatek additive offers a result which could reduce problems with concrete corrosion."



THE ECONOMY OF THE FUTURE WILL BE CIRCULAR



by
**Ángel Luis
Sucasas**





INSPIRED BY THE CIRCLE,
THE PERFECT FIGURE,
THE AIM IS THAT THE
FUTURE ECONOMY WILL BE
CIRCULAR. SUSTAINABLE
ENERGY, BUT WITHOUT
SACRIFICING WEALTH AND
GROWTH. THIS IS HOW THE
CYCLE OF WELL-BEING IS
BEING FORGED.

EFFICIENCY IS THE CIRCULAR SOLUTION. THIS IS THE SOURCE OF THE TERM “CIRCULAR ECONOMY”, COINED IN THE EIGHTIES BY DAVID W. PEARCE AND R. KERRY TURNER AS A CONCEPT AS GROUNDBREAKING AS IT WAS INTUITIVE: AN ECONOMY THAT RECYCLES ITSELF AND REDUCES WASTE TO A MINIMUM - OR EVEN BETTER, REUSES IT.

It took time, but the message has got through. Consultants Morgan Stanley, in *The Shift to the Circular Economy* (2017), claim that the model will definitely be employed in the future. Jessica Alsford, the main author of the report, summed it up in *Forbes*, saying that the move towards this style of management would be disruptive in the years to come. Companies who are first to innovate and adapt will be well placed to succeed.

Magnate and sportswoman Ellen MacArthur (who sailed non-stop around the world in a record 72 days) is one of her global mentors. In a now legendary TED talk, she said: “I never truly understood the meaning of the word finite the way I did once I crossed the finish and broke the record. Everything I had in the boat, every packet of food, every bottle of water, was precisely everything I had in the world. I realized that the world economy is no different. It is totally dependent upon finite material which we get only once.”

The last World Economic Summit in Davos advanced the five technological breakthroughs the model requires. At the top of the list is big data and the associated cloud allied to the Rubicon Global online platform. Their objective: connecting waste producers with an independent transport framework distributing it to create new products.

Another key challenge is how to reincorporate the waste into the assembly line. Davos highlighted an Apple robot with 29 mechanical arms. It is able, in 11 seconds, to take apart a discarded iPhone on the assembly line. Calculations say close to 27,000 tons of material have been recovered by the robots for reuse, including pure gold.

The circular economy works on the basis that everything is finite and susceptible to transformation. In the new world, there is nothing lacking and nothing is surplus.



REMATERIALIZATION

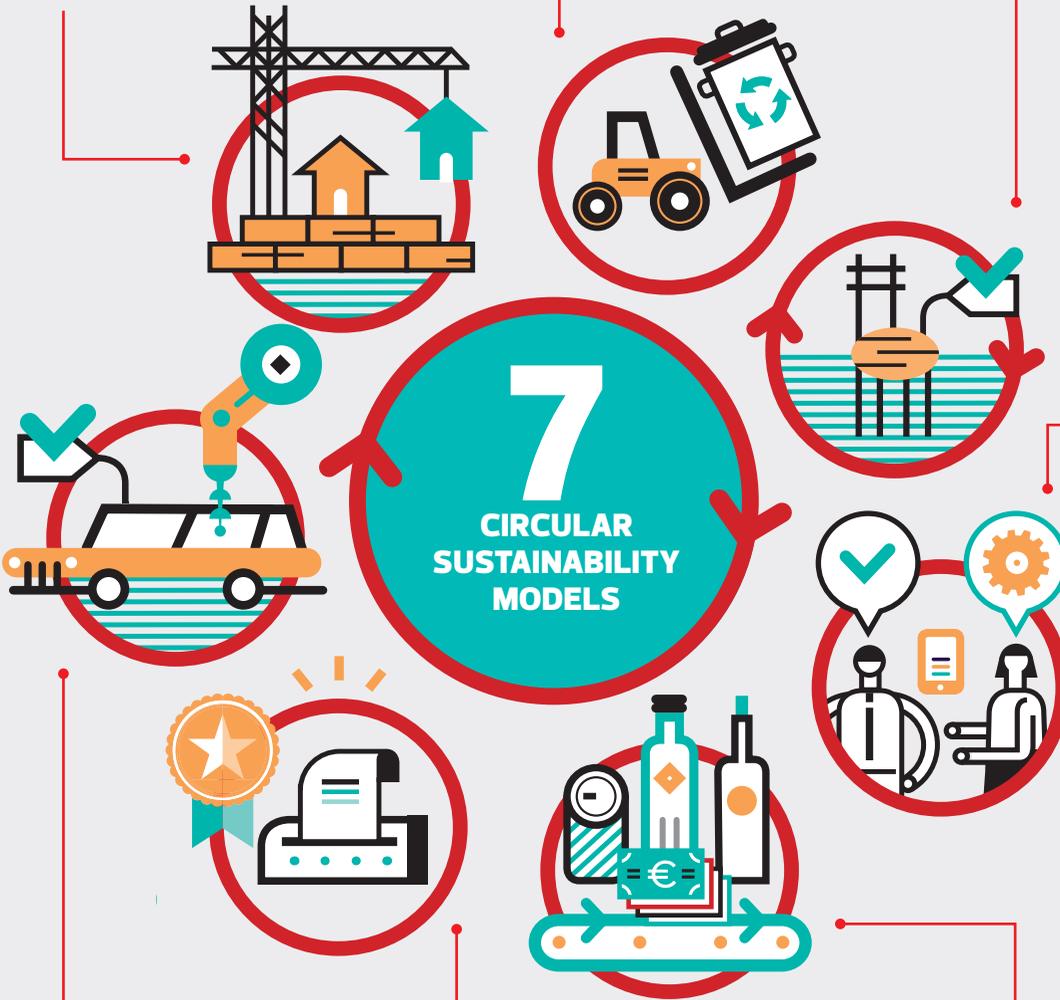
Transforming one product into another new one. Companies like Stone Cycling apply it in the construction sector, producing bricks made entirely from waste materials.

RECOVERY

By using a web of management and intake, a producer recovers a used product. Consultants PwC have implemented a circular recovery system for their uniforms.

RANGE

The manufacturer is able to create a product which does not generate waste, either because it is biodegradable or can be reintegrated into a recycling loop. This design is analogous with the biological metabolism. The idea is that the product components can be designed so that the recovery flow remains constant, as with nutrients in an organism.



REPAIR

The manufacturer offers to repair its own products instead of encouraging a use-and-throw-away mentality. iFixit is a global web of repair experts who aspire to create a systematic and global business. They seek to share knowledge regarding troubleshooting, so that people themselves can solve problems.

REMANUFACTURING

Reintroducing the same used products back into the assembly line. This is not a new concept. The French commune of Choisy-le-Roi premiered the production of automobiles based on older models in 1949, due to the scarcity of materials following the Second World War.

RESTORATION

The manufacturer acquires the product, repairs and restores its newness, putting it back on sale for another buyer. Philips already employs this in order to offer alternative technologies and less costly devices for hospitals. They have a guarantee of at least 10 years.

DEPOSIT

A consortium of manufacturers buying their products back from the consumer (once their shelf life is up) in order to reintroduce them into the production chain. A practical example entails deposit and return systems applying a charge when the product is purchased and reimbursing when it is returned. Canada and the US apply this in sectors such as fuel, plastic containers and electronics.

RAMÓN JIMÉNEZ

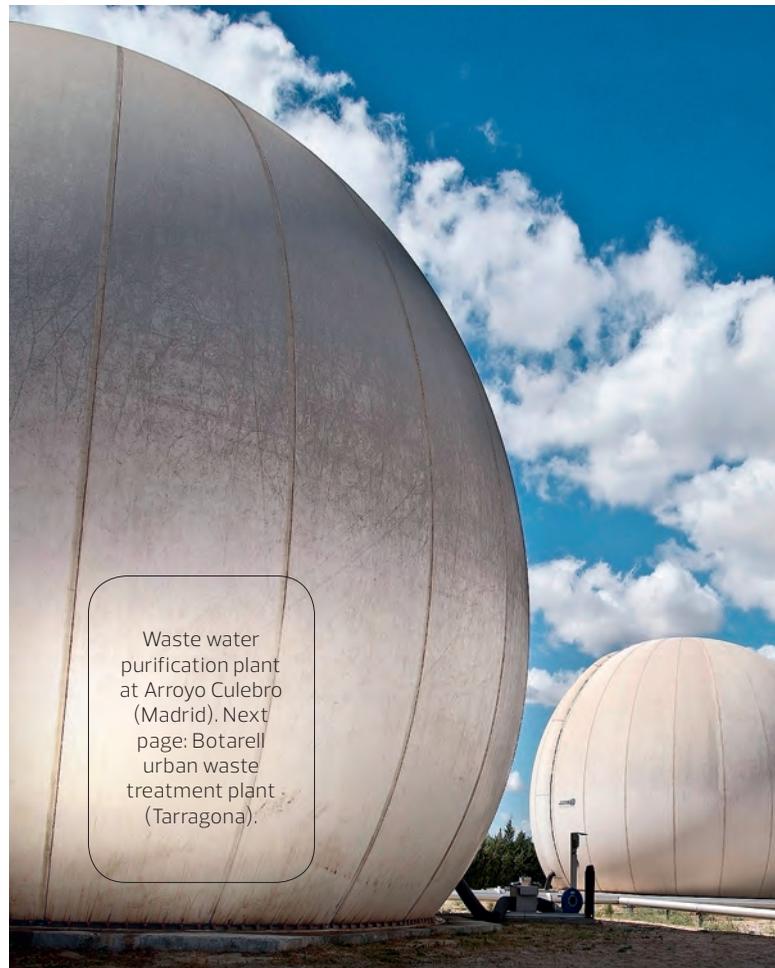
Area Director General for ACCIONA Service and ACCIONA Industrial

“Moving towards the circular model is the economy’s great global challenge”

Population growth, reduction in disposable resources, climate change, and an increase in demand have made the current linear model unsustainable. The circular model, however, goes beyond mere reuse, it covers the product’s entire life cycle: design, production, maintenance and valuation. It implies, for example, changes in the construction and manufacturing processes of material which permit the minimization both of resources used and waste generated. Companies which are the first to adapt will find market niches to develop businesses that would never have even been thought of in a linear economy.

Think of a purification plant where the decision is made to recuperate the phosphorus from the waste water for use as a fertilizer. However, in order for the change to occur, the principle challenge is not the technology, which already exists, but the commercialization of the product. Thus, the traditional purification plant becomes a resource factory, and is able to operate in new markets. All of this

requires overcoming legislative, cultural and logistical barriers. Yet another example of these opportunities lies in waste management. Once they have been generated and cannot be recycled, the solution then moves to energy recovery, through the Waste-to-Energy plants, for instance, which reuse these residuals in the form of electricity, heat or a combination of the two. In this manner, the circle is closed, to prevent disposal.



Waste water purification plant at Arroyo Culebro (Madrid). Next page: Botarell urban waste treatment plant (Tarragona).

THE WASTE TO ENERGY TRANSFORMS THE WASTE INTO HEAT, ELECTRICITY OR A COMBINATION OF THE TWO

ACCIONA CLOSES THE CIRCLE

The company has pioneered the circular economy in various areas of business which are in-line with the new European policies aiming to rapidly advance towards a cycle of sustainability. The EU has earmarked more than 6,000 million euros – from Structural Funds and European Investments and the push for innovation under the umbrella of Horizon 2020 – in order to encourage this change in financial, social and industrial paradigms.



320,000

MILLION EUROS
the volume of business
estimated for the European
circular economy in 2025

▼
The European
Commission predicts
600,000

MILLION EUROS
IN POSSIBLE SAVINGS FOR
BUSINESSES IN 2030

▼
It will generate
2 MILLION
JOBS
in the EU over
the next 13 years

▼
Spain will generate
52,000
DIRECT JOBS
just by applying the
European standard for
waste treatment

WATER

The Vetra process minimizes waste generated during membrane cleaning in desalination plants. The main differentiator in the Watintech project is the reverse osmosis technique applied to residual water filtration to increase the percentage of reusable volume. Sewage co-digestion improves water reutilization. ACCIONA Water has also participated in the Integroil and LIFE-Celsius projects at the European level, optimizing the consumption of water in the oil industry and reducing energy consumption in silt management.

CONSTRUCTION

The guiding idea: industrial symbiosis. In practice: a coalition of businesses developing a model based on sustainability, understood from three principal perspectives: environmental, economic and social. The cyclical component of FISSAC (the acronym for the project coordinated by ACCIONA Construction) transforms one industry's waste into prime material for another. In this manner, initiatives such as the PaperChain project convert paper industry waste into raw materials for construction, mining and the chemical industry.

INDUSTRIAL

Referring to the final product of an operation as waste, discards or residuals, is one idea which the circular economy tries valiantly to combat. Waste-to-Energy is a technology supported by ACCIONA, demonstrating how useful these waste products/discards/residuals can become with a little ingenuity applied, reusing materials to generate energy, while reducing the level of waste discarded.

SERVICE

ACCIONA Service functions from the moment it selectively collects waste, preventing that a valuable and reusable product ends up in the garbage, through solutions which give new meaning to grass cuttings, by converting them into fertilizer, algae as bedding for cattle, the use of purified water for irrigation or machine parts used to repair other machines. Similarly, through ASELIP, we participate as signatories to the Pact for a Circular Economy.

A GIFT

OF

THE

GOD

RA



Egypt intends to supply 20% of generated electricity from renewable resources by 2022.

IN THE NEW EGYPT, AS IN THE ANCIENT ONE, THE SUN IS AGAIN BEING WORSHIPPED. A MEGAPROJECT WITH THREE PHOTOVOLTAIC PLANTS PROMOTED BY ACCIONA IS DRIVING THE SUSTAINABLE ECONOMY IN A COUNTRY AND A REGION THAT DEPEND ON FOSSIL FUEL.

by

Santiago Gómez López

EARLY 2,500 YEARS AGO, HERODOTUS DESCRIBED EGYPT AS A GIFT OF THE NILE.

Annual floods turned the meadows surrounded by desert into fertile land. They were watering an already ancient civilisation when the Greek historian wrote about it. The Egyptians, however, venerated another divinity much more than water. The Sun, the giver of life - the one that made everything possible, from the last grain of sand to the last drop of the Nile. The god Ra continues to bless Egypt, where they are beginning to take advantage of the gift of solar radiation in order to reduce their dependence upon fossil fuels. ACCIONA will contribute through three photovoltaic plants which will be established in the Aswan region, only 15 kilometers from the great river.

Middle Eastern and North African countries (MENA) have based their economies on oil and

ACCIONA WILL ADD THREE NEW SOLAR PLANTS TO POWER SOME 150,000 HOMES



gas for decades. Nonetheless, the transition to a more sustainable and carbon-free energy model has started to be considered strategic. It is no coincidence that IRENA, the International Renewable Energy Agency, has its headquarters in Abu Dhabi (United Arab Emirates). It is looking to move this enormous potential ahead. The MENA countries need to diversify their ‘single crop’ energy sourcing and match the growth of their population and their economy within sustainable parameters. The drastic drop in price for renewable technology, particularly wind and photovoltaic, are in their favor.

There is still much left to do; over 90% of electricity generation capacity installed in the region is fossil-fuel-based, though the majority of Arab countries have set objectives regarding renewable energies and have supportive policies – mainly since the 2015 Paris Climate Summit. They prefer to earmark

Location of the three solar plants that will be built by ACCIONA.

CONTRACT CEREMONY

The strategic importance that Egypt grants this contract was reflected in the solemnity of the event. The contracts for the project were signed in the presence of ACCIONA Chairman, Mr. José Manuel Entrecanales (left); the Egyptian Prime Minister, Sherif Ismail (right); and the Ministers of Electricity & Renewable Energy, Mohamed Shaker El-Markabi, and International Cooperation, Sahar Nasr. Mr. Kamel Lazaar, Chairman of Swicorp, and other executive directors of ACCIONA were also present.

hydrocarbons for export rather than burn them for electricity, given that there are more sustainable, ever more competitive options. The International Energy Agency (IEA) expects that the capacity for renewable electrical generation installed in MENA will grow by 60% in the coming five years, until it surpasses 40 GW, or more than half of what is generated in photovoltaic installations. This growth is being led by Iran (with hydroelectricity), Morocco, the UAE, Egypt and Jordan.

OPPORTUNITY

Egypt produces 65% of its electricity mainly from natural gas (of which it imports 15%) and 29% from oil (with 40% imported). The government has begun a program supporting investment in renewable resources through feed-in tariffs, with a strategic objective of covering 20% of the electricity demand with renewable resources by 2022. Based on IRENA estimates, this would imply developing 10 GW of wind and photovoltaic energy by that date. In 2015, they had barely reached 8%.

ACCIONA has, for some time now, been paying attention to opportunities in the renewable resources that the country has to offer. This has led to a 50-50 alliance with Saudi group Swicorp to construct three photovoltaic plants with an estimated investment of 180 million US dollars. For ACCIONA Energy, the operation represents an entry into Egypt (the 15th country to host its installations) and to position itself better within the MENA area, where the group already maintains an important presence in Infrastructure, Water and other businesses.



Located in the photovoltaic complex at Benban, in the Aswan region (Upper Egypt), about 40 kilometers to the northwest, the new plants will produce energy equal to the consumption of some 150,000 homes and avoid the 297,000 tons of CO₂ emitted annually into the atmosphere by the fuel-oil power stations. Work will begin in late 2017 or early 2018 and should take a year.

A 25-YEAR CONTRACT

The production will be supplied to public electricity concern, Egyptian Electricity Transmission Company (EETC) thanks to a 25-year contract for the purchase and sale of energy. Financing for the operation was signed with the International Finance Corporation (IFC), an entity of the World Bank Group, as well as with Asian Infrastructure Investment Bank (AIIB), two institutions specializing in financing private projects in developing countries.

The project consists of three identical plants of 50 MW nominal (62 MWp) each, totaling 186 MWp peak power. Each of these will be equipped with 190,774 polycrystalline silicon modules supplied by Jinko Solar, on horizontal-axis tracking structures produced by STI Norland. The tracking technology is similar to one already used by ACCIONA Energy at its South African plant at Sishen (94.3 MWp). ■



BENBAN, ASWAN AND KOM OMBO

A desert area of 37 km², located near the village of Benban, was chosen to house one of the largest photovoltaic complexes in the world. Divided into 41 sections, it will include all the necessary infrastructure to house other plants of up to 50 MW each, for a total of 1,800 MW upon completion. The region is famous for the giant Aswan Dam, whose construction between 1959 and 1970 required the transfer of 120,000 people and 22 archeological ruins, including the Temple of Abu Simbel (currently located some 300 kilometers from its original location) and the Temple of Debod, which since 1970 is in Madrid, Spain. Just 19 km from Benban, along the Nile, is the Temple of Kom Ombo (see image above), constructed by the Ptolemaic dynasty in the 2nd Century BC, which combined its religious function with the entertainment area for battle elephants.



VIDEO
<http://acciona.sa/PkKc30gubiN>

A GREAT TRAIN JOURNEY (UNDERGROUND)

THE UNDERGROUND TRAIN LINES IN DUBAI OR QUITO ARE CHILDREN OF THE MADRID METRO, A CENTENARIAN PIONEER. UNDERGROUND ENGINEERING WITH ACCIONA'S OWN BRAND OF INNOVATION. FROM PICK AND SHOVEL TO 2,400-TON TUNNEL BORING MACHINES.

by **Miguel Ángel Bargaño**



The Madrid Metro has always been one of the most advanced in the world. It inspired a mining-based construction method called the Madrid Method.



TBM shield working on the expansion of the Madrid network, between Sainz de Baranda and Pavones.

MUSTACHED MEN IN SUITS. A FEW WOMEN IN HATS.

Crowded together under a domed roof next to what looks like a railway carriage. The old snap is familiar and shows the Madrid Metro opening ceremony presided over by King Alfonso XIII in 1919. Work had started two years earlier on a single line, eight stations (from Sol to Cuatro Caminos) and 3.5 kilometers of track. A hundred years on, Madrid's suburban network, including the light railway lines, consists of 320 kilometers of operating track plus 319 stations.

A mode of transport with a long tradition but also a sign of modernity. More than 155 million travelers use it every day all over the world. "Metro and light railway trains are fast, profitable and environmentally friendly," says Colombian psychologist and urban expert Carlos Felipe Pardo in his study *A guide for sustainable urban development in the 21st century*, sponsored by the United Nations. Benefits that, up to a short time ago, were enjoyed only by the most advanced countries and which encouraged many other nations to climb on board.

Metro tickets and season tickets are much more affordable compared to the 9,000 dollars average expenditure made by car drivers, according to the American Automobile Association (AAA). But it also saves its weight in gold in terms of time, as any Ferrari owner stuck in a traffic jam will tell you. Plus, it saves the planet from costly emissions: a Princeton study recommends "investing more cash in building new metro networks and expanding or improving existing ones".

ACCIONA was already fully aware of these advantages before they became synonymous with a sustainable future. The company started building

tracks for the Madrid metro in 1946 and continues doing so to the present day. Between 1995 and 2003, the company took part in the biggest expansion in the history of the Madrid rail network, one of the largest in the entire world. The company has been involved in the development of the Barcelona metro network (lines 9 and 5), Bilbao (line 2 extension), Valencia (line 5) and Málaga (still in progress). At the same time, thanks to its experience in the Spanish underground, ACCIONA has consolidated its position as one of the leading companies worldwide in this infrastructure and transport engineering specialty. For example: elevated and underground railway lines in Dubai (United Arab Emirates), and

MORE THAN 155 MILLION TRAVELERS USE IT EVERY DAY ALL OVER THE WORLD

underground lines in Quito (Ecuador). ACCIONA has also been awarded contracts for suburban railway lines in Santiago de Chile and Warsaw, in Caracas, Oporto...even in Hong Kong.

THE MADRID METHOD

However, the Madrid Metro continues to set the standard. In fact, there is a tunneling method named after the city, developed in 1917 and copied all over the world, even today. According to the article *Perspectiva tras 90 años de construcción en el Metro de Madrid (Perspective after 90 years of construction in the Madrid Metro)* (2010), by engineers Jesús M. Trabada Guijarro and Raúl Talavera Manso, the Madrid Method is based on mining techniques and starts by building the upper mid-section, so the unprotected open face is relatively small.

Another huge qualitative leap was the appearance of tunnel boring machines, TBMs, in 1995. “These



machines don't just bore the tunnel, they build it. They are literally tunnel factories. As they dig the tunnel, they fit the reinforced concrete linings,” explains José Luis Guijarro, ACCIONA's Civil Works and Architecture Manager on the building site for Phase 2 of the first Metro line in Quito (Ecuador). The tunnel boring machines build many more kilometers in much less time than was possible with earlier techniques and are one of the most complex



A HUGE QUALITATIVE LEAP IN THE EXPANSION OF THE MADRID NETWORK COINCIDED WITH THE APPEARANCE OF TBMS

TRANSPORTING TITANS

Before tunneling work can start, you have to transport the boring machine, which, when fully assembled, measures more than 100 meters and weighs thousands of tons. Of the three TBMs used by ACCIONA in Quito, two were made in Germany and the other in Spain. They all need to be adapted in some way, since they're made *à la*

carte, depending on the type of terrain. They arrived in Ecuador by ship, were dismantled, and from the port to the city they travelled by road on 58 heavy goods vehicles. Transport often involves additional works being carried out (for example, structural reinforcements to bridges), as not all roads are in a condition to take this kind of mega-load.

advances in construction equipment. They're so big, expensive and complex that they're given their own names, just like ships and aircraft. As a matter of fact, "the greatest development in the tunnel network took place from 1995 onwards," explains José Antonio Gallego, Civil Engineering Services Coordinator for the Madrid Metro Works Department. Between 1917 and the mid-1990s, the network covered 116 kilometers, but in the 12 years up to 2007, some 185 kilometers were built.

NEXT STOP...

The way stations are built has also changed substantially. At first, and up to the 1980s, work was always done out in the open whenever possible. That was until the 1990s, when the method known as cut and cover was introduced. "This consists of building the station walls and then the roof is placed over it at ground level," says Guijarro. This method was a huge step forward in terms of safety and speed. The open trench method meant that the street had to be closed off to traffic for two or three years. In Quito, the use of cut and cover meant the city's busiest avenue only had to close for six months. "In that time, we built the facing walls for the station, fitted

the roof cover slab, and resurfaced the entire avenue,” adds Guijarro.

TBMs dig through whatever gets in their way. “The Madrid Metro was dug in fantastic excavating conditions. Unlike in Bilbao, alongside the tidal river, or in Seville, where the terrain is very difficult,” he says. That’s the one factor that splits TBMs into two major groups. “The moles, for hard soils, are based on side grippers that press against the rock and move forward using that pressure. In softer soils, however, that side pressure would sink into the soil and stop us moving forward. In that kind of terrain we use ‘slurry shield’ tunneling machines, with grippers placed behind the bore head and acting like a rear ring; this provides the push that allows us to move the machine forward.” In this second group, there are TBMs that can work beneath the water table, in water, and others that operate away from the water table.

HUMAN SECURITY

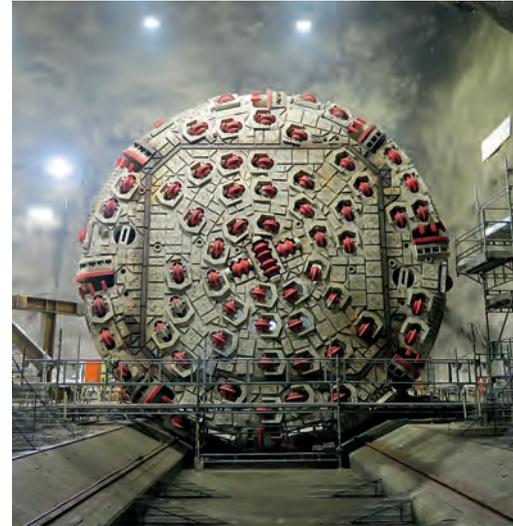
These giant boring machines are worth their weight in gold in terms of improved safety. “The operators are protected by a circular crown of steel and separated from the front working end, so it’s logical that the accident rate is lower compared to previous methods in which people were excavating the soil directly,” he points out.

Methods are developing at the same rate as the profession, with a move towards more qualified tunneling personnel. “Before, we only had road engineers, public works engineers and surveyors,” says Guijarro. “Nowadays, automation demands such a high level of expertise that we’ve got mechanical engineers, electrical engineers, telecoms engineers, environmental engineers, and so on.”

That engineering adventure began in Madrid a century ago, and today Spain exports sector and process innovation professionals to all five continents. “We’ve set a precedent that’s difficult to match,” the expert argues. “The best Metro in the world has been built in Madrid, in the shortest time and at the lowest cost.” ■

TUNNELS MADE BY ACCIONA

TBM shield. The most cutting-edge machines can bore through almost sixty meters a day.



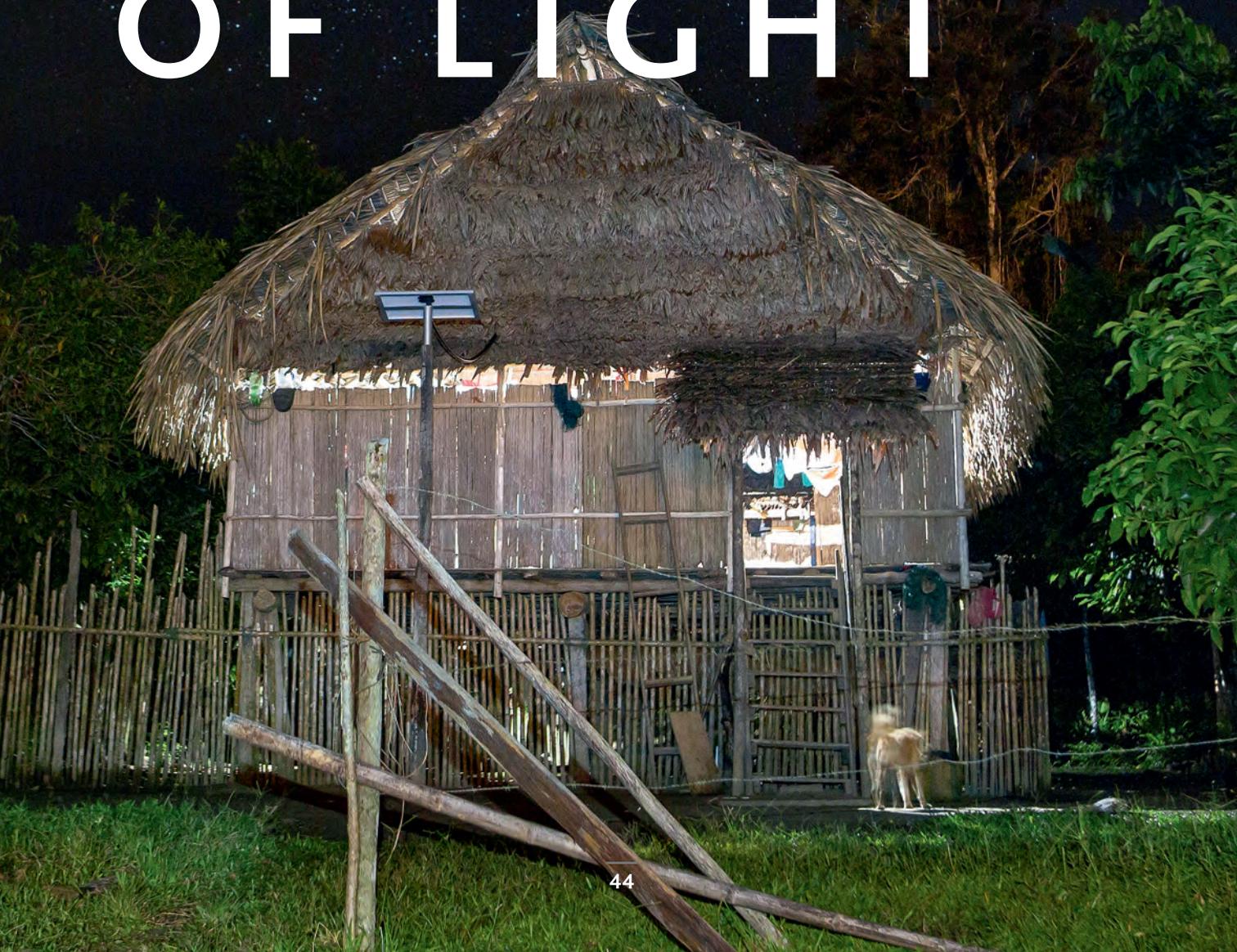
Counting metropolitan railways, high-speed trains, water pipes, ramps and roads, plus gas and power transport, ACCIONA has built more than 600 kilometers of tunnels on the five continents. Most of them have involved excavating with tunnel boring machines, ensuring greater safety, less associated damage, work completion in a single phase, quality of finish, and strength of the concrete used for tunnel linings. Their predecessors appeared in the late 1960s. However, they were nothing like the latest generation of increasingly large and powerful machines, with tunnel diameters of up to 17 meters. Early TBMs required background surveying work to prevent the machine from going off course. Nowadays, they’re more like aircraft with GPS systems, guided by software and data processing. The machines used by ACCIONA in the Folle Line tunnel (Norway) are 150 meters long and weigh 2,400 tons. The machines working in Quito have just beaten the excavation speed record, tunneling 1,131 meters in 20 days. Early machines bored through 5 meters a day.



<http://acciona.sa/BdZy30gubmG>

VIDEO

THREE DAYS IN SEARCH OF LIGHT



AFTER MEXICO AND THE PERUVIAN ANDES, NOW IT'S THE TURN OF THE OTHER WORLD, THE AMPHIBIOUS CONFINES OF THE AMAZON. SUCH IS THE REACH OF THE 'LIGHT AT HOME' PROJECT BY ACCIONA MICROENERGY FOUNDATION. HERE IS A CHRONICLE OF THE ADVENTURE.

The 61 families participating in the project no longer need to rely on oil lighters for light.

by

Francesco Manetto,
El País correspondent
for Colombia, Venezuela
and the Andean region

photos

Juanjo Fernández



THE PORT OF IQUITOS, IN THE PERUVIAN AMAZON, IS ABOUT AS FAR OFF AS YOU CAN GET.

Dozens of people wait in the early hours of the morning for a boat to one of the communities along the Amazon, prepared to ride the river and its tributaries for hours, in order to travel what are, in reality, only a few kilometers. It takes them to a small market, where the residents hope to sell their modest harvests, the catch of the day or game they have hunted, in their attempt to break out of the subsistence economy. This is the story about overcoming geographic and technological isolation. It is based on a pillar of civilization: light. The ACCIONA Microenergy Foundation has launched the Light at Home program, powering up four communities along the banks of the Napo River with photovoltaic systems in a new pilot project.

DOOR TO THE JUNGLE

Our three-day voyage begins in Iquitos, which for centuries was the entry point to the most extensive jungle on the planet, and follows the route taken by Jessica Olivares and Jorge Ramírez of ACCIONA Microenergy Peru, who traveled to contact communities, introduce them to the photovoltaic revolution, supervise the installations and finally, light up the homes of 61 families. Bypassing the junction between the Napo and the Amazon saves a bit of time in order to reach Nueva Unión, the first settlement. Following the initial stretch by boat, you take a “moto-taxi” from Indiana to the port of Mazán. There, a boat awaits and the real journey begins.

In Peru, over 400,000 people have no access to electricity services, mainly due to the difficulty of extending grids through remote locations or areas that are hard to access.

The distances along the river form the principal challenge for the project. The Colombian, Ecuadorian and Brazilian borders are all close by, but the exuberance of nature and absence of land routes seem to have frozen time. There is no mobile coverage and most of the territory cannot even receive broadcast frequencies from local radio or television. There are few wells. Electric generators are a luxury available only in a handful of localities. In Nueva Unión, Vencedores de Zapote, Nueva Antioquía and Juan Pablo II, there are no services or expectation of change.

NEW LIFE

Nine months ago, however, the families, who only had oil lamps to light up their long nights, began a new life. The photovoltaic panels allow them to dispose of two fixed, and one portable, electric lamps in each home. There was also a new attraction: the possibility of connecting small electrical devices such as radios, tablets, blenders and DVD players, and later on even refrigerators, buyable from a user center in Santa Clotilde, the district capital.

Electric light is now the focus of their hopes and concerns. The project requires the constant care and attention of the ACCIONA Microenergy Peru team, however, not only from a technical point of view, but also in the psychosocial sphere. This is reflected in the manner in which Jessica and Jorge take care of the communities and manage their concerns.





Meanwhile, classes are over for the day at Nueva Unión's school, and the home of teacher, Betty Nancy Cruz, has become a meeting point. Everyone present applauds the electrification initiative. "This is a great help felt by all the families and by the 16 students. We often go to each other's homes in the evening and watch the children doing their homework. This never happened before," explains the teacher. "It improves living conditions and we can take care of household tasks until later at night. Supper is much calmer. The children can do their homework. We can even have a party," points out her husband. Light at Home is modifying the culture of these families, who debated and voted on their

The pilot project has reached homes typical of this hot, humid region of the Amazon. Built from wood, they are open and elevated on posts to avoid flooding.

"WE GO TO EACH OTHER'S HOMES AT NIGHT AND WATCH THE CHILDREN DOING THEIR HOMEWORK"

100% SATISFIED

People are happy in the four communities reached by Light at Home. An initial survey reveals 100% of homeowners to be satisfied or very satisfied. Dioselinda Alvarado of Nueva Antioquía is convinced of the benefits. "We will never go back to how it was before," she states, before showing off the

armadillo she's about to cook for the family's supper. Alvarado is the treasurer in charge of making the payments for the community, which she says work out at less than they used to pay for non-electric lighting. As with all those we spoke to during this trip, she believes that electric light has entered their lives for good.

participation, and now need to take charge of the equipment installed, as well as organizing quarterly payments for the service.

Vencedores de Zapote, the remotest of the four communities, is almost deserted in the afternoon. The dogs play with the monkeys and the majority of the men are hunting or fishing. It is one of the poorest areas that Jessica has worked in and despite this, she says, it is among the most respectful toward the installations and in making the payments. Along with Nueva Unión, Nueva Antioquía and Juan Pablo II, they are changing this image of remoteness you get looking out from the docks of Iquitos. The next stage is to take Light at Home all along the Napo River. ■

 <http://acciona.sa/3HEa30gubr7> VIDEO



WHITE CHRISTMASSES AND BROWN TRASH CONTAINERS

WHITE IN THE SENSE OF CLEAN, AS IT DOESN'T SNOW MUCH IN MADRID. ALTHOUGH IT DOES RAIN TRASH FROM PARTIES, BUT THE CITY'S SPECIAL CLEANING SERVICES AND VOLUNTEERS DO THEIR BIT TO PREVENT FLOODING. THIS YEAR BRINGS A NOVEL CONCEPT: A BIO-WASTE CONTAINER.

by

Ángel Luis Sucasas and JP Zurdo



THE WEIGHT OF A THOUSAND ELEPHANTS

Over Christmas, ACCIONA Service is mobilizing a small logistics army with an ecological conscience: more than 135 trash collection trucks weighing between 3.5 and 32 tons. Some are open-backed with modular bodywork to accommodate lifting gear, tippers, elevator platforms and high or low side slats. They have a number of jobs: moving, cleaning, repairing and maintaining street trash containers. The fleet aims to keep its carbon footprint as low as possible. All the trucks run on compressed natural gas and one is 100% electric, perhaps showing the future for transporting heavy loads with zero emissions. Two fleets of 10 vans and 9 cars are also fitted with electric engines. Why such a huge operation at Christmas? Easy. Because 5,500 tons of trash are collected every day in Madrid – that's double the amount for a normal day. The weight of a thousand elephants.

Trash containers are also on vacation and in their own way they become Christmas stockings packed with the things you'd associate with excess. For example, electronic devices, clothing and toys. The explanation: what were once exciting Christmas presents in past years are now making way for this year's new arrivals. The story could easily be the theme of a tale that's both gloomy and a sign of the circular economy. You can see why workers on the compacter trucks feel a bit sorry when a soft toy falls out of a bin, like Mr Burns' famous teddy bear in *The Simpsons*.

Another more predictable kind of trash without a story attached is glass, and let's hope there'll be much to drink to this year. This will be a good time to make a generous gift to all our fellow citizens in the form of sorting for recycling. Everyone knows that in the throes of celebrating friendship or singing regional anthems, good habits sometimes get forgotten. Madrid City Council explains in detail how to do your sorting on Madrid.org and gives a list of the various clean collection points for other types of trash, like batteries, x-rays and medicines.

Speaking of responsible sorting, there's something new this year. A new bin color in addition to the blue, green, yellow trash cans and the grey organic waste containers. The newcomer is the bio-waste container, with its brown lid, destined to swallow no less than 70% of the city's household waste, including food leftovers, paper napkins and diapers. ■



The fleet aims to keep its carbon footprint as low as possible. All the trucks run on natural gas or electric engines.

Christmas Day and New Year's Eve, two red-letter days in the year when, in theory, Madrid's trash doesn't get collected. But it does. A special voluntary service takes on the extra load of waste and clears the overflowing street containers. ACCIONA is collaborating with this operation in the eastern part of the city so that Madrid residents, tourists and other visitors don't have to put up with this contrast in the urban landscape – Christmas lights over their heads and trash piling up under their feet.

The routine of 135 daily services across all of Madrid's nine districts is not actually so routine.

A HUNDRED YEARS OF GLORIOSO

PIONEERING BODEGAS PALACIO CELEBRATES A CENTURY MAKING GLORIOSO, ITS BEST-KNOWN WINE

by **Patricia Alcorta**



A RED FOR FISH AS WELL AS MEAT

FROM THE FIRST BOTTLE IN 1917 TO ONE A CENTURY LATER

The brand celebrated its longevity, practically unique in this D.O., with a Glorioso Special Selection edition, a 2014 vintage, 100% tempranillo, the product of at least 13 months in Bordeaux casks and half-a-year in the bottle (below, the 1917 and 2017 bottles). The grape comes from vines kept for the special process and a final purpose of versatile pairing at the table. The wine's structure and balanced acidity (5.2), say the winery's oenologists, make it a good accompaniment for both red and white meats, as well as fatty fishes; cod baked or in a garlic and pepper sauce (pil-pil), tuna, fresh mackerel, swordfish or shark.



Tango lyrics will have it that 20 years is nothing. A hundred, though, is another matter. During a century of making Glorioso, the anniversary of which was celebrated this spring, this fine red wine has won over 200 gold medals in competitions. "Let us understand the vines, bring in new techniques, make a wine for today's salons and tables. Let the Rioja Alavesa wine demonstrate its liveliness and gain world standing. It deserves as much." These words were spoken in 1894 by Bodega's founder, Cosme Palacio, and became a roadmap for the wine's success. Cosme Palacio had studied oenology in Montpellier, France, and became the first in Rioja Alavesa to use French oak barrels and, in that sense, Bodega Palacio could be considered (what we call today) as a pioneer, no small feat in this most mythical of wine countries. Palacio's oak vision is now the hallmark of an exclu-

sive club – the Historic Wineries of the Designation of Origin (D.O.). Achieving this continuity owes much to Glorioso. "It is the first brand to represent the winery's contemporary spirit. We believe in origins, knowing where we come from. Maintaining roots is fundamental for getting ahead in life," explained Roberto Rodriguez, the company's oenologist. The Basque palate seized upon the idea and Glorioso quickly made a name for itself among the industrial bourgeoisie of Bilbao. The connection can be seen in the advertising history as well. The brand acted as the patron of the Hanging Bridge, at a time when neither vintners not engineers imagined that Glorioso would become a centenarian or that the bridge would become a World Heritage Site and the world's oldest ferry.

www.gloriosorioja.com

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