



02, 03 March

# Engineering: the Cities of the Future



**WORLD  
ENGINEERING  
DAY**

*Venue: Instituto de la Ingeniería de España  
C/ General Arrando 38, Madrid*



Madrid World Capital of  
Construction, Engineering & Architecture



WFEO / FMOI



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**INSTITUTO DE LA INGENIERIA  
DE ESPAÑA**



**“ENGINEERING THE CITIES OF THE FUTURE” &  
DÍA MUNDIAL DE LA INGENIERÍA 2023**



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## *THURSDAY, MARCH 2ND 2023*

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### 09:00 OPENING

On March 2, 2023, the conference "Engineering: the cities of the future" was inaugurated, which was held at Instituto de la Ingeniería de España, located in Madrid, the world headquarters of engineering.

**Mr. David García Núñez, President of Madrid World Capital of Construction (MWCC),** introduced the conference and welcomed the attendees to Madrid as the World Capital of Engineering 2023.



He began by valuing the role of the engineer. "We project highways that join roads, singular buildings that inhabit economic activity, ports that connect countries, airports that reduce world distances, high-speed rail lines that cut time and unite people. In short, we build places to live and grow".

Madrid Capital Mundial is an entity promoted by the Madrid City Council and the Community of Madrid that was born on March 4, 2020, at a difficult pre-pandemic time. On March 4, 2023, it celebrated its third anniversary coinciding with World Engineering Day.

It began with 23 public and private entities and, three years after its creation, there are more than 160 entities that have believed in the "Madrid World Capital" project, that was born "for Madrid and for the whole world".

Madrid Capital Mundial has created a unique business ecosystem and a benchmark in the world, whose objectives are clear: to promote Madrid as a Spanish Brand and to be an international benchmark in urban solutions.

For this, they have the promoters of the most important urban developments in Europe for the next 15 years, Madrid Nuevo Norte and Valdecarros.

In addition, they collaborate closely with the United Nations and with the GIH of UNESCO, being the only Spanish entity to participate in their work groups. They also work closely with the New York City Hall to size up and reflect on their mobility model.

García Núñez gave way to **Ms. María Jesús Prieto Laffargue, Former President of IIE and former President of WFEO**, not without first thanking the attendees for their presence and participation and the support of the sponsors who have made this event possible in the city of Madrid.



**Ms. Prieto Laffargue**, after mentioning the present representatives of the world institutions and welcoming the attendees, stated that the congress would be "an open window, giving a harmonized voice to the engineering profession, bringing to light fundamental issues such as water, energy, mobility, urban planning or disasters" topics that "will be rigorously analyzed and debated with qualified opinions, regardless of any ideological focus."

"The engineer creates sustainable solutions and clean and available technologies to meet the basic needs of society and make cities safe," she said.

Engineering allows the growth of the cities of the future as a motor of innovation and human progress, but at the same time, it creates a social risk of exclusion, marginalization, poverty and environmental damage that must be alleviated.

For **Ms. Prieto Laffargue**, cities have come to play a central role in policy making and therefore opportunities must be seized, city planning and service delivery adopting a holistic approach and combining efficiency of technical solutions with economic efficiency, social acceptability and ecological integrity.

Today, science, technology, knowledge and the efficient use of resources can solve specific needs. Therefore, "what the world needs is more engineering and better engineers."

Engineers are not only there to build roads, bridges, airplanes, ports, electronic networks, telecommunications networks or apply advanced quantum technology, but also the decisions they make are capable of altering and transforming the physical and social environment.



Next, **Mr. José Trigueros**, president of Instituto de la Ingeniería de España (IIE) took the floor to present the institution he represents, an institution with more than 100 years of activity, and to welcome the attendees to said institution, venue of the Congress "Engineering the cities of the future".

"In this house we do not talk about civil engineering, telecommunications engineering, mining engineering..., here we talk about ENGINEERING, in capital letters. We managed, through 20 technical committees, technical advances that are presented and distributed to the whole of society", he stated.

For **Mr. Trigueros**, it has been a challenge to organize this congress, with the collaboration of José Vieira, President of World Federation of Engineering Organizations, WFEO, to share knowledge of Spanish engineering with representatives of international organizations and

institutions and other professionals and companies for which that engineering plays a fundamental role.

The congress has been conceived with the aim of dealing with all the hot topics in the world of engineering such as energy, new materials, changes in large cities, the effects of climate change on cities and their surroundings, the change of infrastructures, demographic change, mobility, water, communications and the promotion of the participation of women engineers and the need to increase their number in the world of engineering.

In this regard, **Mr. Trigueros** pointed to the former president of the Engineering Institute of Spain as a woman who marked important milestones in the sector. “The women who reach these positions, and here there are many representatives of this, do not arrive because of the so-called female quota, but because of their effort, knowledge and knowledge. It is what we have to promote in young people”.

In Spanish universities, as in other countries, there is a low rate of female students, around 25%, a percentage that they want to increase because “the knowledge of women in more technical fields is necessary” and “this is a magnificent forum and a great speaker to be able to express it”.

**Mr. Trigueros** alluded to the climate change summit held a few months ago in Egypt, and to the biodiversity summit in Montreal to make one last reflection: “climate change has come, we are going to mitigate it, take measures to adapt and maintain our biodiversity.

He ended by assuring that “if all of us engineers were the ones who ran the world without politicians, the world would be better”.

**Mr. José Vieira, president of the World Federation of Engineering Organizations, WFEO**, spoke for whom, he assured, it was an honor and a privilege to participate in the opening ceremony of the congress in a city like Madrid and congratulated the IIE for this for the program that was to be developed during the three days.



**Mr. Vieira** was happy because he considers that the event represents the effective commitment of WFEO to build solutions to the challenges of global society.

World Engineering Day, for sustainable development proclaimed by UNESCO, “offers the opportunity to engineers, the achievements of engineering in our modern world and to improve public understanding of how engineering and technology are fundamental to life modern”.

Technology is essential for sustainable development. Cities are the ecosystem product of socioeconomic, cultural, and political forces. Since ancient times, all urban systems have their own genetic code where each community chooses specific physical characteristics.

Producing the unique character of the city is important to define the starting point for the future of cities, because it starts from a very different situation towards new realities with common challenges and that will define human development in the coming decades. "When we think about designing the cities of the future, we must understand that their planning will be very different in New York, Madrid, London, Kiev, Beijing, Tokyo, Manila, New Delhi, Kinshasa, Cairo or Rio de Janeiro."

Therefore, for cities with different geographies and different levels of urban development, political, social, economic and environmental frameworks must be taken into account. They can be defined in three challenges: the urbanization process of the world population, the design of information and communication technology and inclusive development.

The urbanization of the world population suggests that, within 25 years, 6.5 out of 10 people will live in a city and the size of settlements will grow into megacities, mainly due to urban development in the southern hemisphere, more specifically in Africa and Asia-Pacific. "This could mean that the transformative force of urbanization is likely to be greater in developing countries than in developed countries," Mr. Vieira said.

For **Mr. Vieira**, in this context of rapid urbanization, the quality of the infrastructure "means wealth" and a deficient infrastructure "means poverty". Access to clean water and sanitation, smart temporary transportation systems, decarbonization, efficient energy and consumption, waste management, and recycling are those key functions required for a well-managed city.

Personal computers, mobile communication devices and the new possibilities offered by ICT improve and modify traditional urban services, optimizing the design of internal transport networks and information and telecommunications services.

On the other hand, climate change and its consequences are crucial and critical issues and challenges facing the international community due to the overlapping crises of water, food and energy, with very significant negative impacts on socio-economic development and the well-being of communities. people.

"When we address those threats and challenges, we realize the overwhelming and pervasive involvement of engineering and engineers. That is why this year's motto on World Engineering Day is about innovation in engineering for a more resilient world" says **Mr. Vieira**.

The relationship between infrastructure, economic growth and the quality of life in cities must be recognized with the role that innovation can play in improving it.

**Mr. Vieira** stated that he is "confident that by combining the forces and knowledge of the global engineering scientific community, it will be possible to find solutions and measures to scale up and improve infrastructure to reduce poverty and meet the challenges of global warming and climate change, both in developing countries and in countries where the vulnerability of infrastructures and societies is more evident".

Also, he predicted that "this conference, in addition to committing to being informative and exciting, will be a success and we will have the impact that advocates for a larger, and increasingly influential WFEO, to help achieve the sustainable development objectives of the United Nations."



## 09:30 MAIN SPEAKER

**Mr. Xing Qu, Deputy General Director of UNESCO**, began his speech by thanking the World Federation of Engineering Organizations (WFEO) for organizing the congress and its longstanding cooperation with UNESCO.



WFEO was created under the Asis of UNESCO and, at their proposal, UNESCO proclaimed March 4 as World Engineering Day.

**Mr. Xing Qu** thanked the WFMO for its very active role in organizing and coordinating celebrations around the world, through its members and associated institutions, and the Spanish Engineering Institute for hosting this year's celebrations in Madrid.

"Imagine, what would life be like today without railways and telecommunications?" This was the question that **Mr. Xing Qu** posed to the listeners, and he cited some innovations that have improved life such as the steam engine, invented 3,000 years ago, or the telephone 150 years ago. Also, he invited attendees to keep in mind those who invented the computer or smartphones, every time they use them.

As **Mr. Xing Qu** pointed out, innovation has played a key role in solving the challenges of the past, and "we will need all our ingenuity to solve the enormous challenges ahead".

In addition, he pointed to climate change as one of the most demanding challenges we face, as rising sea levels and altered weather patterns "are putting people and the natural world at risk."

Between 2019 and 2020, 97% of people affected by natural disasters were victims of weather-related events.

With the expansion of the world's population and the unprecedented pace of urbanization, cities have become hotbeds of devastation with "limited capacity to adapt and overcome."

To mitigate the impact of natural hazards, **Mr. Xing Qu** said that "we must design our cities to be more exposed to these impacts." For this reason, he considered this year's theme for World Engineering Day very appropriate: engineering innovation for more resilient cities.

Innovation is very important to improve resilience and this must be accessible, inclusive and beneficial for all, designing affordable, sustainable and easy-to-use solutions that take into account the needs and perspectives of communities.

During the current industrial revolution, we are seeing the rapid emergence of technologies such as artificial intelligence or the Internet of Things, for example. These emerging technologies offer exciting opportunities to make cities more resilient and inclusive. As innovators, "engineers will have a vital role to play in reinventing the cities of the future," said **Mr. Xing Qu**.

It is paradoxical that, currently, there is a shortage of engineers in the world. The need to train more engineers, with the right skills for the challenges we face today, was one of the points reflected in the UNESCO Engineering report published in 2021, to which the WFEO contributed.

"With the skills we need to reinvent our cities, we show the agreed responsibility to train and retain the talent that will bring new perspectives and creativity to the field of engineering," he said.

UNESCO is committed to investing in youth because it means investing in the future. For this reason, the UNESCO engineering program focuses on the development of education and the improvement of the representation of women in engineering. More specifically to young people in Africa and young women.

In addition, work is underway in the UNESCO Escalation Action Network for young people to equip them with the skills to find innovative ways to build resilience to climate change and is being fostered by education, training and exchanges between young people from all over the world.

On the other hand, this international institution is working with the non-profit society called Women in Engineering to convince girls between the ages of 13 and 17 to consider a career in engineering. The goal of this 10-year campaign is to use workshops to reach 1 million teens in at least 10 regions by 2027.

UNESCO has been doing this for 25 years through the four Women in Science program. To date, more than 3,900 women, from around the world, have been recognized through this program. The goal is to achieve gender parity, not only in technical roles, but also in leadership positions.

According to **Mr. Xing Qu**, UNESCO "practices what it preaches" and ensures that it is "incorporating gender equality into our own international and intergovernmental scientific programs" and added a fact, "about 42% of project leaders of research, within the International Geosciences Program, are women".

Through its expertise in science, technology, engineering and mathematics, UNESCO is helping particularly vulnerable countries to become climate resilient and is providing small island developed states with political support for the development of early warning systems.

Regarding floods and droughts, he ensures that a structure must be designed that can withstand extreme weather events and adapt to climate change. For example, cities must be able to combat the effects of the heat island effect by implementing innovative solutions such as green roofs and green walls. This vegetation will have the added benefit of reducing noise and air pollution.

There are many to make cities more resilient. To do this, we must consider a city as a whole. That means not only making buildings more resilient, but also urban transport, energy, water, and waste management systems.

**Mr. Xing Qu** said that the carbon footprint of cities should be reduced by improving energy efficiency and transitioning to renewable energy sources. This will not only help mitigate the effects of climate change, but will also improve air quality and reduce reliance on fossil fuels. They will also need to adopt waste management systems that are based on circular economy principles and invest in smart technology to improve waste, energy and water management.

Innovative solutions can also address the shortage of affordable housing in cities. This can be done through energy efficient housing and modular construction, for example.

**Mr. Xing Qu** ended his speech by inviting attendees to join him in the challenge of designing, with creativity and innovation, the resilient cities of the future.

## CONCLUSIONS

- The congress will deal with all the hot topics in the world of engineering: energy, new materials, changes in big cities, the effects of climate change, infrastructures, demographic change, mobility, water, communications and the participation of women engineers.
- Engineers are not only there to build or apply technology, but also to make decisions capable of transforming.
- The World Engineering Day, proclaimed by UNESCO at the proposal of the WFEO, offers the opportunity for engineers to show the achievements of engineering in the world and improve public understanding of how engineering and technology are essential for the modern life.
- It is necessary to take into account: political, social, economic and environmental frameworks.
- There are three challenges: the urbanization process, ICTs and inclusive development.
- The key functions of any well-managed city are: Access to drinking water and sanitation, intelligent temporary transport systems, decarbonization, efficient energy and consumption, waste management and recycling.
- The need to train more engineers and provide them with the right skills to face the challenges are points reflected in the UNESCO Engineering report (2021), in which the WFEO contributed.
- UNESCO is committed to investing in youth, because it means investing in the future, and improving the representation of women engineers, the objective of the UNESCO engineering program and the work in the UNESCO Climbing Action Network for young people.
- UNESCO works with the non-profit society called Women in Engineering and with the Four Women in Science Program. The objective, to get more engineers and more parity.

## 10:30 “ENERGY AND RAW MATERIALS, DEPENDENCE OF THE CITIES”



**Mr. Víctor Manuel Fuertes, General Coordinator of MWCC**, moderated the first table "Energy and raw materials, dependence on cities" giving the floor to **Ms. Esther Alonso, General Director of Energy and Sustainability Atlantic Copper** who presented her company.

Atlantic Cooper is a copper smelter and refinery located in Huelva, belonging to the FREEPORT group, one of the largest copper miners in the world, with activity in South America (Peru and Chile), North America and Indonesia. "In fact, one of the mines in Indonesia is considered one of the largest copper and gold deposits in the world," he clarified.

In 2021, buildings and the construction sector have been responsible for 34% of the world's final energy consumption and 37% of CO2 emissions, figures significant enough for the COP26 in Glasgow to establish some objectives:

- By 2030, new buildings must be carbon neutral in operation.
- In the year 2050, all buildings must be neutral and resistant, but in life cycle, in direct emissions and in construction materials.

And how is this achieved? Through 3 pillars, Mrs. Alonso detailed:

- Energy efficiency
- Green electricity supply
- And reduction of the carbon footprint in construction materials (cement, steel, aluminum, copper, etc.

As of today, there are already some energy codes for buildings, but there will be two new inputs:

- Decarbonization has to be at the origin, in the planning design.
- This design must consider adaptation to climate change.

"We are facing climatic havoc, situations of extreme temperatures, floods, fires...", added **Ms. Alonso**.



The buildings in their design must be able to be prepared for these new climatic situations.

In Europe "we are designing directives" under two concepts: neutrality in life cycle analysis as a whole and circular economy. Recirculate possible non-hazardous waste, within the construction sector.

There are already countries, such as Denmark, where very demanding limits are being established for CO2 emissions.



**Ms. Esther Alonso** gave East Germany as an example of what is being done in Europe. For 3 years, the Fraunhofer Institute, together with an alliance of 16 companies and universities, has been working on a project whose objective is to achieve a climate-neutral neighborhood with a high degree of energy self-sufficiency and with very affordable energy costs for citizens. It is now in pilot tests. First there is a diagnosis, through thermography, drone technology, etc., and lastly the design involves a supply of green electricity, mainly solar, ceramic batteries, an underground hot water tank, with the help of geothermal energy and digital models and of energy management.

In the end, it is a paradigm shift. It goes from a totally centralized supply system to a system where energy autonomy is very high.

In this context, Atlantic Cooper is a facilitator of the transition because copper is present in all the technologies associated with the transition, with the exception of batteries. In addition, the great penetration of renewables will imply, in the case of Europe, the construction of more than 6 million kilometers of distribution lines, pointed out Ms. Alonso. This can give an idea of the increase in demand that this transition will entail in the copper sector.

In reality, the energy transition is going to mean a drastic increase in the demand for metals and the increase in population, expected by 2050, will be along the same lines.

All this may lead to experiencing a metal deficit by 2050. This is a weakness, but in the case of Europe "we face additional vulnerability," she said.

In Europe, "we are pursuing strategic sovereignty", but for these two conditions must be met: availability of resources, that is, raw materials, and availability of technology.

China does not have the resources and has the transformation. China does not have cobalt, it does not have copper, but in the technologies associated with energy transformation it plays a fundamental role.

Europe has very little mining presence in the world and she considered that "it should be strengthened." In the case of Europe, and trying to work on this strategic autonomy, another of the pillars is recycling. Here, the case of copper is paradigmatic. Copper can be recycled as many times as necessary, since its properties are not degraded. This, in the end, leads us to the concept of "urban mining".

According to the Fraunhofer Institute, the amount of copper embedded in society (buildings, infrastructure, power lines...) is estimated at 450 million tons, half of the world's copper reserves. This "gives an idea that promoting recycling is key for the copper sector," he said. Atlantic Copper has a "Circular" project, which will come into operation in 2025, whose

objective is the diversification of the company's raw materials. They are going to use the metallic fraction of the electronic scrap, all mobile phones, computers, disused television screens, that is, the metallic fraction contained therein, to obtain a "black copper". It is a copper with a purity of 96% that is then incorporated into the conventional process, obtaining, in the end, a copper of identical quality.

With this "Circular" project, it is possible to recover not only copper, but also tin, nickel, gold, silver, and precious metals to a lesser extent such as platinum, necessary in electrolyze technology, and palladium, the metal Europe is made of. totally dependent.

According to **Ms. Alonso**, "we are fully aligned with the strategy of the European Union."

**Ms. Alonso** closed her speech with a reflection related to the Paris agreement and the EU's commitment to climate neutrality which, by 2050, will mean a change in the geopolitical socio-economic model, but which, in the specific case of Europe, "It is necessary to strengthen our strategic sovereignty and, for this, it will be necessary to review our supply policies for necessary and strategic critical materials, if we want to reach a successful port."



For his part, **Mr. Jean Eudes Moncombe, President of the Energy Committee, WFE**, began with a question that, up to now, had not been raised, and that was in line with the title of the congress: what is a sustainable city?

For **Mr. Moncombe**, a sustainable city is a resilient and clean city, both in terms of climate and in terms of local pollution, since citizens must be taken care of and their access to energy allowed.

Regarding the city, at the urban level, he assures that there are three different and important issues to deal with: subsidiarity, geography and governance.

He cited Paris as an example, since it only has 10% of the electricity supply it needs and, therefore, its energy independence is not possible, it needs to have cooperation and integrate into the Grid in order to guarantee energy supply.

In this case, as engineers, we know the solution, "the security of supply for Paris and Europe is important, despite the problem of governance in terms of civility." For this reason, he affirmed that it is not necessary to ask only if a city is energy dependent, but rather how to make the city sustainable.

As mentioned above, **Mr. Moncombe** raised two points:

- **The supply.** Security of supply and accessibility of energy.
- **Cleaning.** The energy supply can be clean, for example, a carbon-free energy supply. But on the demand side, a city can choose to be sustainable, for example, with regard to passenger transport, since they can choose whether to put bicycles, electric cars, more or less cars, and this has consequences in terms of energy.

**Mr. Moncombe** assured that, if you hold a position of responsibility in decision-making, you have to decide based on the objective regarding energy demand, water, telecommunications, sanitation..., because they are issues that are not directly related to energy, but have consequences on it.

In addition, he raised the need to distinguish between two different issues: the energy

condition and the digital transition, because having a large number of common essential elements, they compete with each other.

Because of this, he stated that “we won't be able to run both transitions at the same time. We have to synchronize a global way of organizing not only the energy transition, but any transition that we want to execute”.

Therefore, he raised the option of choosing a systemic approach. Do not focus only on the carbon footprint because there are more emissions.

“We must not dream, let's not enter into ideologies, into fashions”, he assured. It is necessary to be based on facts, figures and rigorous analysis, something in which the engineer has an important role to help the elected political leader and, to them, “I would tell them to think in the long term, not only in the short term.”

He concluded by pointing out the importance of the role played by the citizen because engineers “offer solutions” but it is the citizen who must change their habits in relation to transportation, for example.

**Mr. Eric Ohaga, President of Engineers of Kenya, IEK**, also began his speech by referring to three aspects of energy and focusing specifically on the case of Africa:

- Analysis of the institution in terms of supply and demand.
- How these cities can be better supplied.
- Perspective of how is the energy situation in Africa.



50% of the population currently lives in cities and they contribute approximately 70% of the greenhouse gases that currently exist. By the year 2050, this population will continue to move to cities and will continue to pollute the environment. Therefore, we are talking about the increase in greenhouse gas levels by the year 2050.

Currently, in the year 2023, it is required to be able to supply cities reliably, around 10,000 million tons of oil equivalent. When you move and project this to the year 2030, that value will increase to about 12 billion tons of oil equivalent. This shows that cities “are very critical” in terms of energy supply.

Fossil fuels still contribute enormously in terms of supplying these cities. Nuclear energy also contributes in terms of supply with 7%. And of course, “we look at renewable

energy sources that supply more than that 7%.”

If you contrast this with rural areas, you see that fossil fuel will contribute around 69% and then renewable energy increases in percentage terms to over 26%, while nuclear energy remains at 7%. This is the scenario in terms of supply. And this too “is critical in terms of climate change because fossil fuel still contributes so much,” he said.

In terms of GDP, energy consumption is normally directly proportional to the level of development of any country. Therefore, as countries grow, it can be equated to the level of energy consumption. That is, if you have a high GDP, energy consumption will also have to increase. When GDP goes down, consumption goes down. It goes in proportion. Overall per capita consumption is rising.



The lack of supply generates stress and suffering in the population, as could be seen in the 2012 blackout that caused homes in the US to lose power, in the hurricane that hit the country, affecting 8 million homes, the Japan earthquake that hit power plants causing power shortages affecting the operations of several cities for several weeks and for which the government had to restart some nuclear power plants.

“This illustrates that we need to have a very reliable, stable and valuable source of energy for us to move forward and develop as well,” **Mr. Ohaga** said.

He raised regional integration as an immediate need. Guarantee energy security through interconnected networks, with energy groups that allow communication and combination to supply different parts of the country.

Other solutions that they are promoting is the use of renewable energy, "although the nature of intermittency means that, for every megawatt that you produce in renewable energy, you must have a conservative energy source" and the efficient use of storage systems to power supply power when required.

On the other hand, he pointed out that they cannot eliminate the use of tap fuel because it still contributes more than 50% of the energy required. For this reason, currently, access to energy is prioritized to later promote the use of renewable energy.

In Africa, currently, there are about 600 million people without electricity. They have dirty kitchen systems. They are using firewood for cooking and, therefore, there is still a population that does not have access to a clean energy source, which represents a great opportunity to improve in terms of supply.

He emphasized the need to improve the population's access to energy and, subsequently, make a smooth transition. "Other countries are making efforts to guarantee access to energy and thus boost cities, urban and rural populations." In this sense, he pointed to Ghana as an example of policies that are being carried out aimed at universal access.

Kenya, "where I come from", is also making very concerted efforts in terms of supply where every Kenyan within a radius is connected to a transformer at subsidized rates in order to improve their access. The access rate currently stands at around 75% and is being promoted to reach 100% by 2030.

Currently, 91% of the energy mix that is being shipped every day is clean energy because it contains geothermal, wind, and solar energy and that makes it very possible that they could transition to net zero as they go along.

Rwanda is also another country that is making very good progress in access to energy, it is at 60%, currently. By 2030, they will move toward 80% and many other sub-Saharan, African countries, **Mr. Ohaga** noted.

He stressed the need for other African countries to access energy first, as they move towards the transition to net zero. "We must ensure that these African countries first access the energy



that is critical for them to move and develop as nations." To finish, he quantified the required investment at around 25 billion dollars per year.

"We can make those particular generation plans to be able to develop the transmission lines and, eventually, the distribution systems that will be able to distribute that energy to the last mile of homes. And, of course, talk about smart systems, smart metering, smart distribution, so that we eliminate losses in the lines and make the system efficient", he detailed.

To ensure supply within cities in a 24-hour economy, redundant and reliable supply distribution and transmission systems must be in place.

Regarding the cost of energy, **Mr. Ohaga**, pointed to the need for it to be affordable for the consumer, but without neglecting the fact that generators can recover their investment.

Therefore, the demand must be managed so that energy is not misused when it is not needed. For this, the equipment used in industry and in homes must be energy efficient, he concluded.

Regarding the efficient use of energy, within the city of Madrid, **Mr. Alfonso Sánchez, CEO of EMT Madrid**, spoke about what is being done, more specifically, in relation to public transport.



The Municipal Transport Company (EMT), is a 100% public company, all the shareholders belong to the Madrid City Council and provide mobility services in the city. It owns the exclusivity of surface public transport, that is, buses and public bicycles, but they also manage car parks, park-and-rides, the municipal tow truck and the cable car service.

The fundamental challenge of the EMT, in Madrid, is to comply with the standards given by the European authorities since the contamination criteria were not met. "That, this year Madrid has finally achieved it" assured **Mr. Sánchez**.

Madrid has managed to comply with European standards by applying a 360 environmental sustainability strategy, which has acted on all sources of pollution that the city produced, because an important part was produced by surface transport,

more specifically, public transport.

The EMT is transforming our entire fleet towards zero emissions and diesel buses have been eliminated. "Madrid has become one of the first European cities to have the entire fleet clean," he stated.

The EMT fleet is mainly powered by compressed natural gas and is undergoing a transformation towards electricity. Diesel was phased out in 2022, after 75 years of using it. The goal is that, by 2033, all the buses that circulate in the city of Madrid are zero emissions.

EMT's current fleet is 108 electric buses, out of a fleet of 2,100. This year it will increase to 330 to achieve that, in 2027, a third of the fleet is electric to meet the ultimate goal: to have the entire electric fleet in 2033.

To achieve this, the EMT has not only bought electric buses, but must transform its infrastructure to make it sustainable. New operations centers are going to be built, new bus depots that will be covered and buildings that tend to be neutral, and all the energy that the

EMT buys is also from renewable sources.

This is leading to the construction and adaptation of the 5 centers that they have in the city, each one with about 400 buses, centers that are being transformed to take that step from gas to zero emissions.

After some analyzes carried out on emissions, the EMT has verified that electric buses are the ones that behave best and, although gas also behaves well, it continues to emit greenhouse gases, hence its transformation.

To carry out this transformation process, at the EMT, a 2021-2025 strategic plan was undertaken, which involves an investment of approximately 1,000 million euros, half of which was used to supply electric buses and the rest is allocated to digitization and infrastructure transformation.

In this way, electric power and electric traction, in buses, have the best costs, so that an electric bus is more efficient and much cheaper than combustion.

In addition, the EMT has a 10-year bus amortization policy. Gas or diesel buses used to have a maximum age of 10 years. Now, with the electrical system, guarantees are being obtained, by suppliers, of up to 15 years.

This allows, according to **Mr. Sánchez**, to reconsider the strategy and increase the duration of these buses, amortizing them in 15 years with a reform in the middle of the life cycle. “The simplicity of the electric motor, compared to the combustion engine, makes maintenance costs more competitive,” he said.



The costs are also competitive from the point of view of traction, despite the increase in the price of energy. Traction costs are kept below gas or diesel and also maintenance costs. Therefore, "it is a tremendously efficient cost that is what has made us opt for the electric battery bus as the main source of energy within our company."

Mr. Sánchez also reported on two new operations centers, one of them in the construction phase and the other in the very advanced urban planning phase. There are two operations centers that are covered and that use inverted pantograph technology for cargo.

The installation is on the roof of the operations center. They are centers completely covered by photovoltaic panels to generate energy for these buildings that work 24 hours a day, 365 days a year and maintain the charge provided by the photovoltaic panels. Technology still does not allow the generation of enough energy in the space of these facilities to cover the total charge energy of the buses themselves.

As **Mr. Sánchez** explained, the inverted pantograph is being used and, now, in another third operations center "we have already installed these inverted pantographs in some structures that we have just recently inaugurated with an avant-garde project in Spain and Europe".

"We decided that the pantograph should be outside the bus to avoid weight and to avoid vibrations and deterioration of the pantograph and we have arrived at that solution with Smart charging, an intelligent charging system that allows us to charge in optimal conditions depending on the work cycle that go to do the bus and even the price of energy at different

times of the day”, he added.

The EMT is studying hydrogen in depth in another of its centers, although they consider that, for a city like Madrid, it is not the most profitable because hydrogen travels longer distances. A bus from the city of Madrid does a little more than 230 km a day and the essential thing is that it can operate 16-18-20 hours, which is what a bus operates daily. Therefore, "for us, the operating time is more important than the autonomy that the vehicle itself may have," he clarified.

Based on these criteria, they see hydrogen as more suitable for medium and long distances, although they consider that it must be explored because hydrogen allows less energy dependence than with gas. In addition, the fluctuations in gas prices make it impossible to have a forecast of the costs and, being clear about the costs since the beginning of the year is relevant for a company like the EMT.

The EMT is also building a hydrogen plant. They have purchased 10 hydrogen buses that make up a scalable pilot project to 20, a smaller number in proportion to the total 2,000 buses in the fleet.

The objective is to produce the hydrogen to obtain sufficient photovoltaic energy, in this operations center, to generate this green hydrogen, compress it, use it in buses and see the complete cycle of hydrogen in public transport that, "for the future, can have more foundation in a company like ours that, today, what it bets on is the battery-electric bus" he indicated.

**Mr. Sánchez** also spoke about the Carabanchel Depot, a new electric charging station in which the bus automatically connects to the charging infrastructure and in an appropriate position and optimal security situations. The pantograph charges automatically and the whole system, Smart charging, decides when to charge the bus to make it as efficient as possible.

This facility is also equipped with photovoltaic panels for power generation. It produces energy for 10% of the total number of buses on the pier (52) or, failing that, to export it to the operations center so that they can use it for regular maintenance.

The EMT has yet another project, the use of the biomethane generated in the Valdemingomez plant of the Madrid City Council, a project that generates emission-neutral energy with the garbage created by the city of Madrid. In principle, it is supplying power to a line of 20 buses that moves approximately 4 million people a year and travels 1 million kilometers.

Of the total biogas generated by this plant, only a small part is consumed to feed the bus fleet. If all the biogas generated were consumed, in 2030, "we would have a third of the fleet powered by biogas and two thirds of the electric fleet, so that we would be neutral in emissions in 100% of our fleet", assured the **Mr. Sanchez**.

The Dehesa biomethane plant, located in the city of Madrid, and the recently inaugurated biomethane treatment plant enable the reduction of more than 43,500 tons of CO<sub>2</sub> per year in the Community of Madrid.

**Mr. Sánchez** announced that the EMT will continue to install photovoltaic panels throughout the company, such as in the large areas they own and, in their park-and-ride parking lots in order to generate renewable energy to use throughout their network.

Regarding the hydrogen station, although at the moment it is for exclusive use, he expressed the intention of the EMT to share it with other agents of the Community of Madrid who may need it at any given time.

To conclude, he mentioned the injection that they have achieved from the next generation

funds in Europe, transformation, recovery and resilience funds that the European Union has endowed to relaunch the economy and that have allowed the EMT, thanks to having a well-defined strategy and a future project, accelerate the transformation process.

**Ms. Pilar González, Iberdrola's Innovation Manager**, also wanted to share Iberdrola's vision of the energy transition and assured that the company has been concentrating its efforts on decarbonizing the supply.

Iberdrola has been developing renewable technologies so that they are now the cheapest sources of electricity almost everywhere. Now, she assured that they should focus on those technologies that will be able to decarbonize. And the only way to do it is "through electrification of course, clean and green energy."

And how is this done? Through technologies. Renewable technologies are there and at competitive costs and "they will continue to reduce their prices". Between now and 2030, "we are going to see reductions of between 30 and 40% and the amount of solar and wind energy that we are going to see will increase exponentially."

This happens because renewable energies were started for an environmental objective, then the question was the cost, so the technologies were improved to reduce it and, now, it is about ensuring the supply. So, "for the first time we have these three objectives aligned together: environmental, cost and competitiveness, and security of supply," said **Ms. González**.

The forecast is that, by 2030, 50% of the world's electricity will come from renewable energies.

In this decade we must reduce the cost of these new technologies and "deploy them as quickly as we can." Technologies such as electric vehicles and heat pumps.

30% of final energy demand goes to the transport sector and most of it is fossil fuels. That means that almost 30% of emissions come from the transport sector.

For this, there are solutions such as lithium-ion batteries that make these vehicles electric vehicles that are "super-efficient" since electricity is already transformed energy. **Ms. González** explained that "every time she uses an electric vehicle, for each unit of energy, she gets three or four times more energy than with the same unit of fossil fuels."

There are innovations in every part of the electric vehicle supply chain. The most important, of course, are the batteries. Raw materials will increase demand to produce those batteries, but "it doesn't matter because we're finding ways in that chemistry to reduce the amount of those metals." In fact, LFP batteries do not have cobalt, most of it is iron and lithium. And, for example, "there is a Chinese company that has the first prototype with a sodium ion battery, it is quite amazing."

Sodium, for example, is another material that can be used. Its energy density is not as good as lithium, but it is a very abundant material all over the world and its cost is cheaper.

Battery innovations will lead to cost reduction that will make electric vehicles even more competitive, because the current problem is that the initial cost is higher than combustion.

Governments and local community authorities are offering incentives to take advantage of electric vehicles that use renewable energy sources.

Regarding the electrification of heat, he pointed out that heat is a very important part of the energy demand since 50% of the energy demand in Europe is used to provide heat. For this there is technology called heat pumps that, for every unit of energy you use, you get three or five units of energy in the form of heat.



You can pump heat from the outside to the inside thanks to the thermodynamic process. **Ms. González** affirmed that she has the equipment that only “we have to reduce the cost of”.

The initial cost of the heat pump is still very high. If you take into account the fuel that it will consume, and the asset, which is the total cost of ownership of the equipment, it is much cheaper than fossil fuel. But, she stressed, “the initial costs are higher.”

To mitigate this, already existing incentives are needed in Madrid where you get €3,000 if you get rid of your gas boiler. Also, the European Union is putting a lot of money into it.

In Sweden, almost 80% of the heat in buildings comes from electricity or district heating, and part of that district heating comes from heat pumps. If you talk about the transportation sector in this country, more than 90% of light vehicles sold are fully electric or hybrid electric. That means that, in a few years, your entire fleet will be electric. She noted that “still, there are some people who argue that batteries don’t work well in cold climates.”

Oslo has the goal of having the first fully electric public transport in 2023. Similar goals are also pursued in Madrid, perhaps not this year, but in the years to come.

“I am sure that the 2030 goal that Mr. Alfonso Sánchez was mentioning will be presented because, really, I believe that the cost and the electric passes will make a change. And I am sure that it will be even before 2030”, she predicted.

How do we use energy in Spain? Electricity is only 23%. At Iberdrola, “we are making a great effort as a public service company, in particular, to decarbonize that part.”

**Ms. González** pointed out that “it doesn’t matter if there are those who sell electric vehicles or if there are electric companies, like my company that sells 100% clean electricity, we really need to change the way we use it”.



If half of the energy demand is replaced by electric vehicles and boilers by heat pumps, efficiency will increase. “We will have to achieve that, instead of having 23% electricity, we have 75% clean electricity in the coming years”, Spain’s goal for 2030.

Iberdrola is the leading energy utility in Europe, the third largest utility in the world, and the leading investor in renewable

energy and pioneer in wind power. And “we have been anticipating the energy transition for the last 20 years.”

Iberdrola has invested in networks. For the company, the networks are the backbone of the energy system. They believe that supply and demand must be connected intelligently. In addition, it is investing in energy storage, especially hydroelectric power.

The company, too, is worrying, not only about making large investments in renewables, but that its customers make those necessary changes and provide them with electricity so that they

abandon fuel and gas.

Green hydrogen will be part of the long-term solution, and as a more expensive way to use energy, they will be used where there is no other alternative because, “every time you convert electrons to molecules and then back to electrons, you are losing a lot of energy” he clarified.

Iberdrola is present in almost all parts of the world, mainly in Europe, Mexico and Australia, and has an important business that “is taking us to other Asian countries where we were not before.” We are the first win energy developer in almost all geographies. It is a global energy company, has 65,000 million euros in market capitalization and has 40,000 employees.

**Ms. González** ended her intervention by emphasizing that, for decarbonization, “we already have the tools, we have cheap renewable energy, we also have technologies on the demand side to make these things happen.”

**Mr. Víctor Manuel Fuertes, General Coordinator of MWCC** and moderator, wanted to close the table highlighting several headlines:

- Circular and sustainable economy.
- Accessibility and territorial rebalancing.
- Transition to zero emission.
- Guarantee of supply as an efficient model.

## CONCLUSIONS

- Atlantic Cooper is a copper smelter and refinery located in Huelva, belonging to the FREEPORT group, one of the largest copper miners in the world. The company pursues, in Europe, strategic sovereignty for which resources and technology must be available.
- Buildings and the construction sector have been responsible for 34% of the world's final energy consumption and 37% of CO2 emissions. Objectives: by 2030, newly built buildings must be neutral both in terms of carbon and in operation, and in 2050, in addition to being neutral, they must be resistant throughout their life cycle.
- Applicable objective: Energy efficiency, supply of green electricity and reduction of the carbon footprint of construction materials.
- Decarbonization has to be at the origin, in the planning design and, this design, has to consider adaptation to climate change.
- The energy transition will mean an increase in the demand for metals and the expected increase in population. Between now and 2050 it will continue to increase, so there will be a shortage of materials.
- According to the Fraunhofer Institute, the amount of copper embedded in society is estimated at 450 million tons, half of the world's copper reserves. Encouraging recycling is a solution. Copper can be recycled as many times as necessary, since its properties are not degraded. Atlantic Cooper's "Circular" project aims to recycle and recover metals.
- The security of supply, the accessibility of energy, and that this energy is clean, will allow sustainable cities to be achieved. Resilient and clean cities. And, it is not necessary to ask only if a city is energy dependent, but how to make the city sustainable.
- The energy condition and the digital transition have a large number of common essential elements, they compete with each other and they will not be able to execute the transition at the same time.
- Engineers offer solutions and citizens must change their habits. The demand must be managed so that energy is not misused when it is not needed. Not only the way in which electricity is generated must be changed, but also the way in which it is consumed.
- The population is moving to the cities, so the levels of pollution and greenhouse gases will increase by the year 2050.
- It is necessary to have a very reliable, stable and valuable source of energy so that we can advance and develop. Energy security must be guaranteed through interconnected networks. Also, there must be efficient use of storage systems, in order to supply energy when required.
- It is necessary that the vulnerable population access energy first and, as progress is made, transition to net zero. It will be necessary to have more affordable subsidiary access systems.
- With geothermal, wind and solar power, it is very possible to transition to net zero as you go along.

- Madrid has managed to comply with European standards by applying a 360 environmental sustainability strategy. The EMT is transforming the entire fleet towards zero emissions, and they have eliminated diesel buses to achieve clean surface transport. In addition, they are transforming their centers. The objective of the EMT is to have the entire electric fleet in 2033 (total fleet of 2,100). Transformation process that has 1,000 million euros. They have obtained financing from next generation funds for all of this.
- Despite the fact that the cost of electric is higher, the durability is extended and the amortization is more profitable.
- Smart charging is an intelligent charging system that allows charging in optimal conditions depending on the work cycle of the bus and even the price of energy at different times of the day.
- The EMT is building a hydrogen plant for green hydrogen. In addition, they work with biomethane generated in Valdemingomez. They have a biomethane plant in La Dehesa for the treatment of biomethane and they are installing photovoltaic panels in their centers.
- Iberdrola is the leading energy utility company in Europe, the third largest utility company in the world, and the leading investor in renewable energy and pioneer in wind power. They are developing renewable technologies and are focused on decarbonization. The amount of solar and wind energy that we are going to see will increase exponentially and work is being done to improve the technology to reduce costs.
- The forecast is that by 2030, 50% of the world's electricity comes from renewable energies.
- Lithium-ion batteries make these vehicles electric vehicles that are “super-efficient”. Sodium is another material that can be used, although its energy density is not as good.
- To replace combustion heating, heat pump technology is a solution, although it is still very costly. For 1 unit of energy you use, you get 3 or 5 units of energy in the form of heat.
- Green hydrogen will be part of the long-term solution and, as it is a more expensive way to use energy, it will be used in cases where there is no other alternative.



## 12:00 MAJOR URBAN CHALLENGES: DISASTER PREVENTION

**Mr. José Trigueros, President of IIE**, moderated the discussion on major urban challenges: disaster prevention and introduced it, stating that "with the concentration in new cities, disasters, floods or earthquakes are magnified" and that the Cities must prepare for the changes.



**Mr. Pedro Tomey, Managing Director of Fundación AON España**, discussed various topics: the importance of research and the quantification of costs to reach prevention, the identification of the challenges that we face and what is being done from the AON foundation in Spain.



“Natural catastrophes are becoming more frequent and severe and cause great material and personal damage,” he said.

**Mr. Tomey** offered some data from the latest AON report, which concludes that 2022 is one of the most catastrophic and 5th most expensive in history, for insurers. The natural disasters that occurred this year, in 2022, cost 313,000 million dollars, which meant 4% more than the 21st century average. Of those 313,000 million dollars that the catastrophes cost, 132,000 million were insured, which gives a protection gap of 58%. Likewise, 331,000 people died last year, with a special incidence in those caused by heat waves in Europe.

The AON Foundation is concerned about the proliferation of catastrophes and the worsening of their consequences, especially for the most vulnerable people. For this reason, they are in charge of investigating, through their catastrophes chair, and quantifying the cost of disasters, through their catastrophe’s observatory. Their objective: to prevent future events and mitigate their impact.

In their research and quantification of disasters, they have identified two major challenges for disaster prevention:

- The urgency of reducing the insurance gap which, as mentioned above, in 2022 was 58%.
- Advance knowledge of the impact of disasters on critical urban infrastructures to guarantee essential services in the short and long term. And it is in this challenge, in which engineering has a leading role.

Regarding the reduction of the gap, it should be noted that the EIOPA (European insurance authority) shows that only a quarter of the total losses caused by extreme weather events in Europe are insured.

In this sense, the new European Union strategy on adaptation to climate change highlights the growing concern about the affordability and insurability of insurance coverage against natural catastrophes. And it is that, "in light of the increase in the frequency and intensity of some events, the annual review of prices can make the insurance unaffordable, discouraging society from hiring them," he said.

For this reason, EIOPA has developed a pilot dashboard that shows the insurance protection gap for natural catastrophes in Europe in order to identify measures on the vulnerability of buildings, the location of exposure and insurance coverage that improve the society resilience.

A report is prepared, unique in our country and in Europe, in which the cost of the 10 most relevant disasters in Spain that occurred in the previous year is quantified. Its causes, nature, human cost, material damage, costs for the insurance sector are identified, and it includes the impact of resilience, critical infrastructures, and social vulnerability.

To prepare this barometer, Fundación AON has its own committee of scientists and institutions such as the Insurance Compensation Consortium, Agroseguro, the Spanish Engineering Institute (IIE), the academic headquarters of our Chair at the Comillas Pontifical University, and the Tecnum School of Engineering of the University of Navarra, AON Reinsurance Solutions, and international financial analysts. Likewise, the UNESPA insurance Employer, Civil Protection, the UME, the Red Cross and the ONCE Foundation contribute their data and expertise. "As you can see, all of us who have to say something on the subject of catastrophes are represented on that scientific committee," added **Mr. Tomey**.

Some data from the latest barometer carried out, which corresponds to 2021, quantifies catastrophes in Spain at 3,600 million euros, of which 2,320 million euros were insured. Here, he stressed that, in Spain, "we are exemplary and we have institutions such as the Insurance Compensation Consortium and Agroseguro that are really excellent and that provide us with higher protection than the ratios they have in Europe and the ratios in the world".

In that same year, 2021, the barometer shows a series of indices and metrics that, to summarize a few, Spanish companies stopped directly entering about 1,500 million euros and around 23,000 jobs were lost in Spain as a result of the catastrophes of that year. The impact on GDP rose to 1,126 million euros.

Critical infrastructures supported a direct cost of around 522 million euros. In this estimate, the costs of those uninsured items have not been taken into account, the opportunity costs for households and companies, such as lost working hours, lost hours of schooling, impossibility of access to the provision of services, time waiting, etc. Neither are the possible costs of the repair and reconstruction works assumed by the budgets of the competent public institutions.

**Mr. Tomey** referred to one of the most relevant natural catastrophes in 2021, the Filomena storm, which left snow covered much of the peninsula and caused extensive material damage, the closure of the Madrid-Barajas airport and more than 400 roads affected throughout the country, reasons why the Council of Ministers approved the territory of 8 autonomous communities as a catastrophic zone.



The direct economic cost of Filomena, the barometer estimates, is more than 1,200 million euros, of which more than 500 million correspond to insured costs, an estimate that shows that the insurance protection gap for this event was 54.58%.

**Mr. Tomey** clarified that “snowstorms are not covered by the Insurance Compensation Consortium. The compensations that enter the Insurance Compensation Consortium are stipulated in the BOE, they are floods, earthquakes, terrorism, but specifically the storm due to snowfall is not contemplated. This is one of the reflections that “we have made through our barometer; see how we incorporate this type of catastrophic event into the structure of the Consortium and it is on the right track.”

By sectors, the most affected by this storm were the commercial, industrial and public sectors with 48% of the damage, followed by the domestic economies that suffered 30% and the agricultural sector with 22%.

Filomena was one of the most damaging winter storms in the last 100 years that affected a greater number of critical infrastructures with an estimated economic impact of close to 90 million euros. In terms of human cost, the storm Filomena, together with landslides such as avalanches, were also the first cause of death in 2021.

In short, the consequence of this and other catastrophic events in recent years have triggered the awareness of society, companies and governments of the importance of being insured, incorporating climate risks in the decision-making of the different agents, intensify prevention, mitigation and recovery efforts and, lastly, strengthen public-private collaboration in security matters.

**Mr. Tomey** highlighted the first Civil Protection “Horizon 2035” disaster risk reduction Plan, which was unanimously approved by all the political groups of the parliamentary arc at the end of 2022 and which incorporates relevant actors from the sector in matters of security. “This plan is an example of public-private collaboration and constitutes a challenge in the coordination of all parties involved in catastrophes”, he stated.

Likewise, the plan promotes the culture of self-protection by making people aware of the ability to protect our lives, our assets, and offering tools to do so. In short, “a necessary plan for Spain to continue being one of the safest countries in the world.”

Regarding the second challenge, disaster prevention, it consists of advancing in the knowledge of the impact of disasters on critical infrastructures in order to guarantee essential services in the short and long term. “From our catastrophe chair, established in 2016, through research, we contribute, among other things, to making cities more inclusive, safe, sustainable and resilient, recommending the adoption of urgent measures to combat disasters and their effect on our environment” stressed.

Through these investigations, some conclusions have been reached in which, for example, cities will be more resilient when they have the appropriate mechanisms to be able to manage, in the event of catastrophes, critical infrastructures and their interdependencies, since only in this way can they will be able to guarantee essential services to the population in the short and long term in crisis situations.

According to **Mr. Tomey**, they have identified the following key factors for critical infrastructure resilience:

- Horizontal and vertical integration between institutional levels to guarantee their coherence.
- The flexibility and adaptability of the governance system.
- The ability to innovate the technological framework of critical infrastructures in cities to face the challenges of climate change and transform towards more sustainable future models.

In the barometer, they also include metrics for the resilience of critical infrastructures in the face of catastrophes, in which the interrelationships between them are analyzed and the cascading effects that they cause when one of them fails.

**Mr. Pedro Tomey** also states that they have created a 3-dimensional methodology to estimate the economic impact where they take into account: the cost of the infrastructure, the cost of personnel for the repair and the cost of the loss of consumption as a consequence of How has the infrastructure been affected?

To conclude, **Mr. Tomey** assured that the AON Spain Foundation addresses these great challenges for disaster prevention. They investigate and quantify to prevent, and have involved the main actors such as the public administration, the insurance sector, first responders, and experts in the field with the aim of offering society instruments that help us face emergency situations of the efficient and safe way possible and become increasingly resilient. "Investing in prevention is the most profitable for society," he said.

**Mr. José Macharé, President of the WFEO Disaster Risk Management Committee**, continued, recalling Sylvia Hostler, environmental scientist and international specialist in development and a very active member of the WFEO disaster risk management committee, who always contributed to sustainable development and who has recently passed away.



A disaster and catastrophe with great material and human damage, such as the earthquake in Turkey, causes economic losses of great impact and lasting over time. How to prevent the consequences of such a disaster?

According to **Mr. Macharé**, there are several factors and processes that must be done to prepare for disasters of these dimensions. Events are harmful if society is vulnerable to exposure from these events. "We cannot fight against disasters, but we can detect risk, prevent it and thus reduce risk and damage"

The analysis shows us that there are several factors and processes that predict the origin of a disaster. A dangerous event, whether of natural origin (earthquakes, tsunamis or massive movements, extreme weather, EPI events, such as COVID...) or caused by man (fires, explosions, spills or toxic substances...). All this is harmful if it acts on a vulnerable society, whether it is vulnerable due to exposure to the event or due to the fragility of the infrastructure.

The risk, clarifies **Mr. Macharé**, "is the probability of loss of life, economic loss, destruction of



assets in a certain place and in a certain period of time and we cannot stop the disaster if we do not address the risks." This is risk management.

Mr. Macharé distinguished several phases:

- Prospective phase (before the harmful event). In which risk prevention, risk assessment and risk reduction must go hand in hand.
- Reactive phase. Phase in which action is taken in the middle of the danger event. It includes preparation, actions, mainly in logistics, to be prepared to face the consequences and early warning systems as well.
- Response phase. Once the event has occurred, it is necessary to act with rescues, first aid, immediate attention, shelters...
- Rehabilitation phase. Rehabilitate or reactivate vital lines, mainly food, drinking water, sanitation, energy restoration, transportation, and basic communications.
- Corrective phase. Long duration phase dedicated to reconstruction, analysis and possible improvements.

From this last phase, the prospective cycle would start again to better prepare for the next event. This prospective phase is the least expensive and the one that helps prevention; therefore, it is in the phase in which "it is better to invest".

**Mr. Macharé** also provided comparative data between urban and rural environments. 56% of the world population is residing in cities and is increasing. It is expected that by 2050 there will be more than double the urban inhabitants, 4.4 billion, (80%). Cities produce the majority of global energy consumption (66%) and 70% of greenhouse gases are emitted.

Cities are growing and expanding at the expense of rural areas, although, "we must remember that some cannot live without others."

If we wanted to build a city in the future "we would have to imagine what we really want, a greener or smarter city, or both", and that will depend on the cost. The foundation costs are not the same if it grows vertically than if it grows on the surface (horizontal).

The goal is to achieve resilient and sustainable cities at the same time. For this reason, **Mr. Macharé** stated that, "when growing vertically, fragility would be the problem, but resilient design and structure can be made, while, if we do it horizontally, there are other sources of vulnerability, such as exposure, according to the ground, subsidence, flooding, landslides, etc."

**Mr. Macharé** presented an example to the auditorium, that of Pache, a very small city in the center of Italy where a discovery led to the installation of a large factory. Through this factory, the city had to grow and decide whether to grow vertically or horizontally.

If they did it vertically, the main source of vulnerability would be the fragility of the buildings in the design, in the structure, in the materials used. So, the solution is a resilient infrastructure.

If they decided to expand horizontally, the source of vulnerability was exposure to, for example, subsidence or landslides. In this case, the solution is to work with the land use plan.

Another example that **Mr. Macharé** gave was about an alluvial fan in the desert on the south coast of Peru where a gold deposit was discovered. People decided to settle there, despite having water supply problems. Between 4,000 and 5,000 people went to work and, despite the fact that it was dry at the time of the settlement and remains dry for decades, the alluvial fans tend to become active as channels when it rains very abundantly. In this case, the flows caused flooding, the death of people and the destruction of infrastructure.

In this case, "the risks can be reduced through some structural measures, for example, digging

channels that serve as protection and that cannot displace the population. Also, other non-structural measures such as early warning systems”.

The objective, therefore, is to develop resilient cities that **Mr. Macharé** defined as “the capacity of the city to face, adapt and quickly recover from the stressor”.

In addition, he indicated that there may be 50-60 types of stressors grouped into:

1. Natural disasters
2. Financial and commercial
3. Politicians, crime and security
4. Technology and space, cyber-catastrophes, spills, fires...
5. Health and the environment (pandemic, famines and other)

**Mr. Macharé** assured that they work, as engineers, in relation to natural catastrophes, technology, spaces/discharges and health.

The concept of resilience should imply the ability to create foresight because you can be resilient today, but you have to make sure you are resilient in 10 years, 20 years and 50 years. For this reason and because the risk is changing, it is necessary to anticipate how it will change to avoid damage and disasters.

Regarding the concept of sustainability, he assured that there are various programs to help cities build resilience. Global programs of the United Nations, such as UNHabitat, UNDRR, MCR2023 and, also, private initiatives, as well as national strategies and alignments. **Mr. Macharé** cited the example of a private initiative carried out by the Rockefeller Foundation.

“We have to develop, not just a culture of risk, not just a culture of prevention, but a culture of resilience,” said **Mr. Macharé**. For this, it is necessary to consider the participation of engineering and engineers in decision-making processes.

The WFEO works on most of the SDGs, such as 11 on sustainable cities and communities, but there are also two other frameworks such as the Paris Agreement for climate change or the central framework for disaster reduction that “gave us, seven global objectives that should be achieved by the WFEO Disaster Risk Management committee”.

The WFEO published the book on Engineering, Resilience and Disaster Risk Management. And it has been an intermediate evaluation, within the Sendai framework. They have also collaborated with the International Coalition for Sustainable Infrastructure.

To conclude, **Mr. Macharé** alluded to the earthquake in Turkey where more than 42,300 people lost their lives, more than 108,266 were injured and 30,000 buildings collapsed. What if the active faults in the zone were known? “The buildings were not prepared; we do not know if due to lack of foresight or poor construction and non-compliance with regulations.”



**Mr. Kenichi Tsukahara, Director of the Disaster Risk Reduction Research Center in Japan**, who belonged to the Japanese government team for 26 years and, therefore, contributed a more political vision on this subject, took the floor. **Mr. Kenichi Tsukahara** gave a retrospective view of Japan. In Samurai Shogun's, Tokyo had 1 million inhabitants and was a big city to protect the castle and the city. Therefore, the Shogun government made a water delay area that protected from flooding, something that lasted over time and kept Tokyo safe. Entering the 20th century, Tokyo began with industrialization and urbanization and needed to expand its urban area from one million inhabitants to the current 20 million inhabitants.

Japan's policy is to protect the city by building infrastructure. A very large highway was built in the center of Tokyo and flood protection dams. "We tried to protect with infrastructure for our expansion, and at the end of the 20th century, we sought the Japanese government to invest in infrastructure and we protected Tokyo," he said.

With climate change, at the end of the 20th century, the situation worsened by increasing the average precipitation, which is why the government had to change its policy of action. That predicted scenario is an increase of 2 degrees by 2040, which will increase the presence of floods by 100% "so we don't have the possibility of protecting ourselves with infrastructure alone," he assured.

**Mr. Kenichi Tsukahara** explained that the agrarian policy is being expanded and subsidies are being considered to relocate the population to safer places, although they see it as complicated because current residents are reluctant to leave their homes and places of residence.

He also gave another example, that of the city of Hiroshima, and indicated that "fortunately the Japanese population is now decreasing" and, as the population decreased, "we moved those areas back to the center of the cities, a safe area."

He went on to say that "we are focused on fraud protection work" even though it is "very difficult to implement" and now they are working with residents to come up with a new policy.

As he explained, Japan is changing its policy, in this case, focusing on reducing exposure to disasters as a central and priority structure.

**Mr. Kenichi Tsukahara** invited attendees to learn more about the new Japanese policy by visiting the website of the Ministry of Infrastructure.

**Mr. Shankar M. Krishnan, International Federation of Medical and Biological Engineering**, continued with his presentation, who made an appreciation alluding to the fact that "when we meet someone again, we always ask "how are you?", that is to say that "health is the most important," he said.



In addition, he indicated that, although there are few biomedical engineers, all engineers can be one because, by definition, "biomedical engineering is applying mathematics, physical life sciences and multiple disciplines of engineering, electrical, mechanical, civil, structural, chemical of materials, computer science, nuclear, all of them to solve problems of biology and medicine".

**Mr. Shankar M. Krishnan** assured that smart cities must work to improve the quality of life of people, their well-being and their health, in addition to carrying out more efficient urban operations and services to meet the economic, social, environmental and cultural aspects of the present and future generation.

Reproductive, maternal, newborn, child and adolescent health, communicable and non-communicable diseases, universal

health coverage and, most importantly, access for all to safe, effective, quality and affordable vaccines and medicines, all this is medical engineering.

**Mr. Shankar M. Krishnan** explained to the attendees how interdisciplinary engineering is used for innovative and effective healthcare in the future. In smart cities, medical application engineering is discussed to address effective diagnosis, treatment planning, treatment itself, and post-procedure evaluation.

The engineering tools are used for this resilience, to analyze, understand the disease, models of disability, prediction and, most importantly, prevention.

The pandemic that infected more than 750 million people with COVID has highlighted the need to prepare for disasters, with the aim of making effective medical care possible in smart cities.

Having infrastructure, trained personnel, and engineering techniques to face the challenges is the basis for smart cities, especially with an increasing population.

Telemedicine has been in use for 20 years, "but today, everyone knows what telemedicine is," said **Mr. Shankar M. Krishnan**. Now, not just telemedicine, but smart sensors, artificial intelligence, big data, predictive analytics, cybersecurity, 3d printing, precision medicine, personalized medicine, augmented reality, virtual reality, robots, the interface between computer and brain, drones..." are tools that we use for health and everything needs engineering", he explained.

Therefore, "we use all technologies for sustainability, better care coordination and healthcare delivery."

The professor gave several examples such as the robots with which a surgeon performs assisted surgery, allowing him to be much more precise. "The doctor has two arms, the robot has six," he explained.

Other examples were that of a prosthetic arm that requires mechanical engineering, chemistry and a materials engineer or the example of wearables, which years ago no one knew about



and, now, many people have one and in which everyone is involved. type of engineers, mechanical, electrical, computer...

In the case of Smart Hospitals, in smart cities, the Internet of Medical Things (IoMT) has made it easier for all members of the chain (ambulance, nurses, doctors...) to have access when a patient needs to be treated. information and may be better prepared to serve you.

What is the smart approach to disaster resilience? **Mr. Shankar M. Krishnan** assured that the approach should be data-driven and have an integrated resilience program, adding that “we use AI and innovative methods to minimize the destruction of failing critical infrastructure in smart cities.”

A smart city resilience program must be integrated to minimize destruction. The city must prepare for, adapt to, absorb, respond to, and recover from disaster.

According to **Mr. Shankar M. Krishnan**, healthcare is going to change, it is going to be reactive and focused on hospitals and wellness centers, it is going to be preventive and personalized and there will be significant improvements in molecular genomics, analytics, big data, technological support, support in decision-making for health professionals through data analysis... "Thus, it will be more efficient and we will have intelligent health".

Because engineers provide solutions from diagnosis to treatment to achieve higher efficiency, higher quality and lower cost, resulting in a client in a new term called smart healthcare. When talking about smart cities, smart healthcare should be taken into account.

For this, innovative and evolving models must be used with collaboration, cooperation and contribution of multi-link engineering associations that involve diversity and inclusion, including WHO, UNESCO, WFEO, FMBE, academia, industry and governments, regardless of their geographical or economic situation.

**Mr. Shankar M. Krishnan** closed his remarks by encouraging providing equitable access to high-quality care in smart cities that will “result in smarter and more sustainable healthcare”.

## CONCLUSIONS

- Natural catastrophes are becoming more frequent and severe and cause material and personal damage.
- The latest AON report concludes that 2022 is one of the most catastrophic and the 5th most expensive in history for insurers. 313,000 million dollars cost the catastrophes of which 132,000 million were insured, which gives a protection gap of 58%.
- The AON Foundation is concerned about the proliferation of catastrophes and the worsening of their consequences, especially for the most vulnerable people. Their objective: to prevent future events and mitigate their impact.
- At AON they have identified two great challenges for disaster prevention: reducing the insurance gap and advancing in the knowledge of the impact of disasters on critical urban infrastructures to guarantee essential services in the short and long term.
- EIOPA has developed a pilot dashboard showing the insurance protection gap for natural catastrophes in Europe in order to identify measures on building vulnerability, location of exposure and insurance coverage that improve the resilience of the society.
- AON prepares a unique barometer in Spain and Europe, which quantifies the cost of the 10 most relevant disasters in Spain that occurred in the previous year and identifies their causes, nature, human cost, material damage, costs for the insurance sector. and include the incidence of resilience, critical infrastructure and social vulnerability.
- Critical infrastructures supported a direct cost of around 522 million euros. The compensations that enter the Insurance Compensation Consortium are stipulated in the BOE, they are floods, earthquakes, terrorism, but specifically that of the storm due to snowfall is not contemplated, as would be the case of the Filomena storm.
- At the end of 2022, the “Horizon 2035” Civil Protection disaster risk reduction plan was unanimously approved by all the political groups in parliament. The plan promotes, among other things, the culture of self-protection.
- AON has created a 3-dimensional methodology to estimate the economic impact where they take into account: the cost of the infrastructure, the cost of personnel for the repair and the cost of the loss of consumption as a consequence of how the infrastructure has been affected.
- Events are harmful if society is vulnerable to exposure from these events. You cannot fight against disasters, but you can detect the risk, prevent it and thus reduce the risk and damage.
- Regarding disasters, there are several phases to take into account: prospective, reactive, response, rehabilitation and, lastly, corrective.
- When creating the city of the future, one must consider whether one wants to be greener, more resilient, or both. Foundation costs and exposure risks are different if you grow vertically than if you grow horizontally.

- A resilient city is measured according to its ability to quickly face, adapt and recover from the stressor (natural catastrophes, financial and commercial events, politics, crime and security, technology and space, cyber catastrophes, spills, fires, health and the environment.
- The WFEO published the book on Engineering, Resilience and Disaster Risk Management. They have also collaborated with the International Coalition for Sustainable Infrastructure.
- Tokyo began with industrialization and urbanization. It went from 1 million to 20 million inhabitants.
- Japan's policy is to protect the city by building infrastructure, focusing on disaster exposure reduction as the core structure and priority.
- Biomedical engineering is applying mathematics, life physical sciences and multiple disciplines of engineering, electrical, mechanical, civil, structural, materials chemistry, computing, nuclear... to solve problems in biology and medicine.
- Smart cities must work to improve people's quality of life, their well-being and their health. They talk about engineering in medical applications to deal with effective diagnosis, treatment planning, the treatment itself, and post-procedure evaluation.
- Now, not only telemedicine, but smart sensors, artificial intelligence, Big Data, predictive analytics, cybersecurity, 3d printing, precision medicine, personalized medicine, augmented reality, virtual reality, robots, the interface between the computer and the brain, drones...these are tools that are used for health and everything needs engineering.
- Health care will be reactive and focused on hospitals and wellness centers, it will be preventive and personalized and there will be significant improvements in molecular genomics, analysis, Big Data, technological support, decision support for health professionals through analysis of data. It will be more efficient and we will have smart healthcare.

## 15:00 INFRASTRUCTURES AND DEMOGRAPHIC CHALLENGE



The table on infrastructures and the demographic challenge, moderated by **Mr. David García Núñez, President of Madrid World Capital of Construction, MWCC**, began with the intervention of **Ms. Irene Campos, Former Minister of Housing and Human Settlement of Costa Rica** who started from the statement that "infrastructures involve services, care and equipment and, of course, housing", her area of specialization.

Housing requires the infrastructure to have sustainable and resilient neighborhoods. "You must have infrastructure and housing connected with good services and with good mobility," she assured.

Campos pointed out several challenges associated with housing in Costa Rica:

- Provide housing to people with fewer economic resources. People who do not have the capacity to face the purchase of a home.
- Challenge associated with the young population that finds it difficult to access housing.
- That related to older adults. Infrastructure is facing change in relation to demography.
- Challenge for those of middle income. We have a public policy associated with subsidizing and improving the low-income, but not the middle-income.



In her speech, **Ms. Irene Campos** also indicated different housing challenges in Costa Rica, taking into account the population.

Costa Rica is a small country, there are just over 5 million inhabitants, and there is a qualitative housing deficit (referring to housing conditions) of about 152,980 homes. The quantitative deficit (homes where people can live) of about 16,000 homes. This gives a total of some 170,000 total deficit dwellings, data that is calculated with

respect to the volume of population.



That being the case, the situation in Costa Rica is not very serious, but it does exist, assured **Ms. Campos** and clarified that, despite the fact that the data is from the National Institute of Statistics, "there is controversy regarding the qualitative deficit" there are those who understand that it is a subjective data related to the situation in which the houses are and they are not clear about how it is evaluated.

Costa Rica has a public policy associated with housing from the 40s of the last century. At that time, a social reform was carried out where the social guarantees associated with everything that has to do with employment were given, the Costa Rican Social Security Fund was created, which has to do with public health and care for families and, also, a unit that was known as "Cheap Houses" associated with social security was created. This is where public policy begins to provide housing for families with fewer resources.

More than 60 years ago, an institute known as the National Institute of Housing and Urbanism was created, which continues with this public policy associated with housing.

Subsequently, in 1986, at an important moment of economic recession, another law was born that seeks to provide specific financing for these housing subsidies. Because? As **Ms. Campos** explained, because Costa Rica used to work with low-development external financing, which is greatly reduced after a macroeconomic problem in the country and families with fewer resources are greatly affected.

In 1986, an internal way of providing financing resources for this specific program emerged and "we can say that 4 out of every 100 homes have been financed or subsidized," she assured.

This subsidy has several categories. Families with income of up to US 2,828 are financed, the next one contemplates income of up to US 14,100, depending on family income, and lastly, there is another subsidy for extreme need that is a full subsidy that is given to those who need housing and to those who are paid land and housing. In the year 2022, 8,359 subsidies were given.

**Ms. Campos** pointed out different challenges in housing:

- Availability of well-located land where there are quality public services.
- Transport-oriented urban development. City 15 minutes that gives the opportunity to have well-served cities.
- Financing. For young people who want to become independent, older adults, middle-income families and people with informal employment (those who find it difficult to prove their income).
- Quality public space. Above all, associated with the challenge of available land. This leads to the need to increase density and therefore to high-rise construction and urban renewal.
- Citizen security from a gender perspective. How we challenge today's current construction and give more facilities to women who travel through the city with specific mobility and security needs.
- Public housing rental policy and how we promote this rental to families who cannot access their own home.
- New types of housing (co-living, co-housing).

**Ms. Campos** ended her speech by citing possible proposals that can help to face these challenges:

- Public policy for urban land.
- Inclusive and sustainable Urban Housing. That is, find built spaces for urban renewal.
- New modalities of financing/savings.
- New ways to assess the risk associated with families with informal employment.
- Urban renewal.
- Offer of real estate products taking into account the needs.

Another type of infrastructure associated with the city and its demography are the communication routes and, to talk about it, **Mrs. Rosalía Gonzalo, CEO of Madrid Calle 30**,



intervened, who stated that in Madrid there are high possibilities in terms of Housing and, confluence with mobility and infrastructures that offer habitability and quality service to citizens. Madrid is a European city where "we have more resources, perhaps, than in other countries," he added.

Madrid Calle 30 is the company that manages the large infrastructure of the M-30 that gives Madrid viability and mobility, although it has not always been configured like this.

This infrastructure had state ownership and that ownership meant that it had a pressure related to demography and traffic management with a series of drawbacks such as territorial

rebalancing, environmental sustainability, etc.

17 years ago, in 2005, the possibility of solving these problems was given by giving a boost to this infrastructure that was not finished and that had to serve a city such as the Community of Madrid.

The mayor of the moment, **Mr. Alberto Ruiz Gallardón**, set himself the goal of creating an infrastructure different from the one known, at which time the new M-30 and Calle 30 were born, where Rosalía Gonzalo is responsible and CEO.

Calle 30 is a mixed company that would be in charge of the construction of the infrastructure itself and, later, of the operation and maintenance. It is a public-private collaboration model, a reference model.

The construction of this infrastructure was not only the union of the east, north, south and west of the city of Madrid, but also gave the territorial rebalancing that was needed in the city.

In Madrid Río, a large part of the infrastructure that allowed urban regeneration and environmental sustainability with what is Madrid Río as it is known until now, was buried.

The burial meant the union of 40 km, in an urban tunnel that is not only a national and European reference, but also an international one. In fact, as an urban tunnel it does not exist on other continents and receives permanent visits from institutions from countries such as Korea, Australia and Latin America.

**Ms. Gonzalo** explained that the construction was carried out by distributing 4 lots at the administrative level in which all the construction companies that were in Spain worked, putting into operation the talent of 5,000 road, industrial and telecommunications engineers.

The best known of the infrastructure is the burial under the Manzanares River, the least known, he added, is the part of the infrastructure intended for the exploitation of the facilities themselves, in which industrial engineers are an important part, he assured.

Different engineering companies (roads and industry) come together in the work behind this infrastructure to supervise, maintain and control the million and a half daily journeys that pass through the tunnels of the M-30.

Madrid Calle 30 has a management, maintenance and operation contract with which around 13,000 incidents are managed per year, of which, related to emergencies, do not amount to more than 5%. The keys to the development of the contract are focused on the resolution of incidents and the security of the infrastructure, he clarified.

Currently, **Ms. Gonzalo** stated, "there is a team of 400-450 people who work in the industrial, construction and maintenance sector" and, she added that "to continue providing the same service, not only do you have to renew the equipment, but it is also necessary to ensure that the heritage of the infrastructure itself so that it has the best quality". For this reason, in the last 4 years, an investment of around 60 million euros has been made to renovate the control center and everything that is done on the walkways and bridges of the M-30.

"Lastly, I cite the last two major works, the one on the north junction, because there were mobility problems in the area, and the undergrounding of the Vicente Calderón area, both managed from Calle 30, 40 kilometers of undergrounding".

To conclude, **Ms. Gonzalo** invited to see the economic and social thermometer of an infrastructure such as Calle 30 for how it responds to the real needs of the City of Madrid.



To discuss the demographic challenges and solutions in China's rural areas and cities, **Mr. Ling Wen, Chairman of the China Shandong Association for Science and Technology**, who took office in 2019 as Governor of China, took the floor. west of Shandong Provincial Government, China's third largest economic province with a total population of more than 100 million and whose responsibility is to manage the operation of industry, transportation infrastructure, state-owned enterprise, and science and technology innovation.

**Mr. Ling Wen** advanced the three points on which he would focus his speech:

1. From the rural to the cities. Population, infrastructure and employment.
2. Demographic challenges.
3. The solutions.

"I will focus on our engineering," he clarified.

- 1.- From the rural to the cities.

Since 1978, China has undergone a great reform and opening up. Over the past 44 years, China's GDP has grown to \$121 trillion last year. China's urbanization rate in 1953 was 13% and last year it was 73%. China has done a great job in the past 40 years, **Mr. Ling Wen** said.

"We have successfully made the largest contribution to global poverty. In 2020, the Chinese government announced the eradication of extreme poverty across the country. That means that, in the last 40 years, China has lifted some 800 million people out of extreme poverty," he detailed.

Regarding public services and infrastructures in the rural countryside, during the last 40 years they had problems with electricity, drought, telecommunications and internet. Currently, in all the villages in China, he assured that "all families have electricity supply, connected charging, telecommunications and internet service."

In Shandong, "where I have served as governor of the west in the province" we have public transport and express delivery and, with the internet, "we have support so that all families can process purchases online and have immediate delivery of what they have ordered" he assured.



Regarding the population volume and the employment rate, the total population in 1978 was approximately 1 billion with an employment rate of less than 10%. In 2022 this number was 1.4 billion inhabitants with an employment rate of 52%, "which is a great achievement".

"Engineering improves urbanization, infrastructure and people's life expectancy. Engineering great potential in the future," he concluded.

## 2.- Demographic challenges.

2022 was a very bad year for China. It was the first year in which negative population growth was recorded in the last 60 years. The working-age population fell by 6.6 million, 8 times the drop in the total population. The total population decreased by 850,000.

The aging society will face very bad things. The total percentage for the average of these upper-middle-income economies, for people over 65, was only 11%, a number that in 2022 was 13.5%. "You get old before you get rich," he said.

And the third challenge are those related to health and other services, for example: hospitals, medicines, and care for the elderly, social services, public transport, commercial cinemas, etc.

**Mr. Ling Wen** acknowledged having "social systems that are not well done" and "not being well prepared to serve a large number of older people."

The fourth challenge is the coexistence of job storage and unemployment. He assured that there was a mismatch between human capital and market demand since, on the one hand, there was little job offer and, on the other hand, people were poorly trained to meet the requirements requested by companies.

To fix this, China has successfully established the largest education system in the world. The total population with education is 95.5%, with upper secondary education 91.6% and with higher education only 58%.

Over the past few years, China has improved its education system, **Mr. Ling Wen** said. A system of long-life training, vocational skills for urban and rural workers has been established. "A lifelong education," he added.

The Chinese government says workers cannot be fired, but all workers can be allowed to have off-the-job and on-the-job training. For this reason, the central government has given financial support to the training. During these three years, we have 120 million workers who have this type of training on the job.

### 3.- The solutions

**Mr. Ling Wen** concluded by giving three possible solutions to demographic challenges:

1. Artificial intelligence. Labor can be replaced by robots for process verification and anomaly detection.
2. The engineering efficiency that helps to improve and extend the working life.
3. Both the central government and the provincial government have so-called immediate engineering intermediation services. The function is to build the bridge between supply and demand.

**Mr. Martin Manuhwa, Chairman of the WFEO Capacity Building Committee**, began his talk by comparing problems in China with those in Africa and stated that they were very different.



60% of the African population, unlike China, is under 25 years of age and, by 2030, globally, there will be 42% of all young people in Africa. Therefore, "engineering lies in our youth or demographic dividend" and in the use of technology to expand and accelerate infrastructure development, he assured.

"I think we need to deliver, maintain and operate an infrastructure that is world class, green and innovative," he said. Engineers and architects "can, together with technology, help improve the environment, quality of life, health and drinking water, which is very important for Africa," he added.

Africa has critical deficiencies such as slums or lack of drinking water and demographic deficiencies in terms of professional preparation. UNESCO, in its first engineering report, estimated that Africa needs 2.5 million engineers and the figures are 1 engineer for every 7,000 inhabitants in sub-Saharan Africa. In some places it is 1 in 6,000, in others like South Africa it gets lower.

That is why "our population is our hope" and "I believe that this development is such that we must focus on engineering education, quality education and also the ethical and good conduct of these professionals to provide a good infrastructure," he said.

**Mr. Manuhwa** focused on the area of infrastructure to cover jobs that are disappearing with new technologies and to design an infrastructure that is respectful of the environment, easy to maintain and sustainable for end users.

For this reason, he assured that they would focus on the fourth industrial revolution, 4.0., And on returning to those people who have been replaced by new technologies, drones, robotics, AI to carry out other work.

We need to focus on IOT to provide secure infrastructure to lower costs, satisfy customer and improve quality and cyber security to make sure we provide a secure infrastructure.

To do this, he pointed to the need for his new graduates to develop new skills in order to have more practical people who can produce goods and services "instead of writing articles and many non-productive theoretical activities."

In addition, he showed the need to reformat the industries and "see where we come from and where we are going." And technology becomes the answer.



In Africa, 70% of the infrastructure must be worked on and reformed. So we'll jump right in and deal with all three levels of smart fit development: smart infrastructure, integration, and finding the latest solutions and integrating existing ones, ie automate.

With this, he affirmed that they will have all the advantages: smart cities, integrated command control, smart energy and security such as road safety in traffic management.

He also indicated the need to improve the communications and telecommunications backbone, which is still very poor in Africa. Kigali has been designated by the African Union to be an example or model of smart city projects.

He concluded by recommending for Africa quality engineering, education and also technology adoption, as well as incentives to make sure we have a regulatory policy environment that understands how to implement these technologies and innovation, although there are other aspects to consider.

He closed with a clear commitment to capacity building that ensures diversity, inclusion, and transparency in the way technical staff and engineers are trained. Also, to encourage the participation of women.

She said goodbye by issuing an invitation to attend the African Engineering Week which is held in September in South Africa.

## CONCLUSIONS

- The challenges associated with housing in Costa Rica: provide housing for people with fewer economic resources, help to access housing for the young population, infrastructure for the elderly, housing for people of medium income. In Costa Rica there is: qualitative housing deficit and quantitative deficit. It has a public policy associated with housing, the Costa Rican Social Security Fund was created, and also a unit known as "Cheap Houses." 60 years ago, the National Institute of Housing and Urbanism was created. In 1986, another law was created that seeks to provide specific financing for these housing subsidies. Challenges: well-located land with quality public services, 15-minute city development, financing for young people, the elderly and middle-income families with informal employment, citizen security from a gender perspective, public rental policies and new housing modalities (co-living, co-housing). Proposals to face the challenges: public policy for urban land, inclusive and sustainable housing, urban renewal, new methods of financing and savings, new ways of evaluating the risk associated with families with informal employment.
- Madrid Calle 30 is the company that would be in charge of the construction, operation and maintenance of the M-30, with a reference public-private management model, with state ownership. The challenge linked to the M-30 was related to demography, traffic management and other problems such as territorial rebalancing, environmental sustainability. It has united the east, north, south and west of Madrid, and has contributed territorial rebalancing, urban regeneration and environmental sustainability with Madrid Río. The construction was carried out by distributing 4 lots at the administrative level, putting into operation the talent of 5,000 civil engineers, industrial and telecommunications. Today there is a team of 400-450 people who work in the industrial, construction and maintenance sector and around 13,000 incidents are managed per year, of which only 5% are related to emergencies.
- China's urbanization rate in 1953 was 13% and last year it was 73%. Over the past 40 years, China has lifted some 800 million people out of extreme poverty. The population has gone from 1 billion to 1.4 billion inhabitants and from an employment rate of less than 10% to one of 52%. They have had problems with electricity, drought, telecommunications and internet, but today, in every village in China, there are such elements. The demographic challenges of China have to do with the low growth rate, negative for the first time, the aging of the population, and needs related to health and services. They also have an imbalance in the workplace, high demand, but a poorly trained population. Challenge: training within the company to mitigate the labor imbalance. continuing education. Solutions to these challenges: Use of artificial intelligence to cover certain jobs, engineering efficiency and immediate engineering intermediation services. Objective: build a bridge between supply and demand.
- In Africa, 60% of the population is under 25 years of age. Africa has critical deficiencies such as slums or lack of drinking water and demographic deficiencies in terms of professional preparation. UNESCO estimated that Africa needs 2.5 million engineers and the figures are 1 engineer for every 7,000 inhabitants in sub-Saharan Africa. Challenges: take back people who have been replaced by technologies, drones, robotics, AI to do other work and focus on IOT to provide secure infrastructures. Solutions: equip graduates with new skills. Regarding infrastructures: you have to deal with the three levels of intelligent adjustment development: intelligent infrastructure, integration and looking for the latest solutions and integrating existing ones, that is, automating.
- There is a need to improve the communications and telecommunications backbone.

## 16:00 MOVILITY AND COMMUNICATIONS



**Mr. Manuel Sánchez, Head of Service and Telecommunications dependent on the EMT Technology Department**, spoke, who would focus on how communications affect any of the verticals of the mobility service that exist in EMT, for the city of Madrid and how the hyperconnected and multimodal system in which we live forces us to respond.



The Municipal Transport Company (EMT) has 6 lines of business:

1. Urban surface transport buses that started in 1947.
2. BiciMAD, electric public bicycle.
3. Ave cranes, removal of vehicles on the street.
4. Both resident, rotation and deterrent car parks that include electric vehicle charging service, with fast charging points. More than 100 in different locations.
5. Cable car, an emblematic service of the city of Madrid, with two stations in Pintor Rosales and in Casa de Campo.
6. Consulting service in which experience is offered on the business and the use of technologies in national and international projects.

**Mr. Sánchez** offered some figures, EMT is made up of:

- Around 10,000 employees, most of them are the bus driving part.
- More than 2,000 buses. 100% clean fleet that is distributed in 5 operations centers.
- 220 bus transportation lines.
- More than 3,800 kilometers distributed in 10,500 stops.
- 240 million annual users, in pre-pandemic data. Almost 1.6 million users per work day.
- 80 street cranes, distributed in 7 warehouses with 77,000 interventions per year.
- The bicycle service is undergoing renovation, doubling the number, up to 6,000 bicycles and 600 street stations.
- 28 car parks, dissuasive, resident and rotational, totaling some 12,000 spaces, plus the electroEMT service for the fast electrical charging part.
- 80 cable car cabins at two points that can move up to 1,200 users/hour.

As **Mr. Sánchez** pointed out, the service strategy is intended to reduce any barrier that is preventing the use of public transport in four large dimensions:

1. Sustainability, which is aligned with the great strategic plan of the company. Any type of collective or shared transport will increase the sustainability that it needs from the communications that support it.
2. Mobility as a service in a multimodal system. There are users who use different modes of service and require a solution that responds to each of these modes and integrates them into the different dimensions.
3. Payment systems. Combined rate depending on the services and modes that have been used.
4. Information systems facing the citizen. Both the Open Data platform that we give access to third parties so that they can use it to calculate route times, such as panels, waiting time, etc.

The integration of services, in the concept of mobility for EMTs, has this offer made up of the Madrid Mobility 360 application and Mpass ([www.Mpass.mobi](http://www.Mpass.mobi)) in which it is intended to respond to the multimodal environment by integrating the different modes.

The part of payments for own services is also integrated, for the moment, the parking, urban bus, transport card, bicipark and BiciMAD, but for the calculation of routes, other mobility services of the city are also included, although they are not within the powers of the EMT.

The entire range of services requires a hyperconnected system. **Mr. Sánchez** gave some figures, from where the EMT is and where it is going, which show all this hyper connection:

- EMT has about 10,000 M2M #IoT devices on the street in service.
- Today it moves 20 Terabytes of mobile data per month. Above all, the free Wi-Fi service offered to travelers on buses. This service is given with 2,200 access points that are in motion on the street.
- It has 8,000 video surveillance cameras in service on the street.
- With the BiciMAD service completed, it will reach almost 650 sites, each one of the totems will be one more headquarters.
- The EMT Open Data platform receives about 40 accesses per second where the information is made available to third parties so that they can use it and make the route calculations in their own applications.

For all this to work, **Mr. Sánchez** assured that "an underlying communications infrastructure is needed, which must be complex, open, multi-manufacturer and multi-supplier".

From the mobile access side, EMT has devices that can be IoT or M2M, always with an eye on new mobile technologies that provide greater bandwidth and better features. As for the core network, MPLS, FPPH, VPNIP access networks from different providers are needed. "With this differentiation of services, we must have several logical accesses on the same physical access", he added.

According to **Mr. Sánchez**, a demand in the new services is the SD Wan technology that is being implemented, mainly, in the headquarters and that allows establishing that layer between the operator's Wan, giving a multi-operator backup that allows traffic optimization.

What do communication provide, in each line of business, and how can it impact the quality of service and provision according to its dependence on communications for each of the services?

In the bus service there are two M2M SIM cards from two different providers through which you can access both corporate services and fleet management and regulation, which allows service

planning and value-added services such as Wi-Fi at traveler, gamification or video surveillance services. Having the bus connected also makes it possible to offer the different forms of access and payments (MV payment, Tap & go, payment with QR through the application, all the multiple ones), he explained.

According to **Mr. Sánchez**, "if there are no communications, there is no regulation and, if there is no regulation, it will affect the schedules, the planning of the route, with which we have a degradation of the service" and he clarified that "if We do not have a location, we will not be able to give the waiting times and we are once again degrading the service".

In addition, he explained that it is necessary for communications to be stable throughout the bus line because, although they have "survival mode" offline ways of working, they may have problems in the validation part of some processes.

In BiciMAD they have SIM cards and IoT devices, which allows controlling the location part, very important for the redistribution personnel who do street work, especially in the free-floating mode where the bicycles can be located in the station or in any other street place.

On the other hand, the anchor performs a QR validation, with which the online system is needed to be able to do it. If there are no communications, from the point of view of internal communication, "we do not have redistribution, nor location of the bicycles and the problems of use that can generate", he clarified.

For the user "it could be almost worse" he assured, because it may be the case that they cannot unpin the bike and cannot use it. And, "if the problem of communications from the Totem, we have interaction problems with the user, with the Totem itself to carry out recharges or the operations that have been established and, from the central office, we lose visibility of the state of the Totem" he added.

In the parking lots. They are integrated into a private network with automatic access with a license plate reader and, at the same time, it allows us to establish the logic in combined price if public transport has been used, especially in dissuasive parking lots.

Being connected allows the user to see the availability of electrical charging devices and validate the charges. In this case, if the communications are missing, there is no automatic access, a manual access may be required, there may be validation problems for the payment of the combined rate that requires post-correction work and, in the loading part, there is no there is visibility of how the electric chargers are located neither by the user nor by maintenance and operations.

The complete ecosystem of mobility in Madrid is multiple, "we have different operators with different technologies and for this to link, they have to be hyperconnected, just like EMT services are. The only way is for all systems to be available and talk to each other for a multimodal system to work. The user assumes that the services must be available in the manner and time", assured **Mr. Sánchez**.

**Mr. Manuel Sánchez** ended his intervention by proposing a forecast for the future:

- Connectivity is a requirement for mobility services, both as added value to the service and for its own provision. "Over time we are going to need increasingly reliable and cheaper networks that are more cost efficient."
- Multi provider solutions. The WAN, for example, makes it possible to generate that layer of intelligence and generate a multi-operator backup.



- Higher bandwidth and lower latency requirements will grow as delay sensitive applications are introduced. “As soon as we include the video variable within the services that we may have”, he advanced.
- In terms of sustainability, it is aligned with the company's strategic plan and improves with collective or shared transportation. "In neither of the two cases is it possible if they are not supported by a layer of technological infrastructure that provides that hyperconnected world in which we have to function."

**Mr. José Ángel Tamariz, Director of Europe and New Markets, Director of Asset Management of Ferrovial and Director of Cintra, a subsidiary of Ferrovial**, spoke, presenting what his company is doing in terms of mobility and sustainability.

Ferrovial is developing its own highways so that the infrastructures are prepared for the arrival of electric and automatic vehicles.

**Mr. Tamariz** assured that there are accidents that could be avoided thanks to automatic vehicles, technology and connectivity with the infrastructure. In fact, 45% of cars are expected to have an automation level of 3 or higher, which means the vehicle will be able to drive itself. By 2030, 100% of cars will have extended connectivity.



The evolution of the vehicle is clear. Now, you have to deal with the infrastructure.

What is AIVIA?

It is about building safe corridors where security is enhanced using smart technology. The goal is that all types of vehicles in any condition, even harsh, drive safely.

Also, with automated vehicles, it will be necessary to coordinate traffic to optimize capacity because, “when the cars are automated, there will be more cars on the road,” **Mr. Tamariz** said.

The AIVIA system sends messages to drivers in real time with relevant information and does so in three different layers:

1. The physical infrastructure of the road. That physical infrastructure needs to be improved by making reflexive payment, smart switching, and improving roadside paint and sensors.
2. The digital infrastructure. Getting connected with cars and creating this 5G mobile network.
3. Road information in real time, sending drivers information about everything that happens on the road. This information must then be transferred to traffic, police and emergency management centers, to vehicles and to third parties such as Google Maps. All at once and in real time.

How is it done? Installing all this technology that is already known and making use of the information. We are not really inventing anything new. “We use laser detectors that are capable of mapping the road with all the information. We use AR that can handle the weather, for example, and of course we use high-definition cameras that are not only recording everything today, but are also capable of detecting any incident in real time.” detailed.

This is something that “we are already doing,” he said, adding that it is already being implemented on a highway that was opened in Virginia last November.

He cited examples of information that can be produced with this system, such as warnings about areas where operators are working, speed restrictions for any reason, incidents with erratically driven vehicles, infrastructure damage, road obstacles, weather hazards such as snow or ice, etc.

**Mr. Tamariz** detailed clear benefits:

- For drivers: make use of a safe road, with real-time information, accident prevention and assume the volume of automatic vehicles that will exist without reducing operability.
- For operators: because it will mean mitigating risks and costs. Safety will protect drivers and save on maintenance. Maximize asset availability and incident prediction and improve decision making, as well as positive social impact.
- For sustainability and the economy: it will be more sustainable, because there will be less emissions by keeping traffic moving and reducing congestion, the environmental footprint will be reduced by increasing vehicle electrification and automation. That will reduce all consumption and emissions.
- For the economy: it will increase regional mobility and competitiveness to economic benefits.
- For society: social impact, through data, and services for people and improvement in transportation.

**Mr. Tamariz** concluded by assuring that he expects it to be an incubator for new and emerging technology with systems at the service of all and that they are developing "with a lot of collaboration and transparency." And he ended by assuring that "it is something good for everyone".

**Mr. Firas N Bou Diab, President of the WFEO Youth Committee**, took the floor to address young engineers working in the field of transportation and design and engineering for road safety.



**Mr. Bou Diab** pointed to the design of infrastructures and key elements of safe roads as a strategic measure to achieve safe and sustainable roads.

More than 1.4 million people die in traffic accidents every year and this figure is expected to continue increasing until it becomes the fifth leading cause of death in 2030. These accidents also entail an economic cost, he indicated.

For these reasons, he stated that the responsibility as designers, engineers, regulators is to create streets and highways that prioritize safety.

This security is in the design of all the elements. For this reason, he showed examples of infrastructures, guardrails, public lighting, road embankments, pronounced horizontal curvature of roads...

**Mr. Bou Diab** went on to talk about the operations of the five

Es of Safe Roads:

- Engineering: Defines the built environment, including road or vehicle design.
- Strict application of the education law.
- Good road behavior through awareness campaigns.
- Awareness. Encourage people to use the roads well.
- Emergency attention, which is important to have medical attention on the road and access to paramedics at the time of immediate attention after a traffic accident in which the provision of first aid can improve the survival of the victims.

For **Mr. Bou Diab**, these challenges should be taught to young engineers entering the transportation field, whose role as a design engineer is to ensure that roads are safe.

It is a triangular classification function:

- Design stage. A planning stage, through land use and control policies, selecting desirable standards and not minimum standards.
- Construction stage. Through the construction of adequate traffic diversions.
- Maintenance and operations stage. With automated traffic management systems for incident management, including mobile communication systems, variable message signs, central room and central control room strategies to achieve road saving.

As strategies to achieve safety, he pointed out mobility, sustainability and design to achieve greater separation between vehicles and people and protect pedestrians and cyclists.

On the other hand, he cited speed as an important approach to maintaining road safety. There are studies that indicate that unprotected users survive being hit by cars of up to 30 kilometers per hour. Modern vehicles can protect their occupants up to 50 kilometers per hour, in the event of an internal collision, and up to 70 kilometers per hour in the event of a frontal collision. The risks for vulnerable pedestrians, such as children, are greater.

As key elements of secure infrastructure design he distinguished between horizontal and vertical alignment. In the horizontal geometry of the roads, have an adequate compensation distance, have consistency in the geometry avoiding monotonous straight lines. In vertical alignment, the profile of roads, how to design divided and undivided carriageways in terms of cross-sectional elements, in terms of lane widths and shoulders, and including widening for sharp curves on both rural and urban roads and the separation of vehicles with pedestrians and cyclists.

In addition, he assures that they are designing safe roads in terms of entrances and exits at the crossings, and in terms of having passenger traffic, either by bus or taxi stop. He also shows part of the generalization provisions for stacking lanes and pedestrian facilities in urban areas such as sidewalks, how to merge the sloping sidewalk with the cross street and bus base.

Also, design of barriers, traffic signals to standardize it, traffic calming measures that are or should be adequately designed, such as speeding, buzzing rumble strips and small roundabouts to play a significant role in slowing down.

Regarding the security countermeasures tested, he indicated that they are divided into different areas depending on whether the area is cleared or not, the area to be widened, the shoulders, if they have cable barriers, railings and concrete barriers, the type of pavements that can be applied, will also depend on the speeds and vehicle volumes, road curves and embankments, and what types of safety barriers are needed on different types of roads.

In addition to all this, we must take into account crossroads, roundabouts, traffic lights, pedestrian and cyclist-friendly environments, sidewalks, disabled people... Hence, the importance of carrying out road safety audits to make roads and highways safer. Audits that will be carried out during the different phases of the design, during construction and after completion, he assured.

At WFMO “we are emphasizing the importance of the sustainable development goals and the importance of achieving that UN agenda by 2030,” he added.

Three strategies that he proposed were: avoiding unnecessary trips, saving fuel, changing mobility by promoting, for example, the use of bicycles and offering a green and pedestrian environment. All ecological and sustainable.



“ENGINEERING THE CITIES OF THE FUTURE” &  
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**Mr. Firas N Bou Diab** concluded by stating that a livable, sustainable and safe city must be created that prioritizes people over cars and achieve mobility for all, a mobility that guarantees social equality and accessibility for the different modes of transport.

And lastly, he alluded to political will, user support and an adequate institutional environment as essential parts to implement the change.

## CONCLUSIONS

- The Municipal Transport Company (EMT) for which fleet data has already been disclosed in the table on energy and raw materials, depending on the cities. The EMT, in relation to communications, the entire range of services needs a hyperconnected system. EMT has about 10,000 M2M #IoT devices on the street in service. Moves 20 Terabytes of mobile data per month. Above all, the free Wi-Fi service offered to travelers on buses. This service is given with 2,200 access points that are in motion on the street. It has 8,000 video surveillance cameras in service on the street. The EMT Open Data platform receives about 40 accesses per second. EMT has devices that can be IoT or M2M. As for the core network, MPLS, FPPH, VPNIP access networks from different providers are needed. A demand in the new services is the SD Wan technology that is being implemented, mainly, in the headquarters and that allows establishing that layer between the operator's Wan, giving a multi-operator backup that allows traffic optimization.
- At BiciMAD they have SIM cards and IoT devices. The anchor performs a QR validation.
- In the bus service there are two M2M SIM cards and they allow access and payments (MV payment, Tap & go, payment with QR). The anchor performs a QR validation.
- In the car parks. They are integrated into a private network with automatic access with a license plate reader and, at the same time, it allows us to establish the logic in combined price.
- Future forecast: connectivity with reliable and cheaper networks, multi-provider solutions, higher bandwidth requirements and sustainability.
- According to Ferrovial, by 2030, 100% of cars will have extended connectivity. AIVIA is building safe corridors where security is enhanced using smart technology. The goal is that all types of vehicles in any condition, even harsh, drive safely. The infrastructure needs to be improved, with flexible payment, better paint and roadside sensors. Get connection with cars and 5G mobile network and real-time information. The benefits would be safer drivers, operators would maximize asset availability and accident prediction, sustainability and economy, regional mobility and competitiveness with economic benefits and services for people with social impact.
- Design of infrastructures and key elements of safe roads as a strategic measure to achieve safe and sustainable roads.
- More than 1.4 million people die in traffic accidents each year and this number is expected to continue to rise to become the fifth leading cause of death by 2030.
- On the operations of the five Es of Safe Highways: engineering, strict application of the law, good road behavior, awareness and social awareness, emergency care.
- Triangular function: design stage (design of a safe infrastructure distinguished between horizontal or vertical alignment), construction stage, maintenance stage and operations.
- A livable, sustainable and safe city must be created that prioritizes people over cars and achieve mobility for all, a mobility that guarantees social equality and accessibility for the different modes of transport.



## 17:00 THE ROLE OF WOMEN ENGINEERS

**Ms. Mari Cruz Díaz Álvarez, President of Comité de Ingenia del IIE**, took the floor to present the women in engineering table, stating that "of every 10 engineers, only 20 are women".



"The city of the future is going to be complicated, highly technical, and it is going to require a lot of talent. Therefore, engineering will never be able to work with 50% of the talent, it needs 100% of the talent, which is why it will need the talent of the women who are represented here today," he stated.

For her part, **Ms. María Teresa Pino, Former President of Unión Panamericana de Asociaciones de Ingenieros, UPADI**, assured that "we are women, engineers, leaders and, not because of that, we stop being mothers, housewives, teachers... The work is hard, but I believe that the dreams and goals that we women have make us carry out these activities with force. And everything is possible when our life partner also supports us.

In Latin America, the proportion of women in science and technology is low, although it has increased in the last decade. This proportion, in engineering, varies between 10 and 30% depending on the countries and regions, depending on the ease of access to education.

With regard to specialties, mechanical or electrical are the ones that have the least number of women, with industrial or chemical engineering being the ones that have the most and being more balanced in civil engineering, distinguished **Ms. Pino**.

Increasingly, he says, "the merits are recognized and women are required, but it is difficult for them to occupy the highest positions in engineering companies unless they are partners or owners", something that also occurs in other professional unions.

Very few professional organizations are chaired by women. Organizations like CONFEA in Brazil, for example, have never had a female president. In Argentina, Uruguay, Bolivia and Colombia, only one woman was president, but "the number of women who access is very low and the support of men is very important to reach it," she said.

At work, many women choose to work independently - FreeLancer -, because it facilitates family reconciliation by having more time freedom, if not, many women would have to leave the career to take care of the family.



Pay equalization continues to be a struggle in America for female engineers. Cases of lower salaries for positions of equal responsibility and with the same qualifications are still detected, but they are occurring less and less.

The Matilda effect continues to exist, which makes the achievements of women invisible and, in general, they are attributed to “male colleagues”. That is, many women do research papers, but then their names never appear.

There is a strong prejudice about the ability of women to perform adequately in some areas of engineering, “it is not an activity for a woman”, which makes them frustrated. It also happens that, many times, it is the women themselves who put other women in trouble. Women themselves have the view that a woman can cause problems at work.

**Ms. Pino** assured that motherhood presents a dilemma. Good mother or successful professional? Some consider working and when they are mothers they leave the profession, others, on the contrary, are young mothers to be able to develop professionally later. Legislation relating to maternity sometimes makes access to work difficult.

**Ms. Pino** cited the main causes of low participation of women in engineering:

- Cultural reasons. In Latin America they are very strong.
- Economic reasons. A low-income family opts for their son to study.
- Low insertion of girls in training programs in science and mathematics. Vocational support workers steer them towards simpler careers and see tougher careers as difficult for girls.
- Society with traditional values. A father is not going to allow his daughter to go alone to study in a city that is far from where they live.
- The self-limitation of women. Inconstancy. Many women set their ceilings low, they don't dream, they feel like they won't be able to do a job because they feel they have other commitments and, in a way, they are fickle.
- Low number of references and mentors. There are few women that girls can reflect on.
- Little sorority. Women in some aspects “we are very supportive and in others we have little capacity for empathy” she confessed.

**Ms. Pino** also launched some proposals for improvement:



- Women engineers. Women are neither better nor worse, we are equal.

- Take a new look at the participation of women in engineering. Do not segregate or limit yourself. “In my country we are recognized and we work shoulder to shoulder with men. The organizations recognize us,” she stated.

- New policies for a greater number of female engineers:

- Specific training

- programs in mathematics for rural girls.

- Positive discrimination mechanism with emphasis on scholarships for girls in Science and Technology.

- Share experiences of successful programs for the incorporation of girls in science and technology.

- Greater visualization of successful engineers. Female mentoring program.

Regarding this last point, I clarify that, "increasingly, there is a greater presence of women in engineering at all levels, which is not very publicized."

She ended her speech by encouraging women to "dream, fight for their goals and who knows... one day be the role models and ideals for many girls."



Immediately afterwards, **Ms. Dawn Bonfield, Vice President of Women in Engineering, WFEO**, took the floor to explain what the WFEO Women in Engineering Committee is doing about the lack of diversity in engineering and how they use engineering to improve the lives of women Worldwide.

The UK, 'where I'm from', has probably one of the lowest numbers of women in engineering anywhere in the world. We have 16% of women working professionally as engineers, 6% of them professionally registered as chartered engineers, around

8% get vocational engineering qualifications, but "the starkest figure is that there are 78% of our registered chartered engineers professionally who leave the profession before the age of 50", he affirmed.

Therefore, there is a great leakage of our engineers and "we know that the reasons are that they do not receive support in their workplace," she clarified.

**Ms. Bonfield** noted that the Committee has four main themes:

1.- Development of engineering capacities. It has already been commented that the volume of women in engineering worldwide is low; therefore, our role is to make young women interested in engineering and enter these careers through inspirational activities and role models. Regarding capacity development, the committee hopes to launch some mentoring programs on International Women's Day this year, though "I think it will be a bit delayed," she said.

2.- Retaining women's progression and leadership roles by helping them assume their position.

The Committee cares about women as entrepreneurs and is looking to work with UNESCO on awards for women entrepreneurs because "entrepreneurship and engineering are very similar and we know we need to empower young people to address the sustainable development goals as entrepreneurs. or as entrepreneurs or as agents of change, therefore, entrepreneurial skills are very important for engineers" he stated.

The Committee is also working with the Global Engineering Deans Council (GEDC), and the International Federation of Engineering Education Societies on the book *Rising to the Top*, which is about role models of leading women in engineering.

Also, she has been involved in writing some of the chapters for the UNESCO engineering report on what are the things we need to do within engineering to encourage more diversity.

To conclude, she assured that the Committee also has a legal letter to help with best practices and make it commit to improving equality, diversity and inclusion and that, "we hope, it is something that we can show as best practices because After all, the WFEO is a membership organization of institutions."

3.- Statistics compilation. There is very little visibility of the statistics worldwide and, to the committee, what "we would like to do as an organization is to be the reference organization worldwide that has these statistics."

The Committee wants to group these statistics disaggregated by gender. So, you can track progress and see where the areas of the world that have best practices are and share them. By doing so, we also "want to encourage all of our institutions to measure and publish these statistics to get the evidence we need," said **Ms. Bonfield**. "I think it's only when people start to understand the statistics that they appreciate the number of women leaving the profession," she added.

4.- Gender sensitive engineering. As engineers, "we create solutions that are accessible and inclusive, making sure we understand how women around the world live."

**Ms. Bonfield** agreed with what was stated by **Ms. María Teresa Pino, Former President of the Pan American Union of Engineering Associations, UPADI**; women have different levels of access and independence around the world.

As engineers, "we have to make sure that we incorporate a gender perspective into politics, planning, budget decisions that we hear the voices of women around the world, and that we understand the difference between fairness and equality," she said.

As a committee, "we are looking at each of the goals while presenting best practice examples of what a good engineering solution really looks like" that takes into account women and their needs to make cities accessible.

Include the use of artificial intelligence in cities that do not discriminate. Take into account the design, security to identify, for example, routes where harassment has been received and provide options for routes that are well lit or without stairs, ensure that there are no blind or risky spots for women, etc.

**Ms. Bonfield** was the executive director of the Women's Engineering Society, and became interested in seeing how technology was used to help women. As time went by, she realized that now women engineers want to show themselves as engineers and not as women, and thus, "we lose track of the fact that, in reality, we have different points of view on things," she stated.

She also cited some examples on how to make cities more sustainable and empathetic, such as making good use of household appliances to reduce emissions, making responsible use of digital technology, designing the city more empathetic to the homeless, more play areas for young people and other areas that help people to be more active in cities.

She concluded by saying that "in industry 5.0, we are going to go beyond creating services for profit, we are going to add value to society".

**Ms. Ania López**, from the **Italian National Council of Engineers**, spoke about the "feminine engineer" and explained to the attendees, "I am the first woman in the history of the Italian National Council of Engineers" which ensures "no It's easy because we always have to show our inspiration and, at all times, they observe us and we have to explain ourselves, but without conflicting because that's not how solutions are found".





The Foundation of the Italian National Council of Engineers has programs dedicated to women because it is necessary to explain without justifying.

1.- Woman's Universe. In Italy there are three sectors environmental engineering, industrial and civil engineering. In Italy 277,201 women study engineering.

2.- Academic training from 25 to 26%, the percentage has barely changed. There have to be specific projects for women. As engineers we solve problems, so the importance of having men and women together should be explained.

The quota of women who enter the university depending on the degree obtained Information and telecommunications technologies has become very important, secondly, the women who graduate, which in Latin America, Europe and Italy is 30% "is not high," he said.

We have created a new Master in biomedical engineering. "We invite important institutions to be in contact with us to create new aspirations. It is important that more women participate in these solutions", she assured.

3.- Working market. Between 30% and 33% exceed employment in Italy. The salary is different between men and women, why if we have the same responsibility? The government in Italy is putting up a special program to remedy this gender gap. (About €200 difference).

The professional record in Italy is a good number and it is increasing, so it is a victory. More and more are registering with professional associations. Role models must be created. It is important to increase the number of women who want to join a college.

4.- Women participate in the national engineering council; I am no longer the only woman. In Europe the percentage of women is not good, but "I continue with my fight", Italy is in 4th place.

The gender gap exists in different countries. We must continue to emphasize and have the support of men.

Participation in activity programs and taking a leadership position is also necessary, for this reason "it is important to create a project, a program to encourage women to move forward", and he considered that "if there are no women who represent the idea, it is a problem".

She concluded by saying that "we must continue working very hard, but it is necessary and very important, the support of the demand for this activity".

For **Ms. Lidia Santiago, Vice president of the Portuguese Order of Engineers**, "engineering is a dream and this is the message that we must pass on to all girls" and added that "it is a profession in which it is possible to dream, project, build and achieve".



The message is: "ideas, dreams, passion, tools, entrepreneurship and realization", she clarified.

Regarding the history of what has happened in Portugal, she considered citing several dates:

1938: the first female civil engineer. In 2024 "we have the year of gender equality in engineering and we are going to have the



National Award for Female Engineers", the **Amelia Chaves Award**, the first graduate in Civil Engineering from the IST and the first admitted to OE in 1938.

In April 1974 there were only 92 female engineers. In 2006, 2,012 and, in February 2023, 12,630 female engineers.



According to the statistics of the portal of the order of engineers, female engineers represent 21.7% of women in engineering in total. Among those registered in the Portuguese Order of Engineers is **Elvira Fortunato**, World Engineering Prize awarded in 2020.

Along the way things change. The largest number of female engineers in the Order are in civil engineering and, later, in chemistry, although this has changed at this time. In

the Order there is civil, electrotechnical, mechanical, environmental and chemical.

In Portugal, it has been seen that many of the girls who went to chemistry, changed to environment.

On March 8, 2018, Women's Day, it was the first time that Portuguese women engineers joined an event and the auditorium was almost full, with the participation of **Belén García**.

In March 2019, an agreement was signed with Brazil. In addition, in Brazil, the Women's program has also been created for the first time and, in September 2019, AFEAG (Female Association of Agricultural Engineers and Geologists) already existed.

In addition, in 2019, "we have received in Portugal a team of female ministers and secretaries from Bangladesh, it was a very important event because we, engineers from Portugal, also entered," she assured.

In 2020 the pandemic occurs. "I thought there was more to do and I created the Luso-Hispanic Engineers group with the aim of motivating girls for engineering, sharing experiences among the engineers of each country and feeding a little the will to be an entrepreneur and create self-employment".

In 2021, with the results of 2020, the Association of Engineers of Bolivia was created. Result of the group of Luso-Hispanic Engineers.

In Costa Rica, Women's Day was commemorated in March 2022. Also, in Portugal we had elections and "we have created the National Commission for Women Engineers and the Commission for gender equality." All fruit of the work carried out in 2020. Here there is already an engineer from Mozambique who has worked and continues to work with this group and has taken simple courses in mathematics and physics to motivate girls to enter Engineering.

They are all connected. **Ms. Lidia Santiago** has, in Portugal, a group of more than 500 women engineers. It is the group of Luso-Hispanic engineers. 2020, 2021, 2022, 2023 and 2024 aim to ensure that, in all our countries, there is gender equality in engineering.

On June 23, 2021, the International Day of Women Engineers was commemorated with the countries that belonged at that time. There were 14 countries: Portugal, Spain, Mozambique,

Argentina, Cape Verde, Bolivia, Colombia, Chile, Cuba, Brazil, Paraguay, Angola, Mexico and Costa Rica.

The objective was to find out how many women engineers there were in their countries. From there, it was concluded that Mozambique has 12% female engineers, Chile 3%, Brazil 9%, Mexico 20%, Portugal 21%, Argentina 24% and Spain has 25%. The average is 28% because there is a higher country, which is Cuba, which has 38%. So, the countries with the lowest percentage "are our work topics," she assured.

In November 2022, the Ibero-American meeting of Engineers, Architects and Surveyors took place in Costa Rica, Ibero-American meeting. But where was Iberia? Portugal only. The next meeting will be in Lisbon in November 2024. "We need Portuguese-speaking Engineers to come to Lisbon, to Portugal," she said.

It has been thought of dealing with global issues:

1. Hydraulics
2. Entrepreneurship
3. Circular economy and sustainability
4. Attract girls to engineering, engineering education
5. 5. IT, digital and platform management

And responsibilities have been distributed. Each group has 2 or 3 coordinators and more engineers in these groups. They are going to apply these global themes in their countries and, in 2024, they will see the results and see these differentiated results, not only by theme but in each country.

The Order of Engineers of Portugal invites all engineering colleagues to participate in virtual, face-to-face and with presentations in Lisbon at EIMIAA, Ibero-American Meeting of Women from November 18 to 21, 2024.

**Ms. Lidia Santiago** concluded by assuring that "it is essential that more girls consider engineering as a profession. When we have more women engineers in decision-making positions, we will have less poverty and more peace."

Next it was the turn of **Ms. He Jing, Deputy Chief Architect, China Institute of Building Standard Design & Research**

Architects fall into the stereotype that it is not a profession for women, but women consistently manage to advance their thinking and shape the cities of the future for a century.



**Ms. He Jing** pointed to 3 periods when female architects from Asia influenced history:

1930-1950. In the context of the industrial revolution, some Asian women received professional education and studied for careers. For example, **Nobuko Tsuchiura** from China, **Parin Jamsetjee Mistry** from India, **Zhang Yuquan** and **Minnette de Silva** from Sri Lanka, and **Miho Hamaguchi**, the first of us to be licensed as an architect

in Japan who dedicated her life to changing the concept of the future in the traditional Japanese living space.

During this period, the number of women architects is still very small, but they made outstanding contributions to shaping future cities with their efforts and they should be remembered.

1950-2000. Participation in urbanization. Following the World War, urbanization accelerated and with it the participation of women architects. 30% of architects.

A group of 5 outstanding female architects, **Wang weiyu, Zhai Zongfan, Zhang Jinqiu, Lin Lin** and **Li Yinong** have designed important public buildings, libraries, museums, airports...the National Convention Center, the Beijing Digital Tower of the Olympic Games have been designed by architects too.

The living conditions of Chinese residents have been greatly improved by the passion of unknown female architects. The Japanese **Kazuyo Sejimaganó** won an architecture Oscar for using everyday building materials to create dreamlike floating spaces.

**Marina Tabassum** from Bangladesh was the Aga Khan Award Winner for Architecture, she designed one of the most important buildings in the world.

**Zaha Hadid** is the first female architect to win the award for her artwork that revolutionized architectural geometry.

2000-2023. Shaping a resilient future. A sustainable future is everyone's goal. Women architects are actively exploring options to reduce carbon emissions from construction.

**Yasmeen Lari**, from Pakistan, was the first female architect in her country in the 1980s. After a flood, she worked on the design of thousands of zero carbon shelters, built with bamboo and designed a smokeless stove to cook in an ecological way.

**Kotchakorn Voraakhom**, from Thailand, sought to improve urban resilience by landscape designing a large urban park that can absorb water from heavy rains to reduce the risk of urban flooding. She also designed a large rooftop farm and food and water storage to prepare for future climate challenges.

**Anupama Kundoo**, from India, used building materials with low environmental impact. She designs homes for homeless children made from mud and recycled materials.

In addition, there are 3 female architects **Ye Qing, Jiao Jian** and **Zeng Jie**, who have been participating in the evaluation of construction standards for green buildings, since 2006. The aim is to reduce energy consumption and carbon emission in the sector and implement the technologies low carbon standards, such as zero emission prefab sponge cities.

**Ye Qing** together with her team designed the iconic green buildings in China that can reduce carbon emissions by 1,600 tons per year.

To conclude, **Shi Lixiu**, a landscape architect, designed the ecological restoration of the competition area of the Beijing 2022 Olympic Winter Games and has devised the strategies for creating habitats for animals and mitigating ecological disturbance caused by construction.

**Ms. He Jing** concluded by stating that architects work with imagination and female architects are also mothers.

## CONCLUSIONS

- Engineering will never be able to work with 50% of the talent, it needs 100% of the talent, so it will need the talent of women.
- In Latin America, the proportion of women in science and technology is low, although it has increased in the last decade. This proportion, in engineering, varies between 10 and 30% depending on the countries
- With regard to specialties, mechanics or electricity are the ones with the least number of women, with industrial or chemical engineering being the most and showing the most balanced in civil engineering.
- Women's merits are recognized and required, but they hardly occupy the highest positions in engineering companies unless they are partners or owners.
- Work-life balance is a challenge. Many women choose to work independently "FreeLancer" to reconcile while others leave the race to take care of the family. Motherhood generates a dilemma: good mother or good professional?
- Many times, the women themselves are the ones who put obstacles in the way of other women who want to develop in managerial positions or technical careers.
- Pay equalization is another challenge. It is easy to find women who earn less than their male counterparts for the same performances. The Matilda effect continues to exist, making women's achievements invisible and generally attributed to "male colleagues".
- There is a strong prejudice about the ability of women to perform adequately in some areas of engineering, the most technical ones.
- There are few leading women to find inspiration and serve as a reflection.
- Low incentive for girls and young women to pursue engineering studies.
- Increased visibility of successful women engineers, scholarships for girls who want to pursue careers in science and technology or specific programs and policies, could help to change the problem.
- The WFEO Women in Engineering Committee identified 4 main issues related to women in engineering: capacity building (WFEO has some programs for this), the advancement of women and the leadership role where the committee meets. interested in women entrepreneurs to help them grow.
- The WFEO Committee is also working with the Global Engineering Deans Council (GEDC), and the International Federation of Engineering Education Societies on the book *Rising to the Top*, which discusses role models of leading women in engineering. It also has a legal charter to help with best practices and get you committed to improving equality, diversity and inclusion.
- Statistical reconciliation, data collection on professional engineers and percentage of women in different countries and organizations.
- Gender sensitive engineering. Learn to differentiate between equality and equity. Incorporate the gender perspective in politics, planning, budget decisions from which we hear the voices of women from all over the world.

- Ongoing need of many women to prove their worth in a profession considered more masculine and where senior managers are often men.
- In Italy there are three engineering sectors: environmental, industrial and civil engineering.
- Only 25%, on average, of engineering students are women.
- Need to continue emphasizing and counting on the support of men. Also, to create programs that stimulate and motivate women to move forward in their professional careers.
- In Portugal, in 2024, it will be the year of gender equality in engineering, there will be a National Prize for Female Engineers, the Amelia Chaves Prize, the first graduate in Civil Engineering from IST and the first admitted to OE in 1938. In April 1974 there were only 92 female engineers. In 2006, 2,072 and, in February 2023, 12,630 engineers. Among those registered in the Order of Engineers of Portugal is Elvira Fortunato, World Engineering Prize awarded in 2020. In 2019, AFEAG (Female Association of Agronomists and Geologists Engineers) already existed. In 2020, the Luso-Hispanic Engineers group was born. In 2021 the Association of Engineers of Bolivia was created. On June 23, 2021, the International Day of Women Engineers was commemorated with the countries that belonged at that time. There were 14 countries: Portugal, Spain, Mozambique, Argentina, Cape Verde, Bolivia, Colombia, Chile, Cuba, Brazil, Paraguay, Angola, Mexico and Costa Rica. In November 2022, the Ibero-American meeting of Engineers took place. The Order of Engineers of Portugal invites all engineering colleagues to participate in virtual, face-to-face and with presentations in Lisbon at EIMIAA, Ibero-American Meeting of Women from November 18 to 21, 2024.
- There are 3 periods in which female architects from Asia influenced history 1930-1050. During this period, the number of women architects is still very small, but they made outstanding contributions. 1950-200 Participation in urbanization. Following the World War, urbanization accelerated and, with it, the participation of women architects. 30% of architects. 2000-2023. Women architects are actively exploring options to reduce carbon emissions from construction. Work to build a more resilient future.



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## *FRIDAY, MARCH 3RD 2023*

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### 09:00 MAIN SPEAKER



The second day of the Congress "Engineering cities of the future" was opened by **Mr. José María García Gómez, Deputy Minister of Housing and Territorial Planning of the Community of Madrid** who, after thanking the organization for the invitation and the assistance of those present, presented Madrid as a "territory of opportunities".

He assured that Madrid society is making an effort to evolve towards a large European metropolitan region. An open region that bets on free enterprise, on the free establishment of professionals, in an environment of low taxes, which allows economic development.

And he stated that "the development of large engineering companies and large industries, related to economic development, are what have given us that leap in quality that has allowed Madrid to become the World Capital of Engineering and Architecture".

Infrastructures, vital for the normal functioning of cities, have to come with an efficient, modern and transformative response from energy so that the urban transformative process allows economic development. "Without sustainable and efficient buildings, an efficient use of energy is impossible to improve the quality of life in the smallest area of our society, which is our homes," added García Gómez.

You cannot debate between growth and non-growth, nor between disordered cities or cities 15 min away. Large metropolises, medium-sized cities and the rural world that require architecture, urban planning and engineering must be developed to have the same possibilities of access to digitization and infrastructure, while preserving the environmental value of the territory.

The evolutionary leap in engineering must be supported by this 4.0 model. The engine of this new construction industry has to do with what is related to construction, buildings and information modeling.

Engineers and architects have the ability to design a building, capture the idea in digital format, calculate the services that the construction will demand, the waste that it will generate, the cost that it will entail, the useful life that it will have and what recycling or reconstruction it may have. All this is the cornerstone of a new model that will make buildings respond to the rational use of scarce raw materials.

With regard to active housing policies, how can you respond to a model of access to housing that did not exist? On the one hand, there is access to housing in the free market, in free

competition and, on the other hand, there is a residual market, which corresponds to the Public Administrations, to serve those who have extreme difficulty in accessing housing.

There is another social mass that has difficulty accessing housing but has a certain economic capacity and, as a natural solution, this access should be resolved from the rental market.

Next, **Mr. García Gómez** presented to the attendees the "Plan Vive Madrid" in terms of construction of publicly promoted housing.

He explained that the administration has land, the raw material for construction for public housing, but no budget to build houses. The best option is to make that land available to economic operators so that they can invest in the building in exchange for its exploitation for a certain time that would allow them to be profitable and that the administration would retain, through an administrative concession contract, ownership of the land and the benefit would revert in favor of the administration.

In the concession of public works, in Spanish and European legislation, there are instruments that mean that the review of the performance of the payment contract by the administration, of said contract, to the concessionaire is not associated with the variation of the consumer price index (IPC) and that guarantees that the contract values do not increase.

If we had relied on the public works concession model, there would be no one who wanted to invest and there would be 1 million square meters with zero homes because, apparently, the public works concession makes a model of exploitation of assets in leases unfeasible, because rent updates are paid by tenants for them, it is linked to the consumer price index (CPI).

This was resolved with the administrative concession domanial with public intervention, in addition to mobilizing the land; it would limit the price for which these homes were going to be rented. The Public Administration in Spain put itself in the shoes of the companies that promote, build and manage the leasing assets and try to find out their economic model for that business and make it attractive with a reasonable return for the investor, before putting it out to tender.

Therefore, an economic model was designed that stated the conditions: how much the construction costs, how much the taxes levied on the construction process cost, what are the margins with which the companies involved in the process operate, what is the term of the concession in years of operation and the rental price at which these rents should be charged to make them affordable to the user and to generate profitability for the business.

In the first instance, 5,400 top-quality homes were awarded in construction, with a significant reduction in the term with high energy efficiency and that can only be done with an industrialized construction. "An industrial process identical to that of the automotive industry, which is capable of building with quality and with a minimum margin of error and in a short period of time", he clarified.

The industrialization of the construction process also allows public-private collaboration 'be to rent' formulas in this model to achieve the objectives earlier in time and the required energy efficiency, he added.

The conception from the beginning takes into account energy efficiency, sunlight is key to heating the building in long winters, but also, the orientation, conversely, allows air conditioning in hot summers. This, combined with the air flows in the building itself that helps those energy and thermal exchanges supported by photovoltaic or wind energy, we can achieve higher quality buildings.

In public-private collaboration, as in the Plan Vive of the Community of Madrid, there are project partners. With returns of 6%, with 50-year exploitation, which has 6,600 homes enabled and which moves an investment of 800 million euros, it is evident that it is not a speculative business, it requires a huge capital amortization with guarantees conditioned by the administration.

Ares and Oaktree investment funds were found that are supported by traditional bank financing such as CaixaBank, with project managers such as Aedas Home and Culmia, which are supported by Aedas in the San José construction company and Culmia is supported by Habitat

They have patented an industrialized construction process that, through factory-produced panels, makes the construction truly industrialized, saves 10 months in construction periods and is highly efficient buildings, because there is no variability in terms of the construction of the partitions and the facades and, in addition, "it allows the introduction into the entire building and conceive how the life of the building will be to know the cost of maintenance, replacement and renovation of the construction", explained Mr. García Gómez.

"If it is possible to go from 1% of industrialized construction to 90% in 2035, we will be able to transfer the construction model to any part of the world. A model supported by research, development and digitization, which represents a first-rate evolutionary leap", he assured.

At this time, there are already 1,700 homes under construction, through this system, another 1,167 that were just awarded 10 days ago. In the next year there will be in the order of 3,000 homes built under this process that does not diminish the architectural quality or the services that users enjoy at an affordable price.

Approximately, he calculated, "the final price of what has been achieved with top quality construction is in the order of 30-40% lower than the equivalent market in the same location. It is an opportunity to access our young people at a competitive price".

It is a reality, land placed at the service of a public purpose. But how much do these projects cost the people of Madrid? €0, he assured. "The citizen has not put a single euro of investment for the construction of 6,600 homes that costs 800 million euros." In addition, it translates into 15,000 direct jobs in the construction phase and 30,000 jobs during the life of the operation.

For closing, **Mr. García Gómez** affirmed that "we charge zero euros in canon, but the public administrations that intervene in this process, the state one has not put anything, the regional one that has put the land and the local one, which is the one that gives services in the area, a tax benefit of around 300 million euros is returned" and "all this heritage remains in the hands of the people of Madrid", he added.

## 09:30 CITIES OF THE FUTURE

The opening of the table on Cities of the future came from the hand of **Mr. Ricardo Río, Mayor of Braga, Portugal**, who described the cities of the future as "an ambition, more than a model, something that must be built and developed with the joint work".



Braga is a city with 200,000 inhabitants, the third largest in Portugal, after Lisbon and Porto and, although it is different in size from Madrid, in terms of challenges and projects that can be developed, they are not so different, **Río** said.

For the mayor of Braga, it is possible to take advantage of the pioneering projects that are being carried out in other territories to implement them in "our cities", for which the exchange of opinions, information and points of view of best practices is important, "so it is You can look at the United Arab Emirates, Panama, Prague and Spain," he said.

The cities of the future are focused on providing livable and sustainable cities.

From the user's point of view, providing quality of life, but also employment and good career opportunities because it is the "crucial element to attract people and settle in the city, without economic opportunities people will not settle", assured **Mr. Río**.

The mayor of Braga pointed to social justice as another important element. A network that safeguards the citizen when he needs it or has difficulties, as discussed before, access to housing, "increasingly inaccessible to the middle class and young people," he said.

From the most environmental perspective, impacts and drastic weather conditions are suffered. The impact it has on the city's infrastructure and the infrastructure's response to these challenges is very important for the future.

**Mr. Río** assured that most cities will invest more in civil protection, in terms of infrastructure and response to possible catastrophes such as the floods in Lisbon and Porto, a consequence of the rains and insufficient response capacity.

This holistic approach can only be provided through the sustainable development goals. The objectives of this sustainable development must be brought to the management of the territory and cities as a monitoring tool, within the strategic framework. In addition, as is also recommended in the United Nations sustainable development goals, a new governance model must be established.

For the great transformation towards the cities of the future, it is necessary to make a joint effort between all interested parties: public authorities, investors, citizens, universities and all knowledge centers, because "together we can develop concrete initiatives that allow us to address the objectives we pursue", assured **Mr. Río**.

In addition, regarding the transformative challenge, he expressed that "I think the biggest challenge is to transform existing cities, especially historical cities like Braga, which is more than

2,000 years old." For this reason, the means and financial conditions to develop this type of project are important for local authorities.

More resilient future cities can be built, with a better quality of life, that can adapt to demographic pressure, to the transformation, which is attracting more people to the cities, but without neglecting the policies that need to be given at the national level, ensuring the cohesion of the territories.

He explained the need to encourage people so that they do not concentrate in the large metropolises, because the territory must be balanced and, for this, good conditions must be created and offered so that people settle in other cities.

In Braga, with this long-term vision, there are medium-term plans for economic development, sustainability, social inclusion and climate adaptation.

**Mr. Río** provided some information. 60% or 65% of Braga's carbon emissions were related to mobility problems, according to the last zero barometer in 2020. Braga was one of the cities in Europe with the most use of own vehicles, while the bus fleet urban was old, and emits a great source of pollution. For this reason, one of the investment priorities in Prague is to renew the bus fleet with electric buses. "Now, around 40% of our fleet is fully electric and the use of public transport by citizens is stimulated," he said.

The organization of the public transport system in the city is also being carried out to ensure the quality of the service and encourage its use. In terms of climate adaptation, "we have been investing a lot in ensuring the city's biodiversity," he said.

Around Braga there are some forest areas that can be an asset in terms of mitigating carbon emissions because they can mitigate those emissions produced by the city. In this area is the Sanctuary of Bom, municipal heritage.

Regarding the efficient use of energy, specific initiatives have also been created, such as the project developed together with the Institute of Nanotechnology and jointly between Portugal and Spain, called "batteries 2030". A research laboratory that has around 400 researchers from around the world working on this project to try to identify new ways to better produce, store, regulate and manage the use and consumption of energy in urban areas.

**Mr. Río** concluded by recalling that "the governance and collaboration model, among all the actors, is very important to achieve the objectives we pursue and engineers play a crucial role because they have the perspective and focus that is needed to make a good use of our basic resources".



**The Hon. Mr. Allen Sellers Lara, Ambassador of Panama in Spain**, began his speech by referring to "one of the marvels of human engineering, the Panama Canal, a country that is the center of the world and heart of the universe," he assured.

You cannot talk about Panama without mentioning its connectivity, thanks to its privileged geographical position and world-class logistics. Its geographical position "has been a blessing and a responsibility".

Since the beginning of the 16th century, Panama has been known as a strategic bridge and connection link between the continents. With the founding of the city of Porto Velho, in the Caribbean, and Panama in the Pacific, logistics infrastructure works were key to development.



The first trans-isthmian road was built so that gold and silver, coming from America, could cross by mules until it reached the galleons that would take it to the Torre del Oro on the other side of the ocean. “At that time, the civil engineers were already changing our continent”, clarified **Mr. Sellers**.

Several centuries later, in 1855, the first transcontinental railroad served as an expedited route for miners and laborers from the US East Coast to reach the promised California.

And the 20th century brought the construction of the Panama Canal, which transformed world trade, opening the market to new ones and the possibility of creating wealth.

The large ports at each entrance to the Canal are part of the urban fabric, today, of the main cities of the country.

Currently, the Panama Canal represents a quarter of Panama's GDP. It directly connects 160 countries, 144 shipping lanes and 1,700 ports. And it has been fundamental for the creation of a maritime cluster, highlighting services for ships, the Colon free zone, the Panama-Pacific trade area and the city of knowledge where universities from all over the world come together.

A very important component of the infrastructure development of this maritime cluster is the free zone regime, unique in the entire region and allows multinational companies to establish themselves in areas close to world-class transport infrastructures, thus opting for scientific, technological, cultural and social of the metropolitan area.

Unlike other countries that have delegated to the private sector, Panama has decided to strengthen the legal certainty of the investment by evaluating and supervising the operation of these zones.

Currently, we have 12 free zones with 123 active companies, 6 free zones under development and 6 projects for new free zones that will improve the quality of life of vulnerable sectors of the country and strengthen this logistics platform and the centuries-old tradition of services, increasing industrialization. These free zones are located in the metropolitan area that extends from the Caribbean to the Pacific. Colon and Panama as main cities that represent 50% of the country's population.

As engineers, we must continue to innovate, the Canal, the trans-isthmian route and the railway are part of Panama's history, but interconnection routes must continue to be opened.

The Tocumen International Airport, the HUB of the Americas, has turned Panama into an international center for the exchange of passengers and air cargo. This year, a new airport terminal was inaugurated in Tocumen, the largest in the region, propping up Panama as an air HUB with connections to more than 90 destinations, 39 countries and transporting more than 16 million passengers a year, 4 million more what the whole country has. In addition, it achieved 54 positions for cargo capacity with more than 90 additional international destination countries.

With this work, Panama is consolidated as a destination with low air freight costs, which is an "advantage tool given the exponential growth of e-commerce and the problem with logistics chains," said **Mr. Seller**.

Thanks to the constant investment of the country, it has been able to grow and modernize the infrastructure as a logistics and transportation HUB. Panama represents a gateway to a market of hundreds of millions of consumers in the region thanks to the 92 free trade agreements of more than 60 countries.

**Mr. Seller** assured that, “today, to talk about any advance, it must have a component of renewable energy”. A recent study highlights the strategic role of Panama and its metropolitan area in the energy transition. It indicates that the strategic situation of the country would allow it to become an attractive HUB for the green hydrogen industry and its derivatives, also playing a central role in the decarbonization of global maritime transport.

The Panamanian government has begun construction of the green hydrogen storage and distribution HUB on the banks of the canal, within the metropolitan area from where Latin American and Caribbean countries will be able to export green hydrogen and its derivatives to Europe and Asia.

**Mr. Seller** closed his intervention by predicting that “the future of humanity is in our cities. With a long-term sustainable investment in logistics infrastructure, we will ensure that cities like Panama remain at the forefront of geographic interconnections and offer the quality of life and economic growth that citizens require.”



**Mr. Jorge Serrano, Technical Director of Madrid Nuevo Norte (MNN)** took the floor to present this project “from the perspective of the private promoter of this development”

Crea Madrid Nuevo Norte is the company that has the majority of the rights for land development and is leading the transformation of the land corresponding to the Madrid Nuevo Norte urban project. This project aspires to become a benchmark in terms of sustainable cities and represents, due to its scale and characteristics, “a unique opportunity for the city of Madrid”, he stated.

**Mr. Serrano** detailed the principal characteristic of the MNN project:

**1.-** It represents an **opportunity** due to its location within the Community of Madrid.

It is an urban transformation project to transform and regenerate the soils of the railway corridor located around the north station of Chamartín, which previously occupied a peripheral location and has now been included in the city, generating dysfunctions in the more industrial soils themselves.

Madrid Nuevo Norte is the opportunity to regenerate all these lands that have ceased to be affected by railway activity and transform them into the great development of Madrid in the 21st century.

On the other hand, the Chamartín station itself is undergoing a transformation process to double its capacity and to be the central node in the connection of the national high-speed network connecting north and south with Atocha. It represents an opportunity for hyperconnectivity to generate a new area of main economic activity in the city of Madrid. The idea is to “suture the wound that those train tracks have generated”.

It has a 10-minute metro connection and, by rail, direct to the airport, physically located about 7 kilometers away, which makes it an opportunity to create a new central business district for Madrid that allows the city to position itself in this global market. of cities that seeks to attract talent, attract economic activity and attract wealth.

We are talking about an action of 2.35 million square meters of urban transformation that makes it one of the most important urban regeneration projects in Europe.

**2.- The innovation.** The cities of the future have to be based on innovation and sustainability, with the citizen at the center. The key points of development must be: habitability, well-being and economic activity.

Sustainability aspects have a lot to do with the climate emergency and innovation, new technologies, solving logistics and mobility problems. These are key aspects that must be resolved in any urban development and, in particular, in one that has the ambition of the Madrid Nuevo Norte project.

**3.- Responsible urbanism.** The project starts by embracing the key principles of responsible urbanism. It is a regeneration; it is not new soil. It is based on sustainability and people-oriented. This project has public-private participation that will be delivered to citizens and managed with private investment.

A report has been produced to detect the sustainable development objectives in a concrete way, in coordination with the Madrid City Council. It has been evaluated that it has an impact on all the objectives, especially those that have to do with water, with economic growth and work, the objective of sustainable cities and climate emergency.

It is not just about identifying but establishing the indicators, the KPIs that allow making the management and design decisions that the project has to take.

**4.- Potential connectivity with national impact.** It is a strategic project for both the city and the region. On those 2.3 million square meters of land, it will generate a building area that will give rise to 10,500 homes, on the one hand, and 1.5 million square meters for economic activity (shops, offices...).

According to **Mr. Serrano**, "it must become a place where people want to go to work, live and settle." This happens by reserving land and more than 250,000 m<sup>2</sup> will be built for public facilities (library, police stations...) and 400,000 m<sup>2</sup> of green areas will be enabled).

**5.- The naturalization of the city is another of the key aspects.** From the point of view of the habitability of the citizen and the climatic emergency and from the point of view of energy efficiency. Reducing the heat island effect is one of those challenges, which is why green areas are key. The tracks of the Chamartín station will be covered, some 200,000 m<sup>2</sup> of track covering on which a new central park will be built.

**6.- That of mobility.** The project makes a radical commitment to sustainable transport. The project adopts all kinds of measures to reinforce public transport, a new metro line, a transport interchange, a new commuter station, and all this to achieve a modal split that reaches 80% of trips in a sustainable way in the office area compared to 20% for travel in a private vehicle. In residential areas this modal split will be 50% private and 60% public transport.

**7.- The infrastructures.** The complexity of the project has to do with the infrastructure it has: the tracks, the station itself, the houses in the area, industrial areas...

**8.- Water management.** Due to its location, the project is in the place where the two main water pipes that bring drinking water from the reservoirs located to the north of Madrid enter, so this water abduction network must be renewed, affecting the three Madrid's main water supply channels.

In addition, it is necessary to think about the management of runoff from the city through sustainable urban drainage systems that allow recycling the water cycle. It is committed to the use of reclaimed water managed by the Canal de Isabel II. These waters, which are only used for irrigation, are intended to extend their use to irrigation of private areas and flashing in private areas. Drinking water consumption in our homes can be reduced by up to 80%.

**9.- Creation of the central business district.** District active 24 hours. There will be a combination of housing, business, commerce and the integration of essential public facilities for the city such as a museum, a convention center and the central park on the train tracks. It will combine public use, private use and economic use to guarantee the functioning of the district.

**10.- Connection between neighborhoods.** The challenge of connecting the existing neighborhoods with the new one must be established.

**Mr. Serrano** He cited some figures on the Madrid Nuevo Norte project, such as that the urban planning will have 10,500 homes, tertiary uses, facing the current 5 towers that are the seed of the business district, it will multiply the buildability of the 4 towers by five, 20 towers will be built around the station and a large park that will become a real forest. Park that, like Madrid Río, which is executed to a large extent on slab.

The amount of land that is transformed for public use represents more than three quarters of the total development land. 25% is the land that is actually used for lucrative activity.

This whole project involves a large capital investment. In the construction phase, over the next 20 years, it will generate more than 200,000 jobs and the activities that the district will develop, in the order of 150,000.

There is an important component of social policy in housing because a large part goes to public patrimony and will be administered by the city council. All this in an environment that generates a significant fiscal return for the administration estimated at 3,800 million euros and that mobilizes a direct investment of more than 11 million euros but that, if the transaction associated with the real estate business (purchase-sale) is taken into account, of real estate manages to mobilize more than 25,000 million euros in the development of the process.

There is an important part of infrastructure, some 3,000 million from the station, but there are 2,000 million that comes from private investment in the infrastructure itself and other figures related to the cost of land, almost 4,000 million euros, to construction, building and business generated for the furniture project.

**Mr. Serrano** closed his intervention by giving some final figures. “This has, apart from the tax return, an impact on the economic activity of the country and the region that has been quantified at 15,000 million euros in GDP. Concentrating 12,000 million euros of those 15,000, in the community of Madrid”.

Next was **Ms. Nahla Ahmed Alqasimi, Vice President of the United Arab Emirates Society of Engineers**, who presented the Dubai 2040 Urban Plan, an inspiring blueprint for future cities.





Dubai has experienced rapid growth and transformation in recent decades. Dubai's urban population has increased, multiplying by 80 times from 40,000 inhabitants to 3.3 million between 1960 and 2020. This was due to the oil reserve's strategic location and visionary leadership.

Dubai's economy is also diversified, not just dependent on oil. There are new sectors such as tourism. Dubai is receiving 14 million tourists, "a very good number for a small city," he said.

The real estate, financial and commercial sectors also come into play.

The city of Dubai has become known for its ambitious projects of innovative architecture and focus on sustainability and smart cities.

**Ms. Nahla Ahmed Alqasimi** stated that Dubai leaders have committed to addressing many issues including environmental impact through initiatives such as Dubai Power Plant 2021 and Dubai Clean Energy Strategy 2050. The Dubai leader launched also Dubai 2040, a plan to realize his vision of making Dubai the best city in the world to live in.

"We need to develop plans and policies that contribute to the quality of our cities, to be a better place for life and for future generations," she stated. Today you are going through strategic challenges, not only Dubai but the whole world.

**Ms. Nahla Ahmed Alqasimi** listed some of those challenges: the large and rapid growth rates of the urban population, horizontal urban sprawl and urban decline, the structure of cities, climate challenges, global change, the technological revolution and the rapid development of artificial intelligence solutions.

The Supreme Council worked on the development of the 2040 plan that improves the quality of life. The objectives of this plan are based on: optimizing the digitization of spatial and infrastructure resources, planning, developing healthy communities, doubling green and leisure areas. All this, improving its qualities, giving a sustainable and flexible meaning to mobility, promoting greater economic activities, improving environmental sustainability, safeguarding the cultural and urban emirate, heritage and developing legislation and comprehensive planning and governance.





Now we have three urban centers and a new one will be developed, green and recreational areas have increased by more than 105%, integrated service centers to cover all the needs of the population through the development of integrated and accessible service centers, using the flexible and sustainable means of mobility and increasing pedestrian and bicycle lanes. Within two or three years we will have the flying taxi.

55% of the population will live 800 meters from the main public transport stations, the spaces for educational and health establishments will be increased by 25%. There will be 168 square kilometers of land dedicated to industrial and economic activities, 60% total nature reserves and natural areas.

For national housing, various options and solutions will be provided with the highest standards. Comprehensive and flexible laws, issuance of an urban planning law to support sustainable development and upgrading in the emirate, a 400% increase in designed space for public beaches and a 134% increase in space for hospitality, hotels and activities.

To achieve these objectives, the following points have been developed and completed as a priority:

- A policy for the sustainability of citizen housing, comprehensive plans to preserve the rural environment by developing an urban plans law to regulate the relationship between developers, investors and government agencies and adopting a flexible model for governance so that the planning sector ensure the balance between sustainable development and optimal use of land and projects.
- Plans and strategies must place the human being as the main focus, establishing priorities with current and future needs.
- Ensure the sustainability of resources and focus on governance as an organizational framework to establish success in implementing plans and achieving its objectives.
- The integration and availability of services within the region contributes to reduce and provide sustainable transport.
- Advanced technologies such as artificial intelligence and big data to help increase the efficiency of urban planning and support decision-making.
- Periodic review of plans for the urban planning support sector to ensure compatibility and adoption of changes.

**Ms. Nahla Ahmed Alqasimi** said goodbye and closed the table encouraging attendees to visit Dubai.

## CONCLUSIONS

- The development of large engineering companies and large industries, related to economic development, have allowed Madrid to become the World Capital of Engineering and Architecture.
- Sustainable and efficient buildings will allow an efficient use of energy and improve the quality of life in homes. Same possibilities of access to digitalization and infrastructures, preserving the environmental value of the territory for all times of urban and rural cities. In terms of housing, there is access to housing in the free market, in free competition and there is a residual market corresponding to the Public Administrations for the most vulnerable and the possibility of renting for those with a certain economic capacity.
- The Vive Plan is publicly promoted housing, with publicly owned land, construction and exploitation of private investment limited in time and with more affordable access to the user, limiting the rental price. With profitability for amortization to the investor and the property, the land continues to be public. The Vive Plan has returns of 6%, with a 50-year term, 6,600 fitted-out homes and an investment of 800 million euros. This also means that the citizen has not invested a single euro in construction. 15,000 direct jobs have been generated in the construction phase and 30,000 jobs during operation.
- Industrialized construction is a process identical to that of the automotive industry, capable of building with quality and a minimum margin of error in a short period of time, optimizing materials and systems with a forecast of the cost of maintenance, replacement and renovation of the construction.
- The cities of the future must be livable and sustainable cities, providing quality of life and employment. This is the crucial element to attract people and settle in the city. For the transformation towards the cities of the future, a joint effort must be made between all the agents involved. Stimulate people so that they do not concentrate in large metropolises in order to maintain a balanced territory. Transport generates emissions and mobility problems. Solution, public transport in the city to ensure the quality of public service and encourage its use. Forest areas will serve to mitigate carbon emissions.
- In Braga (Portugal), specific initiatives have been created such as the “batteries 2030” project, developed together with the Institute of Nanotechnology and jointly Portugal-Spain, for efficient use of energy.
- Panama has a privileged geographical position and world-class logistics due to geographical position and connectivity. The Panama Canal transformed world trade by opening up the market. It connects 160 countries, 144 maritime routes and 1,700 ports, essential for the creation of a maritime cluster that allows companies to establish themselves in areas close to world-class transport. Currently, there are 12 free zones with 123 active companies, 6 free zones under development and 6 new free zone projects. The Tocumen International Airport, the HUB of the Americas, has turned Panama into an international center for the exchange of passengers and air cargo with more than 90 destinations, 39 countries and more than 16 million passengers/year. The strategic situation of the country would allow it to become an attractive HUB for the green hydrogen industry and its derivatives, which is why the government has started the construction of the green hydrogen storage and distribution HUB.

- Madrid Nuevo Norte is the company that has the majority of the rights to develop the land and is leading the transformation of the land corresponding to the Madrid Nuevo Norte urban development project. It represents an opportunity for hyperconnectivity to generate a new area of main economic activity in the city of Madrid, transforming 2.35 million square meters. The key points of development are: habitability, well-being and economic activity. It impacts all the objectives, especially: water, economic growth, work, sustainable cities and climate emergency. It will have a buildable area of 10,500 homes, and 1.5 million square meters for economic activity, more than 250,000 m<sup>2</sup> for public facilities and 200,000m<sup>2</sup> of road covering for a new central park. The project is committed to sustainable transport. The water abduction network will be renewed and runoff will be managed to reduce the consumption of drinking water. The central business district will be created to concentrate all economic and commercial activity. More than 200,000 jobs will be generated and the activities that the district will develop, in the order of 150,000. Economically, it will mobilize a total of 25,000 million euros in the development of the process.
- The urban population of Dubai has multiplied by 80. It has gone from 40,000 inhabitants to 3.3 million between 1960 and 2020. Main sectors: tourism, real estate, financial and commercial. Dubai is known for its ambitious projects of innovative architecture and focus on sustainability and smart cities. There are important initiatives such as the Dubai Power Plant 2021 and the Dubai 2050 Clean Energy Strategy initiatives. City challenges: urban population growth, horizontal urban sprawl, structure of cities, climate, global change, the technological revolution and the development of artificial intelligence solutions. Development of the 2040 plan that improves the quality of life. Forecast for 2040: 55% of the population will live 800 meters from the main public transport stations, the spaces for educational and health establishments will increase by 25%. There will be 168 square kilometers of land devoted to industrial and economic activities and a total 60% of nature reserves and natural areas.

## 11:30 URBAN PLANNING: ENGINEERING, ARCHITECTURE AND SUSTAINABILITY



The session was introduced by **Mr. Mustafa Shehu, President Elect of WFEO**, and began his speaking time by making a point about the title of the table because urban planning is made up of engineering, architecture, urban planning and administration.

**Mr. Mustafa Shehu** focused on the role of engineering in sustainable cities, structuring his intervention in different points:



### 1.- Definition

“Urbanism is the study of cities and the processes and patterns of urban development. It covers the social, economic, cultural and physical aspect of cities and how they function, change and evolve over time. It is about understanding the relationship between people and the built environment, including the ways in which cities are planned, designed, built and managed,” **Mr. Mustafa Shehu** described.

The United Nations Sustainable Development Goal 11 defines sustainable cities as those that are dedicated to achieving green sustainability, social sustainability and economic sustainability. The outcome target for SDG 11 includes, among others, safe and affordable housing, affordable and sustainable transportation system, protection of the world's cultural and natural heritage, reduction of the environmental impacts of cities, providing access to green and public spaces safe and inclusive and ensure the capacity of the future generation.

### 2.- Growth of the urban population

They include the number of cities and human settlements that adopt and implement integrated policies and plans for inclusion, resource efficiency, mitigation and adaptation.

We have gone from 500,000 inhabitants to megacities of over 10 million. As the years go by, the number of medium and large cities will increase. We will have 33 megacities.

For example, in Nigeria, in 1976, there was a head of state, who decided to create another city to move the capital of Nigeria, from Lagos to Abuja, a virgin land where there was nothing and today is the capital of Nigeria with a population of 5 million inhabitants. Lagos today has also expanded more than five times. Egypt has also created a new administrative capital, some 60 kilometers from Cairo.

The urban population is around 30% of the world population. But as we go now, 2020, we might have around 55%, but in 2050 it will be around 65%. The population of the world is around 8 billion now. By 2050, the population will be around between 9.2 and 9.6. The volume of the population will increase and, in addition, there is an aging population. You have to imagine the impact this will have on infrastructures and "it is our duty to study these trends," he said.

The population of Nigeria, for example, in the 60s was 50 million, now we are more than 200 million.

There is a lot of stress on the infrastructure of cities and "it is very necessary for us as leaders, as administrators, to reach the cities, see the trends and offer solutions that make cities worth living".

### 3.- Energy supply (availability, affordability and storage of energy)

As the population grows, so does the lifestyle and the amount of energy supply we need in homes and industries. Therefore, the provision of an energy supply that is reliable, affordable and sustainable is also very important.

### 4.- Greater energy efficiency

In addition to generating electricity, we have to use it efficiently and there are different parameters that indicate that electricity is wasted, so if we save and optimize, it is better. For this reason, measures and mechanisms must be taken into account to ensure that what is used is done optimally, both in homes and in industry and commerce.

Regulatory Indicators for Sustainable Energy, an initiative of the World Bank, is a set of indicators that help us compare national policy and regulatory frameworks for sustainable energy. These tools have become very important because they ensure that everything we generate is used optimally.



### 5.- Sustainable transport

**Mr. Mustafa Shehu** alluded, at this point, to the actions of the EMT presented in the previous day. Transport consumes a lot of energy and any measure to reduce energy consumption in transport is highly commendable for achieving sustainable cities.

### 6.- Water treatment (Supply, storage, distribution)

There cannot be a population of billions of people without an adequate supply of water. This is one of the SDGs that works to ensure that the world population has access to clean, drinkable and safe water. The issue of water treatment, storage and distribution is very critical to ensure that cities are livable and the population remains healthy.

### 7.- Solid and liquid waste management

For solid and liquid waste management, energy-neutral or energy-positive, cost-effective water treatment technology suitable for low-, medium-, and high-income settings can be developed and evaluated that provides improved pollutant removal, minimizes energy consumption, and promote the safe reuse of water. In addition to developing and evaluating approaches to water, sanitation and hygiene challenges in low-income communities.

Solid waste systems can be developed for landfill gas utilization, mineral recovery facilities, disposal of open dumps, open clogs and waste leaks, improvement of disposal quality, development of organic waste recovery infrastructure, and recycling improvement.

### 8.- Affordable and sustainable housing

There is no way that we can achieve affordable and sustainable housing if we do not develop materials, which are used to build houses, that are cheap and easy to manufacture and assemble, to ensure the development of as many houses as possible in a short period of time and within a minimum cost, so that most people can afford the house to live.

### 9.- Climate change

As engineers, "we have to really look at these challenges in order to mitigate those disasters caused by climate change." If the challenges cannot be mitigated, then we will have to adapt to them. How to mitigate the effect of climate change? Reducing the emission of greenhouse gases through sustainable energy technologies and greater energy efficiency, sustainable transportation, sustainable housing. **Mr. Mustafa Shehu** gave the example of the so-called Eco Atlantic City, a city built on land reclaimed from the sea and acting as a barrier for the city of Lagos against the ocean.

### 10.- Small history

The city is a balance between ecological friendliness and practicality. It will house new businesses that will boost the economy through tourism and innovation. **Mr. Mustafa Shehu** invited investors to go to Nigeria, to Eco Atlantic City.

**Mr. Mustafa Shehu** concluded his speech by explaining that "with the increasing pressure on the infrastructure in our cities and the impact of climate change, the deployment of new and emerging technologies has become expedient to address the challenges that these projects can bring". While engineering plays a key role in the planning, construction, maintenance and renewal of cities, it must be recognized that there are many other stakeholders whose input is essential to the development of cities and "engineers must have a fluent way of relating to them" he stated.

**Ms. Raquel Bravo Rubio, Head of the Department of Dissemination and Institutional Cooperation of the General Directorate of Strategic Planning of Madrid**, took the floor to present the Bosque Metropolitano project.



This is a very ambitious project that aims to create a large green infrastructure around Madrid, connecting with existing green areas and creating new areas to enable this special connectivity between territories. This project also shows how by collaborating the different branches of engineering and other professions, it is possible to achieve a direct influence to improve the economic, social and environmental sustainability of cities.

**Ms. Bravo** provided some figures. It is about creating a green ring with a perimeter of 75 km in length, with a total area of 32,000 hectares, of which 4,300 will be new hectares derived from the project's actions, with more than 15 eco-connectors in which the role of the

Engineering is key, with a forecast of planting 1.5 million trees and a significant number of shrubs of autochthonous species typical of the Mediterranean climate and with an approximate calculation of 190,000 tons of carbon dioxide absorbed in about 30 years.

This project goes beyond the borders of the Community of Madrid and the powers of the City Council. Its benefits will be reflected throughout the Community of Madrid. It aims to connect large protected green spaces such as the Cuenca del Manzanares Regional Park and the Lower Park of the Manzanares and Jarama river courses, taking advantage of the connectivity of the Manzanares river between all these spaces and emphasizing different actions that revert to the improvement of different municipalities. that surround the city of Madrid, hence the so-called Metropolitan Forest.

It also connects with another project that the community of Madrid is developing, which is the Arco Verde project.

In 2020, when this project began, an international ideas competition was held for which the scope of work of this project was divided into 5 lots:

- 1.- Between natural mountains (north of Madrid)
- 2.- Uniting urban parks (in the northeast)
- 3.- Southeastern Green Ring
- 4.- The river parks of the south (performances in the Manzanares)
- 5.- Metropolitan ring that aims to close this great green ring that is the Metropolitan Forest with connection to the country house.

It is intended to be a great strategy to green the city and contribute to improving the health of citizens and sustainability since it is connected to other projects such as producing neighborhoods, the renaturation of several green areas near schools.

**Ms. Bravo Rubio** briefly explained each of the lots:

**Lot 1. Between natural mountains.** It is centered in the north of Madrid. There are large green spaces near Madrid where a great diversity of protected fauna and flora is preserved, such as the Iberian imperial eagle.

It is connected to a 25-hectare plot owned by the Madrid City Council, which is intended to have a demonstrative character with respect to all the space around this plot, which is made up of plots that have had a traditional character to that of agricultural uses and that are near the wall of Monte de El Pardo. Here, these traditional uses of the territory will be encouraged and an environmental education and agro-technological innovation center will also be created, promoting this typical Mediterranean landscape character, without forgetting that peri-urban agriculture is part of tradition, history and day-to-day as City of Madrid.

**Lot 2.- Uniting urban parks.** Northeast area of Madrid. It will focus on connecting the large urban parks in the area, such as the Valdebebas Forest Park and the Juan Carlos I Park, with a forest road that will be made up of a pedestrian lane, another for separate cyclist use and also with a significant presence of trees and native shrubs. Citizens will be encouraged to use the forest road, not only for the weekend, but to walk to work or to educational centers in the area in order to improve their health and the carbon dioxide emissions produced in the city of Madrid.

This road was planned, at first, only for this section of the Metropolitan Forest, but in the end, due to the success and social demand, it was decided to integrate the restoration of the Ambroz Lagoons and achieve, thanks to engineering, that this area has an environmental relevance.

**Lot 3.- Southeast of Madrid** and which contemplates an important peculiarity, you can see the character that prints the soil, it has very particular gypsum soils and is close to the Southeast Regional Park, characteristic for the cliffs of the Manzanares and Jarama rivers and it wants to encourage the conservation of this particular ecosystem derived from the specific characteristics of the gypsum soil, promoting a school on gypsum and other issues.

This is an area that, foreseeably, is going to have a very important urban development in the coming years and work is being done with the compensation boards that include the land owners so that the updates of green areas, in these new developments, are consistent with the philosophy of the Metropolitan Forest and are integrated into it.

**Lote 4.- The river parks of the south.** It presents some noteworthy particularities because, in this area, the Manzanares has an indisputable leading role. It is a place where there are several wastewater treatment plants in the city of Madrid, there is also a large number of infrastructures (roads and tracks). It is an area in great need of action in which there are many neighborhood associations demanding that improvements be made in this area and work is going to be done in this sense to restore the river, as a continuation of Madrid Río because it is the river park that exists after this great project. There are other conditions that mean that the action is not going to be the same, but that it has to be adapted to all these circumstances, such as the presence of a large number of spillways with a project for which "we have recently been awarded Next Generation funds", through of the Biodiversity Foundation, and a strategy to restore the fluvial ecosystem of the Manzanares River is going to be undertaken and to replace several concrete spillways with other solutions that allow delaying the release of water so as to recover the Manzanares River Rivera Forest. "We hope it will serve as a model for similar actions in other Spanish cities", said **Ms. Bravo**.

The culture of irrigated agriculture will be recovered. Here, at the time, the project for the Royal Historic Canal of the Manzanares was developed and, still, many archaeological remains are still preserved. There is a building that has traditionally been known as La casa del Peón that will become the farmer's house and that will serve as a link for those interested in the creation of the Manzanares Agrarian Park and to stimulate all uses of environmental education in the area.

**Lot 5.- Close the green ring of the Metropolitan Forest** with the Casa de Campo, using spaces that have been dedicated to the military, such as the Dehesa de Campamento land and the surroundings of the Cuatro Vientos airport to preserve the characteristic pasture of the environment and generate agricultural uses near the Cuatro Vientos airport. It is intended to

promote the key role of Manzanares as an ecological connector.

The Forest of Lost Embraces and the Avenida del Talgo performance have already been opened to the public. Apart from these two projects, a total of 8 are being carried out with a total extension of 52.5 hectares in which different environmental restoration techniques are being implemented and which will serve as a pilot for the rest of the actions to be developed.

It is a long-term project, with a time horizon of about 12 years that will take several legislatures, but which is a commitment by all to improve the environment and the health of the population of the city of Madrid.

**Ms. Bravo Rubio** commented that they are developing different strategies to determine:

- Necessary equipment in each of the areas.
- Land management figures.
- Uses that can be developed on each of the surfaces.

It is such an ambitious process that it requires different concertation and collaboration actions, not only within the City Council, but in conjunction with citizens, companies, professional associations, universities, research centers, land owners, through compensation boards. ... “It is a project for everyone and for everyone”, he assured.

Some events have been carried out with business alliances and with citizens with tree planting and we have developed a communication campaign on public roads in collaboration with companies, with 11 small nurseries in which it was intended to convey the importance of the soil, how the Soil is life support and how the Metropolitan Forest is going to allow, among all of us, “to generate a large number of benefits,” he said.

The role of this project and engineering is to improve the quality of life of people, the environment and society as a whole. This project makes it possible to improve health, sustainability, mitigate climate change, reduce the effect of the heat island, conserve biodiversity, restore and conserve degraded spaces, incorporate urban and peri-urban ecological agro-production linked to the acquisition of habits of healthy and sustainable eating by citizens, creating new facilities and healthy leisure, promoting the green economy and proximity of agri-food products and creating new jobs.

**Ms. Raquel Bravo Rubio** concluded by highlighting “the importance of the participation of all agents, among which engineering plays a fundamental role.”

**Mr. Andreas Brander, President of the European Council of Civil Engineers**, took the floor and assured that he had a “3 S” approach for the transformation of sustainable and solid cities.

The European Council of Civil Engineers in the World Council of Civil Engineers is now joining forces in a common initiative, which aims to raise awareness of the need for buildings based on this “3 S” approach: sustainable, healthy and safe. They can be executed by integrating a structure, seismic retrofit in existing buildings along with energy efficiency improvements.



What started as an initiative in 2020 focused on Europe is now spreading globally. The context for the three S approach was to have an aging building stock, built in the 1970s or so, and lacking modern design and construction standards and techniques, including requirements for resilience, robustness, safety seismic and energy efficiency.

One of the most important human rights is to own safe, solid and sustainable buildings. Adequate housing was recognized in Article 25 of the 1948 Universal Declaration of Human Rights, and in the 1966 International Convention on Economic, Social and Cultural Rights, **Mr. Brander** noted.

Are there established rules and priorities? Yes, the evaluation of the seismic risk, of the structural risk and the definition of strategies of prioritization of the personnel to quantify the required resources and to be able to plan the necessary investments.

However, in many countries, there are no applicable regulations for the assessment or repair of those buildings, but safety must take precedence.

In this regard, he stated that "it is absurd to see countries with seismic risk investing exclusively in habitability measures, terminal insulation in unsafe buildings" and added that "it is a deadly risk and a waste of money."

There is a lack of global, national and regional regulations and standards on vulnerability assessment and retrofit measures. The new trend is smart building and smart financing for smart buildings, "but a building can only be smart when it is safe, solid and sustainable," he stressed.

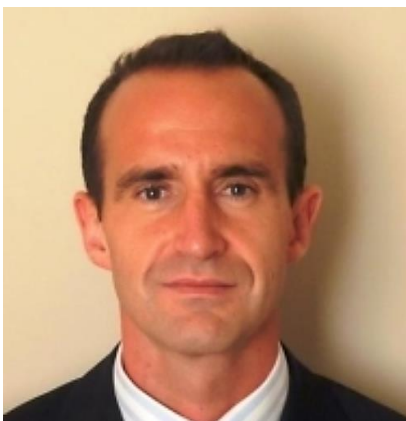
Therefore, a sustainable structural design should be applied whose key factors are life cycle design, optimization, safe structural design and execution, waste reduction, design for use, flexibility and durability of materials and components.

Scientific research has been conducted over the past few years in seismic and other natural hazard assessments, structural vulnerability, retrofitting of existing structures, and sustainability. "There is a common language for working on these problems," he clarified.

Today, the trend is smart financing for smart buildings, but a building can only be called smart if it meets this "3S" approach, safe, sound and sustainable, he recalled.

He concluded by encouraging attendees to unite, see the regulations of their countries and apply this approach to the world of politics and announced that he has prepared a manifesto for the last day.

**Mr. David Muñoz García, Director of Business Development for Urbanization Solution – Europe at CEMEX**, took the floor to talk about the commitment of the CEMEX company regarding climate change.



**Mr. Muñoz** indicated that this commitment is based on two clear foundations:

1. Value creation.
2. Clear commitment to climate change and the environment.

This commitment is translated into a plan called "Future in Action" that aims to achieve excellence in sustainability from 3 different perspectives:

- Climate action
- The circularity
- The management of natural resources



CEMEX has a plan and a goal. The goal is to reach 2050 being a company with zero net emissions and the plan is based on 6 fundamental pillars:

1. Have a portfolio of sustainable products and services.
2. Clear intention to decarbonize operations.
3. Circular economy.
4. Water y biodiversidad.
5. Innovation and collaboration with other entities.
6. Promotion of the green economy.

There is a plan, some objectives and a roadmap with intermediate objectives in which they have tried to be very transparent to achieve them, the objectives that have been validated and confirmed by external organizations.

The intermediate objectives and the main milestones that CEMEX has will be in 2025, 2030 and 2050.

Based on the results obtained in recent years, the company is on the right track. CEMEX does not follow this path alone; it has the support of organizations and entities that seek the same objectives.

Going back to one of the fundamental pillars and the products that CEMEX produces: concrete. It is one of the most used products on the planet after water and is framed within an engineering forum.

Concrete is a material with very important characteristics: it is 100% recyclable and it is a material that, throughout the useful life of the product, is capable of capturing CO2 and this is very relevant to be able to use it in the construction of cities. from the future.

Within CEMEX, and returning to the pillar of sustainable products and services, a new brand has been defined that includes all products that have a low carbon footprint called VERTUA and it is managing to bring together these low carbon footprint products and maintain and improve the behavior of the products that the company had. In addition to VERTUA, additional brands have been developed that also seek to find sustainability.

Innovation is another of the pillars that CEMEX seeks in three different areas:

- The innovation that can be found in support with other external entities.
- An internal program called Smart innovation, which aims to capture all innovation ideas from employees.
- An R&D laboratory in Switzerland that is continually developing new products and services that are quickly brought to market.

A Ventus Capital has been developed, "Cemex Ventures", which is dedicated to seeking emerging and disruptive opportunities that may be future opportunities to develop the world of construction.

All these pillars will allow the transition to sustainable construction to be carried out.

**Mr. Muñoz García** gave various examples:

- A gigantic project that CEMEX is carrying out at its German factory in Rüdersdorf, near Berlin. The objective of this project, in which four consortia and 20 partners are collaborating, is to achieve by 2030 the first cement factory with zero net emissions. "This challenge is extremely complicated," he said.
- Another project is the one carried out with Volvo Truch, through which the first concrete mixer truck in the world has been achieved that is completely electric and that can be certified as zero emissions.

Speaking of spaces, CEMEX has set the goal of making cities healthier, more resilient, sustainable, circular, more intelligent, inclusive... In general, CEMEX wants cities to be more humane.

With this intention, what has been generated within CEMEX is the Urbanization Solutions business with which it wants to focus urban construction from the point of view of innovation and value generation. Within Urbanization Solutions there are 4 different verticals that are:

- Performance Materials
- Industrial construction.
- Circular Economy. Focused on the possibility of reusing designations and construction waste in the future.
- Related Services. This has a lot to do with logistics and the digitization of processes.

All of this makes it possible to have a range of products and solutions, a new value proposition that aims to attack the needs of the construction environment from all possible angles. CEMEX wants to provide solutions to all construction problems.

An example of this are projects that have been developed jointly with entities and companies focused on engineering and architecture throughout the world. CEMEX has projects in Mexico, France, Montenegro, Madrid...

To end, **Mr. Muñoz García** highlighted the public-private collaboration. It is one of the pillars that can be activated and that is something that CEMEX already does with the Fundación Metrópoli and with Madrid Capital Internacional.

He was followed in turn by **Mr. Alfonso Vegara, President of the Fundación Metrópoli SP**, who announced the presentation of "Madrid Innovation Lab. Metropolis 2040" a project that allows visualizing what Madrid will be like in 2040.

The Metrópoli Foundation, the institution that is promoting this initiative, started 25 years ago with a project called "Project of the cities" and worked on 20 cities in the world to find out why some cities were successful and others were not. This effort was made with 20 universities.

The Fundación Metrópoli research center, which in Madrid will be called the Eco Box and "Supercities. Territorial Intelligence" is a book that collects the philosophy of the work with which cities are being designed in different parts of the world.

This methodology, this learning, has been applied to the specific case of Madrid, proposing a series of initial suggestions and proposals on how Madrid could be transformed in the future.



Madrid, within the system of European cities, is viewed as "a great connector between northern Europe and other parts of the world such as Latin America, Africa, even China's efforts investing in Latin America could, to a large extent, capitalize on the industry and Spanish companies, Madrid being a great connector between Europe and other regions of the world", stated **Mr. Vergara**.

Madrid is a municipality, but the functional reality goes beyond the municipality. In a 15-minute isochrone, Madrid has 3.4 million inhabitants, 6 million in 30 minutes and in 1 hour, also

considering high-speed trains and including Segovia, Guadalajara and Toledo, there are 8.6 million people in the environment of Madrid.

The intensity of use of Madrid is within the first ring that we call the M-30, it is a place that the entire metropolitan region enjoys and not only those who live in that territory.

In the case of Madrid and in the case of infrastructures, we see that there are a series of components of excellence, such as the fact that the airport is very close to the center of Madrid, it has two high-speed stations, both Chamartín and Atocha, also in the center and commuter trains and metro.

“If we superimpose all this infrastructure, there are very few cities in the world that have this infrastructure in such central spaces and, within the M-30, almost all the infrastructure is underground. For this reason, we could build the largest sustainable mobility center in Europe inside the M-30, and this is already a proposal for the future”, proposed **Mr. Vergara**.

If we analyze the options of working in such a complex place, it is necessary to have a global vision. The M-30 and M-40, which are the rings of Madrid with this analysis and which are called Space tapes, allow us to identify centralities and the intersection nodes between the M-40 and the radials “which are nodes of great centrality”, he claimed. “It seems that they are on the outer periphery of Madrid, but they are in the heart of the metropolitan region,” he added.

These nodes are essential so that all mobility and the distribution of uses, in the context of Madrid, can be developed. “We have called them the Gates of Madrid”. Key places of integration, employment, residence that have competition for large commercial establishments, for last-mile logistics, are fundamental places so that the accesses to the heart of Madrid can be urban roads, “they can be eco-boulevards,” he said. he.

In this context, these nodes have very good connectivity with the current public transport system. In other words, the M-40 plays an important role, but the largest exercise in decarbonizing a city in Europe could be achieved by reconsidering the design of these radial roads and the M-30, in the specific case of Madrid.

The M-30 has 32kms. in length, 900,000 people live within the M-30, but it has enormous relevance within the metropolitan articulation. Furthermore, the M-30 is not only a physical barrier, it is a social barrier. “They are social imbalances both if we analyze income levels and the percentage of the population that works in the knowledge economy, but in the future, it could be an axis of sustainable mobility, a green axis, an axis of social integration between districts of different levels of income, an axis of economic revitalization”, he assured.

The M-30 could become a large boulevard that absorbs much more CO<sub>2</sub>, that cars work at a much more urban speed like La Castellana, which has three lanes in each direction, but “an additional lane would be considered for public transport, even monorail, injecting green and decarbonizing the buildings would be a very powerful operation to transform the heart of Madrid”, proposed **Mr. Vergara**.

Madrid can also be transformed, even using new technologies that are now much cheaper than a few decades ago and that would make it possible to complete the public transport system and go from an urban motorway to a much more urban road, much quieter for pedestrians, where there are lateral service roads, that we have permeability with the urban fabric, that there is that cross-sectional permeability, in short, to be able to transform Madrid. This would allow working within the M-30, in the heart of Madrid.

Almost 80% of the fundamental routes, the structuring routes for the transport of people and electronic commerce, could evolve to a much more human use. The rest, 20%, absolutely necessary, are routes for mobility in the city.

It is about going from the apple model to the super apple model with many other functions within the city. This theoretical approach, already proposed in other cities, in the specific case of Madrid, would allow dividing the interior of the M-30 into 310 super blocks, into 310 cells of urban life.

For example, in the Salamanca neighborhood there would be the possibility of maintaining the peripheral traffic, the structuring traffic, to inject life into the heart of the city. Recover the interior patios, inject green into the streets and allow children to go outside.

The heart of Madrid could be transformed, little by little, into a much greener, more sustainable city that is a sustainable mobility laboratory with autonomous vehicles, electric vehicles, shared mobility...in short, "a huge opportunity to transform Madrid into a where mobility and decarbonization of buildings are two fundamental elements in the energy equation", he stated.

A solution of neighborhood or city hearts of 15 minutes could be proposed for Madrid. The possibility that there is not a center and a periphery, but rather a much more balanced, polycentric city, where those neighborhood hearts can be activated.

Carry out a transformation encouraging the sense of belonging of the population for the recovery of districts on the outskirts of Madrid and the city, a great connector and an innovation laboratory for urban solutions.

**Mr. Vegara** commented that "we collaborate with the Community of Madrid, in Madrid Capital of Construction, Architecture and Engineering and the Metropolis Foundation for cities of the future" and encouraged the private sector to "invest in transformation projects, within of this integrated vision that we call Madrid 2040".



For his part, **Mr. Davide Stronati, President of the WFEO Engineering and Environment Committee**, spoke of green spaces and the combination between architecture, engineering, time planning, etc. and gave examples such as the Olympic Park in London.

"When I began to investigate the cities of the world that could do the same as Madrid with Madrid Río and the trend is that the most sustainable tend to be in the most developed countries and it is a problem when we look into the future and look at the levels of construction that will be in the less developed countries, mainly Africa, China and India. We have to be more egalitarian and now there are more inequalities, especially when we are seeing the effects of climate change. To this, an additional element can be added, such as the difficulty of living in cities".

The Commonwealth Association of Architects, Planners and Engineers has conducted a very interesting survey across Africa, Asia, the Caribbean, Europe and some Pacific countries on how future-proof we are in terms of professionals. And it is appreciated that there will not be enough architects in Africa and Asia.

If we think that there are not enough architects and engineers, there are not enough schools to produce the professionals we need for the future. So, the final conclusion of this survey, as indicated by **Mr. Stronati** is that "in the countries and in the cities where they are most needed, we need to create more professional figures in the future, such as engineers and planners and architects".

## CONCLUSIONS

- Urbanism is the study of cities and the processes and patterns of urban development. It covers the social, economic, cultural and physical aspect of cities and how they function, change and evolve over time.
- The United Nations Sustainable Development Goal 11 defines sustainable cities as those that are dedicated to achieving green sustainability, social sustainability and economic sustainability. The outcome target for SDG 11 includes, among others, safe and affordable housing, affordable and sustainable transportation system, protecting the world's cultural and natural heritage, reducing the environmental impacts of cities, providing access to safe green and public spaces and inclusive and ensure the capacity of the future generation.
- In Nigeria, in 1976, there was a head of state who decided to create another city to move the capital of Nigeria from Lagos to Abuja. Today it is the capital of Nigeria with a population of 5 million. The population of Nigeria, for example, in the 60s was 50 million, now more than 200 million.
- The urban population is about 30% of the world population. But as we go now, in 2020, we might have around 55%, but in 2050 it will be around 65%. The population of the world is around 8 billion now. By 2050, the population will be around between 9.2 and 9.6.
- As the population grows and lifestyles also change, the amount of energy supply needed in homes and industries also increases. Therefore, the provision of an energy supply that is reliable, affordable and sustainable is essential.
- Transport consumes a lot of energy and any measure to reduce energy consumption in transport is highly commendable for achieving sustainable cities.
- There cannot be a population of billions of people without an adequate supply of water. This is one of the SDGs, specifically 6, which works to ensure that the world population has access to clean, safe and drinkable water.
- For waste management, solid waste systems can be developed for landfill gas utilization, mineral recovery facilities, disposal of open dumps, waste clogs and leaks, improved disposal, organic waste recovery infrastructure, and better recycling.
- Regarding housing, the goal is to make it affordable and sustainable.
- Regarding climate change, mitigate the effects or adapt. Mitigate by reducing the emission of greenhouse gases with sustainable energy technologies and greater energy efficiency, sustainable transportation, sustainable housing...
- Madrid Bosque Metropolitano is a project to create a green ring that will have a perimeter of 75 km in length, with a surface area of 32,000 hectares, of which 4,300 will be new hectares derived from the project's actions, with more than 15 eco-connectors where the engineering is key, with a plantation of 1.5 million trees and shrubs and with approximately 190,000 tons of carbon dioxide absorbed in about 30 years. It aims to connect large protected green spaces such as the Cuenca del Manzanares Regional Park and the Lower Park of the Manzanares and Jarama river courses divided into 5 lots: Between natural mountains (north of Madrid), Uniting urban parks (in the northeast), Green ring of the southeast, The river parks of the south (actions in the Manzanares) and Metropolitan ring that aims to close this great green ring that is made up of the Metropolitan Forest in connection with the country



house. This project allows: improving health, sustainability, mitigating climate change, reducing the effect of the heat island, conserving biodiversity, restoring and conserving degraded spaces, incorporating urban and peri-urban agro-ecological production linked to the acquisition of habits of healthy and sustainable eating by citizens, creating new facilities and healthy leisure, promoting the green economy and proximity of agri-food products and creating new jobs.

- The European Council of Civil Engineers in the World Council of Civil Engineers is now joining forces in a common initiative, which aims to raise awareness of the need for buildings based on this “3 S” approach: Sustainable, Healthy and Safe. Sustainable structural design whose key factors are: life cycle design, optimization, safe structural design and execution, waste reduction, design for use, flexibility and durability of materials and components.
- CEMEX is committed to climate change. CEMEX's objective is to reach 2050 as a zero emissions company. To fulfill its commitment, it has a plan called "Future in Action" that aims to achieve excellence in sustainability from 3 different perspectives: climate action, circularity and natural resource management. This plan is based on 6 fundamental pillars: portfolio of sustainable products and services, decarbonization of operations, circular economy, water and biodiversity, innovation and collaboration with other entities and promotion of the green economy. CEMEX works in three different areas: innovation, Smart innovation to capture innovative ideas from employees, and an R&D laboratory in Switzerland. CEMEX has a second brand called VERTUA that collects its low carbon footprint products. They also have Cemex Ventures, which is dedicated to looking for emerging and disruptive opportunities that may be opportunities for the future to develop the world of construction, such as recycling concrete, since it is a 100% recyclable material and capable of capturing CO<sub>2</sub>. Lastly, they have Urbanization Solutions, which has 4 verticals: performance materials, industrial construction, circular economy, and related services.
- “Madrid Innovation Lab. Metrópoli 2040” is a project that allows you to visualize what Madrid will be like in 2040. It started 25 years ago with a project called the “Project of the cities”. The Fundación Metrópoli research center which, in Madrid, will be called the Eco Box and “Supercities. Territorial Intelligence” is a book that collects the philosophy of work. The largest decarbonization exercise of a city in Europe could be achieved by reconsidering the design of these radial roads and the M-30, in the specific case of Madrid. In addition, they propose to mitigate the territorial and social imbalance. They also consider making transport more sustainable, safer roads, greener boulevards, more pedestrian areas and bicycle paths. Madrid, would allow the interior of the M-30 to be divided into 310 super blocks, into 310 urban life cells. They collaborate with the Community of Madrid, in Madrid Capital of Construction, Architecture and Engineering and the Metropolis Foundation for cities of the future.
- The Commonwealth Association of Architects, Planners and Engineers has carried out a very interesting survey in Africa, Asia, the Caribbean, Europe and some Pacific countries on how prepared we are for the future in terms of professionals. And it is seen that there will not be enough architects in Africa and Asia.

## 12:30 WATER IN THE CITIES OF THE FUTURE

The opening of the table on "water in the cities of the future" was carried out by **Mr. Ignacio González Castelao, President of WFEQ Water Committee**, who made a short introduction to frame the problem of water in cities.



"From the origin the cities settled near a source of water. Now some water risks have revealed their vulnerability to different risks, some of them related to water."

Cities and metropolitan areas are the axis of economic growth. Today they represent more than 80% of the world's gross domestic product (GDP), which also consumes more than 60% of the planet's resources. Regarding water resources, about 10% of the world demand corresponds to municipalities. Domestic water withdrawal has increased six-fold in the past 50 years, and this trend is expected to continue.

If current patterns of consumption of goods and services persist, cities will continue to be responsible for consuming a significant amount of groundwater. The more cities grow, the more exposure to increased dangers. It must be remembered that not all cities have an adequate service for access to drinking water.

**Mr. González Castelao** provided some data such as that 60% of the population is connected to a sewage system and 45% uses safely managed human sanitation services. Almost 80% of wastewater returns to ecosystems without being treated or even reused. And this decomposition of waste accounts for more than 1% of greenhouse gas emissions. This leads to pollution of water resources.

Droughts and floods are increasingly perceived by society as a public face of climate change. In fact, 90% of natural disasters are related to water, and cities do not escape these threats, but only droughts affect 20% of the world's population.

Likewise, 6% of cities are at risk of being totally flooded. Particular rotations should focus on coastal cities with dimensional risk, combined with the effects of sea level rise.

With these scenarios, no matter how much we speed up the action, "it does not seem that we will be able to achieve the ambitious objectives of sustainable development with regard to the nexus between water and cities", predicted **Mr. González Castelao**.

He concluded by ensuring that "new adaptation challenges are presented, but it is also an opportunity for a more pleasant and productive human development with special attention to the sustainability, circularity and resilience of water resources".

Next, **Ms. Sara Perales, CEO and Managing Director of Green Blue Management of the TYPESA Group**, throw a question to the audience: how to do a better management runoff in the city?

**Ms. Perales** focused on the problem of waterproofing, the sealing of the soil with which we usually build our



cities because large waterproof surfaces need large collectors to get rid of runoff water, considered waste, and this means large energy costs.

The waterproofing of the soil produces an increase in flows and, in the volumes that we have to evacuate outside the city, the challenge is to flatten the curve, and make urban developments in such a way that the previous hydrology is reduced before urbanization.

“Not only the quantity but also the quality of these runoffs is important,” said **Ms. Perales**. When we have unitary systems the contamination problem is clear.

But the situation is no less problematic when we have separative systems because those first rainwaters, which clean the cities, carry large amounts of sediment, hydrocarbons, and heavy metals that also contaminate our receiving environments.

To try to solve these two big problems, the proposal at the international level is the implementation of sustainable drainage systems that are nature-based solutions for better rainwater management. It is about reproducing those effects that occur in nature such as retention at source, filtration, bioremediation, integrating drainage solutions into the urban landscape.

An infinite number of techniques can be used, such as vegetated roofs, rain gardens depressed with respect to the adjacent pavement, permeable pavements, etc. In addition, this sustainable drainage approach makes it possible to restore the natural drainage capacity of cities in favor of the circular economy.

The SuDS contribute to adapting to climate change, to coping with floods, but also with droughts and allow us to move towards that circular economy and achieve several of the sustainable development objectives: the objective of clean water, sanitation mainly, but also others.

The SuDS are nature-based solutions that involve decentralized management of rainwater, which is one of the biggest challenges, because in cities there are all very compartmentalized organizations, they work in silos and these solutions not only have to do with the issue of water but also with green areas and pavements and, therefore, great interaction is needed between the different municipal sections to manage it in favor of a much more sustainable and efficient solution.

“In addition, educational opportunities appear and, for example, the incorporation of posters to the works helps citizens see the need to consider runoff as a very valuable natural resource and not as that residue that we quickly dispose of,” he said.

They are solutions that are integrated into the urban landscape, specific for each location and that, in addition, allow you to acquire points in the sustainability accreditations, he pointed out.

Already in 2018, the United Nations dedicated it to nature-based solutions and, at the European level, there are already multiple publications that have been pushing us to implement this sustainable drainage approach.

In Spain, in the current legislative framework, the need for new developments to implement sustainable urban drainage systems was already incorporated in 2016 so as not to increase the risk of flooding. In addition, technical guides have already been published that make it easier for designers and city managers to promote this paradigm shift.

In 2010 with a European project, the Aquaval, these systems began to be tested, which had already been developed in northern Europe, but not so much in the south and, among them, several pilots were built that were monitored to see the efficiency of these systems.

For example, a permeable pavement captures practically all the runoff, compared to a conventional pavement that drastically reduces it, he said.

Vegetated roofs, rain gardens that collect runoff from sidewalks as water from the roofs of adjacent buildings, were also monitored.

**Ms. Perales** presented several examples such as the Bon Pastor in Barcelona, of which she highlighted that with only 7% of depressed green areas that, in addition to all the benefits of green areas, incorporate the management of stormwater from buildings and pavements, it can manage virtually all of the rain for one year and reduce up to 85% of outgoing flows with the return design rain for 10 years.

Another example was the Cristóbal de Moura shaft in Barcelona, which received an award in 2020 and which combines surface solutions with buried solutions to increase the rainwater retention capacity.

In Madrid, he gave as an example the urbanization of the BBVA headquarters, which has drainage ditches and infiltration tanks that largely prevent runoff water from entering the collectors.

In the case of the Parque de la Avenida de Alfonso XIII, informative posters have been installed so that citizens know the actions that are being carried out and educational posters. Another example would be the waterproof pavement of the Wanda, both in the car park and in the bus park.

Many other cities are integrating these systems, for example, in Valencia, some smaller but also very important actions.

Didactic work is also very important to make citizens understand that puddles in green areas can help prevent the flooding of garages in another area of the city.

**Ms. Perales** referred the attendees to visit the redSUDS website where experiences of sustainable drainage in Spain are compiled and announced the next conference, related to this, in A Coruña (April 26 and 27, 2023).

She ended by highlighting that sustainable drainage systems are a fundamental tool for adaptation to climate change in our cities and that it is very important to have a holistic approach that integrates both the naturalization of cities, as well as mobility, educational and water management plans. of rain. These experiences and conferences are also very important because they contribute to the dissemination.

It was the speaking turn for **Mr. Abou Amani, Director of UNESCO's Division of Water Sciences** who connected online to participate in the table and recalled the importance of water clarity.



He affirmed that water is at the center of all the SDGs, because "cities have been facing water problems for all those challenges that we need to face." Make evidence-based decisions with innovative and sustainable engineering solutions.

**Mr. Abou Amani** outlined the current program of the intergovernmental hydrogen group, a scientific program and capacity building element within the program to support member states in tackling complex water challenges.

This program has been implemented since 1975 and has now evolved from a single discipline to a multisectoral and transdisciplinary program, taking into account the issue of water.

Currently, the nine fields of the program are being implemented with the centrality in science for safe water in the environment.

The program has five priorities:

1. Scientific investigation and innovation
2. Education on water in the fourth industrial revolution, including sustainability
3. Closing the data knowledge gap
4. Integrated water management in conditions of global change
5. Science-based water governance for mitigation, adaptation and resilience

When we come to the topic of cities, we all face challenges or similar and there are many challenges to solve in Africa, India, China...in addition, these cities are going to face more and more challenges related to climate and natural catastrophes.

For this reason, **Mr. Abou Amani** wanted to highlight three initiatives that they have been implementing to support cities:

1. A series of water megacities and global change conferences.
2. Initiative to establish an alliance of cities for the Water and Climate Mark, whose objective is to provide a forum for international cooperation for dialogue on water and create a knowledge base on issues related to water and climate and funds for help megacities adapt and mitigate the effect of climate change.
3. The application on the use of the city book. Help the city to better understand the complexity of what happened with respect to the environment.

"We already have the support of 10 cities in Africa and we can provide an analysis on those cities to give them guidance," he said.

Following this analysis, the application of basic frameworks that helps to understand the problem of the challenges that the city faces in the water supply was proposed. And, looking in the long term, with the issue of the potential impact of climate change.

Small island developing states face very critical challenges, such as land scarcity related to rising sea levels. In this case, a framework on climate vulnerability and water resilience in SIDS (islands) has been initiated.

From UNESCO, we are identifying areas for analysis, evaluation and adaptation with the aim of having pilot plans, mobilizing partners who can work to contribute.

From UNESCO, the key point is to improve the knowledge base of water because, if not, we will not be able to make decisions for its management. Cities face multiple challenges and many are related to water.

The next point will be capacity building because in many urban areas it is missing as a basic element. "Unfortunately, it would affect the sustainability of addressing water challenges with those cities," he said.

Lastly, he ended his speech by alluding to the need for a new water culture at all levels and in all cities. "A lot of water resources are wasted in all cities. Water needs to be managed much better so that there is more availability for people and future generations," he said.



For his part, **Mr. Pascual Fernández Martínez, Managing Director of Canal Isabel II** wanted to show an example of what Canal de Isabel II is doing in Spain.

The Canal de Isabel II is a company that now provides urban water service to more than 200 cities in various regions of Spain and in some cities in Latin America and the world.

We supply to 179 municipalities; we cover an area of more than 8,000 square kilometers and we process the water before it is discharged into the rivers so that it is in adequate conditions. treated water can be reused, without the need to obtain new supplies and produce a large number of by-products in a circular economy model.

The challenges that the water sector is having to face are much greater than in the past: the fight against climate change and a new paradigm based on sustainability, corporate responsibility and the economy.

Companies dealing with the management of the urban water cycle face enormous challenges for the future. And among them, **Mr. Fernández**, highlighted:

1. The legalization of the integral water cycle
2. The decarbonization of the process
3. The circular economy
4. Nature-based solutions

The industrial 4.0 and data revolution have reached the water sector, dams, pumping equipment, storage tanks and other key areas of the network. Now, the Internet of Things and other big data applications allow for increased decentralization and remote management of many functions across the entire network. Currently, it is possible to transmit, receive and process much more data at the same time. Automatic decision-making algorithms also allow processes to be transmitted more quickly and agilely.

A short time ago, the Spanish government announced the new resilience program in Spain, financed with Next Generation EU funds, which will allow us to develop systems and tools to develop remote meter readings throughout the country, in the near future. In addition, "we have developed a program that will require an investment of more than 2,000 million euros for it," he added.

The result of the research that is being carried out worldwide regarding the future of the role of artificial intelligence and other urban water management tools will soon be seen.

**Mr. Fernández Martínez** listed the main benefits of having a digitized water cycle are:

1. Optimize the management of water resources using the appropriate source of supply.
2. The information will be adjusted to the automatic decision-making processes.
3. It will reduce the movement of operational employees.
4. It will mitigate carbon emissions.
5. It will manage the personnel to focus on the keys that represent a greater added value.
6. Quick detection of incidents thanks to algorithms that analyze consumption patterns and abnormal pressure variations.
7. Protection of the environment with continuous analysis of water quality to identify parameters that allow prompt response.
8. Risk management and drought protocols. Valuable data allows us to detect drought and flood patterns early to effectively benefit assets for each scenario
9. Lots of new consumer services. Create greater environmental awareness and consumer commitment to save water resources.



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The digitization process requires specific experience in order to automate and optimize processes. A large set of parameters need to be measured automatically on the fly, many of which have difficulties for the power supply to connect and through the criteria we measure flow, pressure and composition, but also others as the power consumption of the connectivity of each equipment.

As a result of the development of narrowband IOT, the amount of data downloaded by meetings can be multiplied, as well as allowing the efficiency of the company's analysis to be increased.

Some data must be processed in real time. For example, when a leak is detected in a network, he clarified. Other information must be stored and available for automatic decision making.

Once a computer has analyzed the data and the operational decision has been made, orders must be transmitted for each gate, dam or pumping system so that each independent element that makes up the entire water cycle acts like a perfectly synchronized machine.

**Mr. Fernández Martínez** also spoke about the surveillance system. It is a system that allows tracking and monitoring in Spain and obtaining a large number of sampling points by population coverage.

"We have used a system that covers about 7 million people, in 117 municipalities and we take information for about 300 sampling points," he explained. The system offers private information so that health authorities can make the right decisions related to a pandemic, for example.

For the decarbonization of the process, the use of renewable energies is needed, in the daily operation of the Canal de Isabel II, in order to mitigate the impact of climate change.

Companies consume huge amounts of energy and we must be aware of reducing this consumption. Canal Isabel II has managed to reduce the energy consumption we had. In addition, the Canal has produced 80.87% of the energy it consumed in 2021, and is committed to being 100% self-sufficient in the very near future.

You have to use any accessible source such as hydroelectric plants, microturbines located along the distribution network, biogas generators that can be used in water regeneration plants and then combine internal processes with solar panels, with hydrogen, any available source. renewable energy is interesting.

Carrying out comprehensive water management allows water co-companies to carry out multidisciplinary environmental management, taking advantage of all the synergies in a process from start to finish.

In addition to wastewater treatment, plants are becoming factories for rich nutrient recovery and energy production, as well as producing a large number of by-products. Of course, "we want to increase the volume of water available through reclaimed water, purification, and generating material for fertilizers. In some plant, biogas is also produced", for example.

Canal de Isabel II has a network to purify and treat water with sewage, commercial and industrial sewage. Every time "we have more experiences for different crises or incidents of water stress and, now, we understand better how early warning systems work", he affirmed.

There are SUDS systems with designs capable of sustainably capturing water and avoiding overloading the sewage network, such as permeability in the soil to save runoff, preventing it from being contaminated as much as possible.

The conservation and importation of the environment is at the four points of the Canal's mission and is always present, operating in the Spanish cities of the future.

**Mr. Fernández** concluded by assuring that from Canal de Isabel II “we want to go a little further in our approach to environmental problems and our fight against climate change. For this reason, we will continue to invest in a water policy firmly based on environmental, territorial and sustainability criteria in line with the 17 SDGs as promoted by the United Nations”.

**Mrs. Marlene Kanga AO, Non-Executive Director and Board Member, Chair of the Sydney Water Corporation Planning and Infrastructure Committee**, took the floor to discuss the work she is doing at Sydney Water Corporation where work has been done in relation to the implementation of sustainable strategies for the city of Sydney.



“It is really very interesting to see the alignment in thinking that is taking place around the world and the urgency of implementing sustainable strategies”, she stated.

This congress is a key moment for the WFEO to promote the UN Sustainable Development Goals (SDGs) through engineering. And World Engineering Day is a perfect platform to talk about engineering and sustainable development.

The UN Global Sustainable Development Report, published in 2019, recognized science and engineering as key to advancing the sustainable development goals. In the report, urban and peri-urban environments were considered one of the entry points for transformation. And here, science and technology are one of the key levers.

“We as engineers, architects and planners have an essential role in advancing this UN agenda to address the SDGs,” said **Ms. Kanga**.

“Sydney Water Corporation is a great example of how to translate the vision into implementation”, he assured. The expansion of Sydney is a great opportunity to implement sustainable city strategies in a completely new site, in what is going to be one of the fastest growing urban areas in a developed country.

The population is expected to grow from the current 4 million to about 6 million. Now, Sydney's second international airport is under construction, due to open in 2025.

The Harbor City area, she said, is great. It has four degrees less than the western part of the city and 30% of trees in the east, double that in the west. The port city enjoys 1,000 square meters, quarter acre blocks with lawns and swimming pools etc. It will have lots of high-rise buildings and the Greater Sydney Commission has produced a dashboard to track what it will be like in terms of transport, water or housing, for example.

Sydney Water Corporation, and the oldest part of Sydney, that is, the one corresponding to the port city, the Harbor Bridge and the Opera House is the most operational now. This area provides some 500 billion liters per year to around 5 million people. Currently, it is responsible for water supply and wastewater, but not stormwater. For this reason, one of the great strategic changes for the corporation was to recognize the importance of rainwater.

Currently, it only goes to the sea, collects it, reuses it and recycles it. So, this was a big sustainability shift.

In the new Western Sydney, there is a small stream called South Creek that is going to be the green backbone of this new urban area. The second airport will also arrive there. The strategic approach is an integrated approach to water management.

Sydney Water, is one of the first water utilities to become a signatory to the United Nations global compact for sustainable SU development. It has 10 reported sustainability measures, is committed to renewable energy, and has a zero-carbon network. In addition, it is focused on climate change, independent weather, independent water supplies, because there are also drought cycles, and water recycling.

A major communication campaign is underway to convince the people of Sydney to drink recycled water. “It is politics, not technology, that prevents us from getting ahead,” **Ms. Kanga**.

Regarding the Canal de Isabel II company in Madrid, “we are interested in technological innovation,” he said. We are using data and analytics and have created a digital twin. As part of the United Nations Global Compact, “we are committed to diversity and equity,” she added.

There is a reconciliation action plan to include First Nations people in the organization and learn from them, in terms of environmental stewardship, because they have a unique connection to the land and can really provide that guidance.

According to annual sustainability reports, based on the United Nations SDGs, **Ms. Kanga** believes that “here, again, is an opportunity to use Western Sydney countryside development to drive sustainable goals”.

The planning and infrastructure committee received project proposals that they tested in terms of water recycling, for example, reusing food waste by turning it into biothane to run treatment plants.

Regarding investment, it is planned to spend more than 10,000 million in the next 4 years. One of the planned projects is an advanced water recycling center, which will be ready by 2025. Another is a north-south oil pipeline that runs along that previously cited backbone. Reservoirs or dams supplying water from the southern part of the city to the north will be connected. “Building resilience,” she noted.

An award-winning stormwater harvesting management plan has also been developed. The idea is to implement watershed management so as not to have that urban runoff. There are 200 giga liters per year in this western area that is currently running off and that they want to capture to make this part of the city green and fresh and more livable.

**Ms. Kanga** stated that “we are now the trunk drainage authority. Whereas before the Government told us what to do, now we are the ones who tell the Government what to do and what is the best way. We are the experts and the Government has accepted and recognized this”.

The design for the management of rainwater and basins with permeable surfaces, are also aligned with what was explained by **Sara Perales**, she assures and this will allow the treetops to grow, essential for the west of Sydney.

The economic and social benefits are estimated at around 10 billion. With a huge cost-benefit analysis. And, here, the countdown to net zero begins. Resources are being recovered, biogas and, in the future, phosphorus, etc. In addition, food waste is being collected to generate energy, thereby reducing the volume of waste.

On the other hand, the Advanced Water Recycling Center will be 10 minutes from the new Sydney International Airport, and will treat 100 million liters by 2036 and waste from all of Western Sydney, especially organic waste, will go to this facility. This will really be a center of a circular economy in a smart city.

**Ms. Kanga** listed other actions they are carrying out, “we are committed to innovation”, she stated. For this reason, “we have an innovation festival every year to generate new ideas, the hackathon” for which the prizes were awarded during the congress. At the academic level, “we have partnerships with five universities in Sydney.”

“We have robots to inspect underground structures. We are, of course, engaging with households so that they can manage their water use. We will be able to demand accurate prices and encourage the use of recycled water. We are testing the so-called hydro loop technology, right now, and that households can implement to treat gray water and recycle.”

The NSW government has what are called sustainable development bonds that are tied to certain sustainability targets. If those targets are met, the interest rate falls a couple of basis points. On the contrary, if you do not meet the objectives, the interest rate increases. Some projects have been financed with it.

“Sydney's cities are essential for the sustainable development of people, the economy, services, the environment and, of course, strong institutions,” she said.

**Ms. Kanga** ended her presentation by recalling that engineers can make a difference in relation to the 17 SDGs, which are so important for cities.

**Mr. Michael Toh, Director of Industry and Technology Collaboration PUB, Singapore National Water Agency** took the floor to explain what work they do in his company.



Singapore’s National Water Agency is a National Water Agency where most of the staff are civil engineers, mechanical engineers and electrical engineers with a common mission. Essentially, making sure that Singapore is one of the most water-carbonated countries in the world. Despite having 700 square kilometers, it will not be able to grow like Sydney or Madrid will.

The mission is to adequately hydrate 5 million people and maintain business on the island, quite a challenge. In addition, the objective is to provide the basic supply of good quality water, recover water for use and control stormwater, they will also be in charge of resisting the rise in sea level, a responsibility they assumed in 2020.

Climate change has taught them that, in addition to dealing with rising sea levels, they must cope with frequent and heavy rains, prolonged dry spells, and seismic movements.



By 2060, they expect the demand for water to grow fourfold and the waste produced, too, will be four times greater.

Today in Singapore technology is very dependent on energy so they have to reduce energy and carbon emissions. In addition, by producing more water, they must be able to reduce waste and recover resources from wastewater.

**Mr. Toh** was keen to share three thoughts he thought were important for engineers to consider: “Look to the future, not the other way, and make a joint effort”.

In Singapore, a lot is invested in technology, in research and development. Since 2005, more than three-quarters of a billion Singapore dollars have been invested in research. This technology and these solutions are intended to address the needs, for which a roadmap is drawn up.

One of the main challenges facing Singapore is that, by 2060, it will finalize a key water deal with Malaysia. Currently, Singapore buys half of the water from Malaysia and they do not know if they will renew it, so they will have to be prepared for any eventuality.

Singapore's National Water Agency is looking for ways to implement the technologies and get people to use them. Therefore, they try to shorten the technological cycle. They help companies scale manufacturing, encourage start-ups, and conduct university research that then doesn't leave university to become solutions. Ultimately, they try to foster a culture of start-ups and SMEs or small media companies, within Singapore, to help the global water community because they believe that some of these solutions can serve other countries. They are already serving it to key markets like Asia, China and India.

Every engineer, every officer, must be prepared to work with the industry and be open to ideas for future challenges. Mr. Toh wanted to encourage companies to make their home in Singapore, believing that “when this cross-pollination of ideas takes place, we will have the best solutions for any utility”.

Today, Singapore is home to more than 200 water companies and 25 research institutes. Therefore, they want to work closely with the industry.

**Mr. Toh** expressed his interest in digitalization because he believes that “with the advent of sensors with the low cost of telecommunications, we also want to be able to take advantage of data from iot, telecommunications digitization to help us do our work.” With this, the objective is to improve operational command and control, data collection capacity and field operations.

He pointed out that “we look for technology that suits us. Not everything is useful, but what is useful to us, like robots or data analysis, we carefully analyze before implementing it.”

“Many people are under the impression that digitization will lead to job cuts or job losses, and it isn't,” he said. When they implemented the smart roadmap, they realized that there were no job losses, but that it helped them perform tasks better.

Later, **Mr. Toh** discussed Marina East's 2021 desalination plan that allows them, from the same dual intake plant located in central Singapore, to treat both seawater and rainwater. This allows them to have resilience and sustainability within the water supply system itself.

On the other hand, they are trying to decarbonize, reducing emissions, replacing them with renewable energy and eliminating emissions.

**Mr. Toh** cited *The Reservoir*, a 60-megawatt floating solar farm, “enough to power all of our waterworks in Singapore, so 100% green water treatment can be achieved if required.”

He also declared that it is clear that they must involve young people, partners, and public and private entities to encourage the management of water.

In addition, they create spaces where companies can collaborate closely with the company. Now, “this center is a home for 30 companies from 10 different countries, working closely together,” he said.

**Mr. Toh** made a comparison, “this is like the nursery for small water companies where we encourage our engineers to continue learning and sharing”.

**Mr. Michael Toh** concluded by inviting listeners to attend Singapore Water International Water Week, concluding by stating that “the basic issue of water treatment, drainage, catchment water waste and water treatment it will continue to happen” and therefore “we want to learn more and we encourage all our engineers to learn more”.

**Mr. Ignacio González Castelao, President of the WFEO Water Committee** and moderator of the talk, closed the table with two calls:

1.- Traditionally, societies have streaks behind technological innovations, but today, as with climate change, changes are taking place ahead of technology. Therefore, “we need these entrenched changes if we are to achieve the goals”.

2.- Call to adaptation. “Knowing that, with the planet's mitigation measures, it is almost impossible to reach the temperature limit established in the Paris Agreement, innovation and investment in adaptation take a really relevant place. We cannot forget that, beyond adaptation, only forced migration remains”.

## CONCLUSIONS

- Regarding water resources, close to 10% of world demand corresponds to municipalities. The withdrawal of water, for domestic use, has increased six times in the last 50 years and this trend is expected to continue. Not all cities have an adequate service for access to drinking water.
- Almost 80% of wastewater returns to ecosystems without being treated or even reused. This decomposition of waste represents more than 1% of greenhouse gas emissions. This leads to pollution of water resources.
- In fact, 90% of natural disasters are related to water, only droughts affect 20% of the world's population. 6% of cities are at risk of being totally flooded. Coastal cities are most at risk from rising sea levels.
- TYPESA focuses on waterproofing, the sealing of the soil with which cities are built, because large waterproof surfaces need large collectors to get rid of runoff water, considered waste, and this entails large energy costs. In addition, it produces an increase in flows and the challenge is to carry out urban developments to reduce the previous hydrology before urbanization. The proposal, at an international level, is the implementation of sustainable drainage systems. It tries to reproduce those effects that nature produces, such as retention at source, filtration and bioremediation, integrating drainage solutions into the urban landscape. SuDS are nature-based solutions that help us adapt to climate change, cope with floods and droughts, and help us move towards that circular economy to achieve sustainable development goals. In Spain, in the current legislative framework, the need for new developments to implement sustainable urban drainage systems was incorporated in 2016 so as not to increase the risk of flooding. The European project, Aquaval, began to test the aforementioned processes.
- Sustainable drainage systems are a fundamental tool for adaptation to climate change in cities. A holistic approach that integrates the naturalization of cities, mobility and educational plans, and rainwater management is important. Water is at the center of all the SDGs.
- UNESCO. The current program of the intergovernmental hydrogen group has been in place since 1975. It is a scientific program and capacity building element within the program to support member states in addressing complex water challenges. This program has five priorities: scientific research and innovation; water education in the fourth industrial revolution, including sustainability; closing the data knowledge gap; integrated water management in conditions of global change and science-based water governance for mitigation, adaptation and resilience. There are three initiatives that have been implemented to support cities: "water megacities" and conferences on global change, alliance of cities for the Water and Climate Mark, in order to promote international cooperation, and the application on the use of the book from the city.
- From UNESCO, areas for analysis, evaluation and adaptation are being identified to have pilot plans and mobilizing partners that can work to contribute. For UNESCO, the key point is to improve the knowledge base of water, because if not, we will not be able to make decisions.
- For the Canal de Isabel II, treated water can be reused, avoiding the need to obtain new supplies and produce a large number of by-products in a circular economy model. The companies that deal with the management of the urban water cycle face: the legalization of the integral water cycle, the decarbonization of the process, the

circular economy and solutions based on nature. Now, the Internet of Things and other big data applications allow for increased decentralization and remote management of many functions across the entire network. The main benefits of having a digitized water cycle are: optimizing the management of the water resource, the information will be adjusted to the automatic decision-making processes, reduction of the movement of operational employees, mitigation of carbon emissions, personnel administration, rapid incident detection, environmental protection, risk management and drought protocols and new consumer services. The development of narrowband IOTs can multiply the amount of data they download, as well as increase the efficiency of analysis. The Canal has produced 80.87% of the energy it consumes in 2021, and is committed to being 100% self-sufficient in the very near future. Possible solutions: accessible sources can be used, such as hydroelectric plants, microturbines located along the distribution network, biogas generators that can be used in water regeneration plants, and then combine internal processes with solar panels, with hydrogen ... The Canal de Isabel II has a network to purify and treat water with sewage and commercial and industrial sewage. SUDS systems are designs capable of sustainably capturing water and avoiding overloading the sewerage network. The permeability in the soil allows runoff to be saved, preventing it from being contaminated.

- Sydney Water Corporation is a great example of how to translate vision into implementation. It is currently responsible for Sydney's water supply and wastewater, but not stormwater. In addition, it is one of the first water utilities to become a signatory to the United Nations global compact for sustainable development of SU, which has 10 sustainability measures reported on, is committed to renewable energy and has a zero network. It is focused on climate change, independent water supplies, because there are also dry cycles, and water recycling.
- It is planning to spend more than 10,000 million in the next 4 years. One of the planned projects is an advanced water recycling center, which will be ready by 2025. Another is a north-south oil pipeline. A rainwater harvesting management plan has also been developed. The idea is to implement watershed management so as not to have that urban runoff. The economic and social benefits are estimated at around 10 billion. With a huge cost-benefit analysis.
- The Advanced Water Recycling Centre, in Sydney, will be 10 minutes from the new Sydney International Airport, and will treat 100 million liters by 2036. So-called hydro loop technology is currently being tested that households can implement to treat gray water and recycle.
- Singapore's National Water Agency is a National Water Agency where most of the staff are civil engineers, mechanical engineers and electrical engineers with a common mission, essentially, to make Singapore one of the countries with the most water gas in the world, despite having 700 square kilometers and not being able to grow like Sydney or Madrid will. The mission is to adequately hydrate 5 million people and businesses on the island. By 2060, they expect the demand for water to grow fourfold and the waste produced to be four times greater. One of the main challenges facing Singapore is that, by 2060, it will finalize a key water agreement with Malaysia from those who buy water thanks to that contract that they do not know if it will be renewed. Digitization and iot systems can help obtain data that facilitates management.
- The 2021 Marina East desalination plan allows, from the same double intake plant located in the center of Singapore, to treat both seawater and rainwater, thus increasing resilience and sustainability within the system itself.

## 16:00 ROUND TABLE: INTERNATIONAL ORGANISMS



**Mr. José Vieira, President of the World Federation of Engineering Organizations, WFEO** acted as presenter of this round table and expressed its purpose, "the idea is to have ideas of cooperation at the institutional level and share the strategic vision of well-being in societies, according to their level of wealth, sustainable access, infrastructures and services".

Advances in science and engineering "are the key to expanding and improving infrastructure to reduce poverty and meet the challenges of global warming and climate change. Engineering has an essential role to play in achieving the sustainable development goals and, most importantly, when it comes to fostering technological capacity, building developing regions and ensuring that future generations of engineers and scientists can design solutions to local challenges and global," said **Mr. Vieira**.

**Mr. Vieira** finished the presentation of the table by detailing the issues that would be discussed and of which "we want to have the perspective for regional dialogue and cooperative projects at these two levels, national and international. We will talk about technological innovation to build and improve resilient infrastructure, food and water supply systems, decarbonization of energy production, and the raising and harmonization of engineering education standards to ensure adequate training."

The first turn to speak was for **Mr. José Trigueros, President of the Institute of Engineering of Spain, IIE**, who assured that the institutions present at the table "are benchmarks in the field of engineering, although all branches of engineering must be incorporated such as aeronautical, agronomist, road, industrial, mining, forestry, naval, oceanic and telecommunications engineers".



At Instituto de Ingeniería de España (IIE), the suitability of the people is guaranteed, young people enter and there are around 300 people working and updating all the knowledge they have. We do not only have this knowledge, there are collaborations with individuals and some international representation, within the institute, which will increase with collaborations that will be signed.

"Our mission is to contribute to the development of engineers, to contribute to the benefits of society and to contribute to advancement", added **Mr. Trigueros**.



At IIE, conferences are held on the future of hydrogen in the maritime sector, new materials, alternatives for climate change, the evolution of traditional intelligence to artificial intelligence, etc. “Conferences are available on the YouTube channel”, he announced.

**Mr. Trigueros** ended his speech by referring to the intention of the IIE, “we want our knowledge to reach all parts of the world, we want to sign collaboration agreements and protocols with all the institutions present here and the exchange of students or recent graduates with in order to exchange knowledge and human relations”.

The speaking time continued with **Mr. Fernando de Almeida Santos, President of the Order of Engineers of Portugal, OdEP.**



The Orden de Ingenieros de Portugal (OdEP) it is a professional public association “that has too many professional attributions from the state,” he said.

The recognition of the engineering profession is not done by the State, it is done through the OdEP, and they do it because prestige is gained for the developing society.

The three main points for the 3-year mandate, and for the engineering of the 21st century, have been to create new specialties for the engineers of the future for new needs such as aeronautics, biotechnology, industrial engineering and management, food engineering, safety and quality. of engineering; disseminate knowledge and topics that concern the different specialties.

With the Bologna process, there are two levels of school: Bachelor and Master. The results are classified into 4 levels of complexity and are distributed with the necessary engineering skills. “We have developed a training program and systems that they had in Italy. It is a kind of registry that brings together schools, experience, practical training, field work and publications, articles, congresses and engineering management”, he clarified.

**Mr. Fernando de Almeida** announced his intention to “have a pilot experience this year. There were private clients who asked that, in public contracts, there be a curriculum, but with certification. We take care of this in Portugal. This certification helps to gain confidence in the public, so we are contributing to the development of society and the credibility of engineers.”.

They also work on issues of sustainability, digital transition, new digitized infrastructures, energy sustainability. For example, for its cooperation and resilience plan or the port of Portugal that work for the sustainability of the system.

The OdEP claims to have a problem and it is the engineers' fault. A problem for the whole of Europe, which is why they are establishing cooperation with the Institutes of Portugal to discuss politics with them and solve this type of problem.

Participation in this type of event is, for them, a strategic issue where they can defend their international engineering efforts. They also have different bilateral agreements with other countries and agreements with Spanish universities. In addition, some Spanish companies in Portugal can afford the recognition.

Mr. Fernando de Almeida concluded with a statement “our engineering is good, so we can easily enter other countries where we work and we are already working on engineering 5.0”.

**Mr. Song Yonghua, Member of the Executive Board of CAST and Rector of the University of Macao**, took the floor and spoke about Energy and smart cities and how institutions can work hand in hand to solve problems. "Universities, for example, in addition to being a place of engineering education, are places for research and for finding solutions that challenge problems," he said.

During the sessions, much emphasis has been placed on energy, because the energy system is a source of global carbon emissions. Cities are the main battlefield because they consume around 75% of the energy and produce 70% of carbon.

China, in particular, had 20% urbanization in 1992, until now it is 65% with energy consumption around 85% and emission 85%, and energy consumption continues to rise. Demographics and urban settlements played an important role in the contribution of emissions in China.



As supporting institutions, **Mr. Song Yonghua** mentioned the China Science and Technology Agency, which is the largest non-profit organization in China, with more than 200 national societies including: warfare, science, technology and engineering, and with more than 80 engineering societies. This association serves as a bridge between science, the scientific community and the government.

**Mr. Song Yonghua** stated that he works closely with the WFEO as they are members of the group.

Among the activities they carry out, he pointed out that they organize the engineering and innovative technologies committee. In addition, they established the Woman Engineer Award in 2021 and the Chinese engineering organization created the Chinese Society of Engineers.

With these organizations they work on capacity building and development to achieve carbon neutrality. In addition, they have a series of published books and are committed to the work they do with WFEO to find solutions to climate problems.

As **Mr. Song Yonghua** said at the beginning, the university is a place for training and research and they are in collaboration with the University of Macao where "we rank number one," he said.

In addition, they have a State Internet laboratory and association, the only laboratory in China in the area of smart cities. In this context of smart cities, and with state collaboration, they are using interference technologies to address the problems derived from them.

The fundamental goal is network detection and communication to capture the data, communicate and form larger data, and intelligently do the analysis, decision making and application of smart energy, smart transportation and disaster prevention.

Currently, in the area of network communication and smart sensing, they are working on 5G for smart energy for cities. In short, "we want resilience, clean, resilient cities, and high-efficiency systems thanks to current technologies," said **Mr. Song Yonghua**.

In the case of Macao, it is a very demographically dense city, "we continue with the investigation to achieve Carbon neutrality", he assured. "The electricity supply is 90% imported, 10% local," he said.

For this reason, "we proposed seeking the integration of solar and photovoltaic energy, powering electric vehicles and buildings, technology to reduce indirect carbon emissions, and green energy, which is clean, but monitoring how it is formed to see if greenhouse gases are generated, green energy from renewables", he explained.

In addition, Macao continues to cooperate with Portuguese-speaking countries with which we have great ties, through large projects. We have scholarships for engineering students from Angola, Mozambique and other places in the world.

**Mr. Song Yonghua** concluded by saying that "cities around the world share similar challenges or opportunities, and to achieve sustainable smart cities, we need the involvement of the whole of society. At CATS we will continue to promote cooperation".

It was time for **Mr. Salvador Landeros, President of the Pan-American Union of Engineers Associations, UPADI**, who assured that the Federation has 27 organizations in two observatories in Spain and Portugal.

**Mr. Landeros** emphasized 4 things:

- Effectively and efficiently solve the technological problems that concern society in order to improve the quality of life.
- Engineering is essential to meet the needs of the population
- Economic development and provision of services to society.
- The value of the lines of engineering in the social function.

He assured that "a large part of development is based on the knowledge economy and, therefore, taking advantage of science and technology can reduce inequality and accelerate the economy."



Engineering influences all the SDGs because, in all of them, there are engineering activities. **Mr. Landeros** pointed to the lack of a strong social protection system. For example, in products that generate economic growth, poverty can rise and work can be mechanized (for example, in the agricultural sector). Another example, climate change, with innovation focused on global sustainability.

**Mr. Landeros** focused on several topics to take into account and to think about, such as: the industrial revolution 4.0 with cybernetic physics; physical electronics; iot; energy; biological material sensor; digital transformation, important to grow and have economic benefits; data science; engineering; transport; the new disciplines of engineering and the necessary skills for the engineers of the future.

And he added others like: the basic skills, the analytical background, the discipline, the specific knowledge, the transferable scoring skills that IT will continue to need, the stability to write code, data, device analysis, digital skills, digital learning... "This It is very important for engineers" he assured.

And he did not want to leave behind others such as: artificial intelligence machine learning, big data, multidisciplinary issues, complicity, business skills, science, making globalized engineering provide a general culture for engineers, ability to dimension issues open, promote the participation of engineers from different countries, etc.

The Pan American Federation promotes the subordination of personal interests to those of the country and cultivates the motivation to reach global issues.

Mr. Landeros shows the need to invest in infrastructure for transforming telecommunications, transportation, food production and distribution, electric power, oil, the chemical industry and mining, water resources, the automotive industry, aerospace, industry, and education. Priority, in infrastructures, education and social welfare such as housing, health and security.

"You have to think bigger," he says. "Train more and better engineers for their technological development, common areas of higher education, academic, accreditation, professional skills and training for research innovation," he explained.

For **Mr. Landeros**, the best skills can be: orientation, problem solving, working with people, use and development of technology, analytical thinking, innovation, active leadership analysis, critical thinking analysis, creativity, initiative leadership and social, use of different technologies, monitoring and control technology, programming design, resilience that is tolerance to stress, flexibility, planning and strengthening of education.

To conclude, he pointed out the need to combine: government, academia, society, the industry environment and innovation with sustainable development.

**Mr. Ralph Appel, President of the Federation of European Engineers, FEANI**, took the floor and announced that he would discuss the evolution, tasks and activities, and the objectives of FENAI engineers.



In the Federation of Engineering Organizations in Europe there are 33 member countries representing around 6 to 7 million engineers. And, as **Mr. Appel** pointed out, "we all suffer from the same problems" so it considers it good to take ideas from others and meet to exchange opinions.

This year it became what has been called Engineers Europe. Historically, FEANI has focused on issues of education and recognition of engineering degrees between countries. Now, they have created a European monitoring committee to assess engineering qualifications, they also issue the card, which is a kind of certificate to confirm their qualification of engineers, for cross-border movements of engineers.

Currently, instead of focusing on education and degree recognition, they will talk more about job content as engineers.

**Mr. Appel** recalled a phrase that he applied to engineers, "innovation is the commercialization of technology". They need to translate solutions into commercialized solutions, solutions that people can buy and use. For this reason, now, Engineers Europe will work more on technological content that has created working groups focused on this type of solution.

FEANI has detected the existing gap in engineering, there is a lack of engineers and many of those who exist are close to their retirement age, so they encourage young people to choose engineering as a career.

They have been working with the European Commission in Brussels. As a result of this work, they obtained a professional project with around 1.5 million euros, over three years, called Engineers for Europe and they have successfully built a consortium of 13 partners throughout



Europe with people from the associations of engineering, universities, industry, and organizations.

Now, they want to develop a skills council, looking to 2050, to decide what future qualifications are needed for engineers to have the right skills.

*Engineers Europe*, "will give us a base in Europe to start conversations with universities, in order to develop curricula for the future," said **Mr. Appel**.

He concluded by emphasizing the commercialization of technology and the use of knowledge of science and technology to develop solutions for customers, people and humanity as the main themes that drive them.

Speaking time for **Mr. Papias Kazawadi, President of the Federation of African Engineering Organizations, FAEO**, to talk about who FAEO is and what they stand for, African aspirations, student aspirations and how to position themselves.



In Africa, the cities of the future must be designed around the vision of Africa, expressed by the African Union. The vision of the African Union is to become an integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in the international arena.

The vision and scope of the Federation and Africa is that Africans take full responsibility for their own development. That is, high standard of living, quality of life and well-being, environmentally sustainable climate and resilient communities, intersecting infrastructures, health, well-fed and educated citizens, women, engaged and empowered youth, strong cultural identity, values and ethics.

There was the idea that Africa has the lowest industrial human development index, but, through engineering, you can contribute to the eradication of this extreme poverty. We must consider all the engineering data and help governments to implement the programs for the 2030 agenda. We must ensure the participation of engineers and defend and promote links between the industrial world, the educational world and professional bodies.

The focus, now, is to work with the involvement of institutions that generate value for society. Also, enhance partnerships that promote WIN-WIN mutual benefits. "FAO believes that digitization is a game changer by offering a home-grown solution," he said. FAO is committed to promoting equality, diversity and inclusion.

Engineers can become accelerators of all development aspirations. For this reason, from FAEO, they believe that they can accelerate the implementation of the country's national development objectives, the implementation of AFCTA, the 2030 agenda and the implementation of the SDGs.

He concluded that "Africa will depend on preparing engineers to problem solve, reinvent, rethink and reshape, through consistent programs of structured upgrade and selection. In short, to get closer to the cities of the future with resilient infrastructures".

**Mr. Papias Kazawadi** concluded by saying that "FAEO's commitment is to ensure the development of a competent, diverse and inclusive workforce that is capable of providing the necessary solutions for the development of African cities."



**Mr. Kamel Sahnoun, President of the Federation of Arab Engineers, FAE**, took the turn to speak about the FAE, which works uniting Arab engineers in favor of sustainable development.

The Federation of Arab Engineers (FAE) was founded in 1963. Currently, it has 18 countries as members with which it collaborates, with 12 community technical committees and its mission is: to collaborate with the Arab Engineers Development Coordinator unit for Switzerland; cooperate, among different committees of Arab engineers, for the improvement of scientific and technical training; and that engineers keep up to date on international standards, in addition to protecting the economic, professional and social situation of members and ensuring respect for engineering.



The FAE has organized scientific conferences to improve the development of Arab countries. Symposiums and seminars were held last year on topics such as digital technology, modern methodology engineering, the future of transportation and the world conference on smart cities, global guidelines, and transportation management.

Tunisia is a member and now has 90,000 engine engineers in Tunisia, 70% under 40 years of age. The mission is to organize the profession and protect the member, contribute to help the engineering needs in Tunisia, organize training courses for members and scientific conferences improve the development of the country.

For example, they organized an international symposium on engineering and food safety in Africa. They have organized seminars and have done studies for the government on security standards, engineering engineers 5.0, etc.

They also have a national council and an executive council, in which there are 25 regional committees and 13 sectoral and functional offices, and they have 16 authorities that support our activities.

For his part, **Mr. Adil Al-Hadithi, Secretary General of the Federation of Arab Engineers, FAE and Founder of FMOI**, explained that the Arab Federation of Engineers includes 11 permanent committees:

1. Committee on Engineering Education in Oman
2. Committee on Telecommunications and Information Technology in Bahrain
3. Energy Committee
4. Libyan Water Resources Committee
5. Construction Committee
6. Egypt Committee
7. Committee of Arab Women Engineers in Syria
8. Transport Committee of Jordan, Iraq,
9. Public Safety Committee
10. Committee on Health and Medical Engineering Technology in Iraq
11. Consultative Committee of the Consul.



According to **Mr. Adil Al-Hadithi**, they are working “hard” to achieve the goals. In addition, the FAE is coordinator of support and cooperation of the Arab organization. At the same time, he supports the relationship between the FAE and the international organization.

The Supreme Council convenes an annual meeting, at the end of each year. The head of the engineering body held an annual meeting at the beginning of the year. The head of the specialized authorities and the head of the standing committees convened one annual meeting as well, and the executive board convened three.

The FAE is interested in joint activities between the standing committee and the relevant specialized body. Based on the nature of the activities, the FAE had a vision that the conference and the activities carried out by the union will focus on issues of interest. Arab countries, meanwhile, benefit from being available to work in the future.

**Mr. Al-Hadithi** announced that “we want to have joint activities between permanent committees and technical committees and we seek alliances, cooperation with other associations, with common interests, at the regional and international level.”

The activities are focused on issues that “concern us in the Arab countries”, but he showed his intention to “have a more international appreciation”.

To conclude, he expressed her desire to “develop or promote the participation of women engineers in the different committees and that of young engineers”.

**Mr. Huang Wei, President of the Federation of Engineering Institutions of Asia and the Pacific, FEIAP**, took the turn to speak, alluding to the issues discussed by other speakers on the problem of climate change, the energy crisis and the unbalanced distribution of resources, etc.

The sustainability of the whole world depends, to a large extent, on whether we choose to compete for limited resources with each other and how we use these resources to find new solutions.

**Mr. Huang Wei** pointed out precisely this, “the reason why we need international organizations. We are building the tower of the modern bubble where our differences in cultural

background, language, and economic advantage translate into diversity of ideas and experience.”

A precise example is that the rapid development of the Internet and mission-enhanced technology has allowed us to communicate virtually beyond the limits of time and geography, especially in the last three years, in the wake of the Covid19 pandemic.



What are the disruptive technologies that can change the way we live in cities, especially smart ones?

**Mr. Huang Wei** said that his team, together with the Blacksburg Institute of Electronics at Northwest Polytechnic University in China, has made a lot of breakthroughs that could be recognized as disruptive technological advances:

- A system of electronic screens PLEDS, screen technology that will replace LEDs and that will be more flexible, economical and green electronic screens. In addition, this new material, PLED, "can comply with the SDGs and we will be able to take advantage of the developments as much as possible," he assured.
- Perovskite nanocrystals. They may have low resolution issue, but remains to be seen.
- Organic elements can replace the previous ones, being more efficient and freer of toxins and, in addition, they do not present a risk during the sweeping process. This occurs in ventilators used during X-ray security screening and medical examinations. The current problem is the huge doses applied in contrast to the low-resolution feedback, not to mention that they are poisonous. To get started with this technology, our team is using metallic and even pure organic allies as a replacement for traditional fans.
- Investigation of photographic materials at scale through revolutionary innovation. The team has managed to solve a number of critical issues in material stability, low conversion, light-to-electric efficiency, manufacturing complexity, and significant contamination.

“With more technological development like this, we are able to design cities for the future to remain true to the UN SDGs,” he said.

According to **Mr. Huang Wei**, “my experience in science and technology has led me to believe that scientific advances come from consolidated disciplinary foundations, which I have coined by most critical disciplines, is the so-called MILPA concept, term which comes from the initials of five disciplines: mathematical sciences, information sciences, life sciences, medical-physical sciences and art sciences.

Eight scientific fields are most likely to cause life-changing breakthroughs: flexible electronics, artificial intelligence, materials science, the Internet of Things, space science, health science, energy science, and data science.

“Only by importing global innovation in disruptive technology, as we can design it to improve our cities, will we help build a sustainable future,” he concluded.

**Mr. José Vieira, President of the World Federation of Engineering Organizations, WFEO**, gave way to the round of questions.





**Mr. Ralph Apple, President of Federación Europea de Asociaciones Nacionales de Ingenieros (FEANI)**, after the events in Turkey and Syria, asked “can we do anything to help those affected by the earthquakes? Can we do something together with FMOI or FEANI?”

Mr. Ralph Apple replied, “I see all the regions have technical committees, so we could expand the scope of the standing committees. We have intensive conversations with our colleagues in Switzerland to discuss common standards in technologies and international standards should be recognized so that the basic rules are applied everywhere”.

Mozambique suffers greatly from the consequences of climate change. How can we take advantage of the collaboration between institutions to alleviate the effects of climate change in my country? How can young people help us?

The answer was given by **Mr. Salvador Landeros, President of Unión Panamericana de Asociaciones de Ingenieros (UPADI)**. He said “In Latin America we have more intense disasters due to climate change. What needs to be done is to exchange more information and data, for example, studies of meteorological conditions. I ask for more cooperation in this regard.”

In addition, several requests and reflections were launched from the room:

- I would like FMOI to commit to work on the frequent mismatch between the need for specialized engineers, in specific locations, and the specific training they have and what is needed.
- Based on the observation that there are no women among the panelists, of those engineers in your organizations, how many are women?

**Mr. Salvador Landeros** responded to comments about the number of women in institutions. “It is not easy to know supply and demand, but there is a good representation of female engineers, although more are needed both in quantity and quality.”

He added that “one of the objectives is gender equality and women's participation, something that has continued to grow permanently in recent years and should reach the 50%.”

- Let's see if the FMOI helps us to have concrete information about the number of engineers that there are in the federations of the table. It would be nice to have an organization that kept the accounts of registered/federated members in all organizations and that could be updated annually, for example.
- When talking about recognition of engineering degrees, it would also be necessary to differentiate between those who work for themselves or for others.
- There are very active members who participate internationally, but it would be nice to see the participation of young engineers. Of those known to FMOI, could you see how many have had international recognition?
- As a humanitarian engineer, I need institutions that make our work visible. We have the technical part and we have to communicate it to all the people so that our voice has more echo and more strength.

Comment by **Mr. Song Yonghua, Member of the Executive Board of CAST and Chancellor of the University of Macao**: “We are trying to integrate the degrees, as established by the institutions and the administrations, and it is important to promote engineering in society, because engineering issues are unknown to them. We have to defend our profession, feed them and convince them to become engineers. There are engineering solutions to some problems, but you don't know about them. We could try to establish alliances, promote the engineering profession and create university cooperation.”

Comment by **Ms. Teresa Pino**: “As professional organizations we have an obligation to ensure our engineers support cross-border services. They are done, but it is not known, it is done outside the law. When I assumed the presidency of UPADI (Woman) we signed an agreement that it would be good to take it up again, because we have more experience and it is time to look for common ground.”

## CONCLUSIONS

- In IIE, the suitability of the people is guaranteed, young people enter and there are some 300 people working and updating all the knowledge they have. The intention of the IIE is to sign agreements and collaboration protocols with all the institutions present and the exchange of students or recent graduates to exchange knowledge and human relations.
- The OdeP. Professional public association. The key points for the next 3 years are to create new specialties, for new needs: aeronautics, biotechnology, industrial engineering and management, food engineering, safety and engineering quality; disseminate knowledge and topics that concern the different specialties and contribute to the development and credibility of engineers. They work on issues of sustainability, digital transition, new digitized infrastructures and energy sustainability.
- University of Macao. Universities, in addition to being a place of engineering education, are places of research to find solutions. The China Agency for Science and Technology is the largest non-profit organization in China, with more than 200 national societies including war, science, technology and engineering, and more than 80 engineering societies. It serves as a bridge between the scientific community and the government. They created the Woman Engineer Award in 2021 and the Chinese engineering organization created the Chinese Society of Engineers. They have a state Internet laboratory, the only laboratory in China in the area of smart cities. Macao is a very demographically dense city and they pursue carbon neutrality.
- UPADI. In the Federation they have 27 organizations in two observatories located in Spain and Portugal and in five regions. Focus on various themes: industrial revolution 4.0 with cybernetic physics, physical electronics, iot, energy, biological material sensor, digital transformation (important for growth and economic benefits), data science, engineering, transportation, new engineering disciplines and skills necessary for the engineers of the future. The Pan American Federation promotes the subordination of personal interests to those of the country and cultivates motivation, skills and training to reach global issues. Need to combine: government, academia, society, industry environment, innovation and sustainable development.
- FEANI. There are 33 member countries representing around 6 to 7 million engineers. This year, it became what has been called Engineers Europe. Historically FEANI focused on education and recognition of engineering degrees. Now, they have created a European monitoring committee to evaluate engineering qualifications and issue the card, a kind of certificate to confirm their qualification for cross-border movement of engineers. They obtained a professional project, with around 1.5 million euros over three years, which is called Engineers for Europe. They want to develop a skills council, looking to 2050, to decide what future qualifications are needed for engineers.
- FAEO. The vision of the African Union is to become an integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in the



international arena. They want to work with the involvement of institutions because they generate value for society. FAO is committed to promoting equality, diversity and inclusion. FAEO believes that they can accelerate the implementation of the country's national development goals, the implementation of AFCTA, the 2030 agenda and the implementation of the SDGs. FAEO's commitment is to ensure the development of a competent, diverse and inclusive workforce that is capable of providing the necessary solutions for the development of African cities.

- FAE. It has 18 countries as members with which it collaborates, with 12 community technical committees and its mission is to collaborate with the unit of the Development Coordinator of Arab Engineers for Switzerland and to cooperate, among different committees of Arab engineers, to improve scientific training, and technical and that engineers are kept up-to-date on international standards, in addition to protecting the economic, professional and social situation of members and ensuring respect for engineering. Tunisia is a member and now has 90,000 engine engineers, 70% under 40 years of age. They have a national council, an executive council in which there are 25 regional committees and 13 sectoral and functional offices and have 16 authorities, which support our activities.
- FAE-Founder FMOI. The Arab Federation of Engineers includes 11 standing committees. The FAE is the coordinator of support and cooperation for the Arab organization, at the same time it supports the relationship between the FAE and the international organization. She is interested in joint activities between the standing committee and the relevant specialized agency. The activities are focused on issues of concern in the Arab countries, but are interested in having a more international appreciation and promoting the participation of women.
- FEIAP. The sustainability of the whole world depends, to a large extent, on whether we choose to compete for limited resources with each other and how we use these resources to find new solutions. The Blacksburg Institute of Electronics, at Northwest Polytechnic University in China, has made a lot of breakthroughs that could be recognized as disruptive technological advances: flexible displays, perovskite nanocrystals, organic elements, which can replace the former being more efficient and are free of toxic, photographic materials. MILPA is a term that comes from five disciplines: mathematical sciences, information sciences, life sciences, medical-physical sciences, and art sciences.

## 18:00 PRESENTATION OF THE WORLD ENGINEERS CONVENTION WEC 2023

From October 9th to 15th, Prague

**Mr. Daniel Hanus, President of the Czech Association of Scientific and Technical Societies**



After showing his appreciation for participating in the conference organized in Madrid, on the occasion of MWCC 2023 World Engineering Day, he invited attendees to the WEC 2023 World Engineering Convention, which will be held from October 9 to 15 in Prague, organized by the Czech Association of Scientific and Technical Societies and the World Federation of Engineering Organizations, WFEO, under the auspices of UNESCO and the Prime Minister of the Czech Public Ministry, Peter Fiala.

**Mr. Hanus** stated that “the World Engineering Convention is the flagship of the WFEO, which is why it is heard every four years on different continents of our planet”.

After assuming the organization of this Convention that, until now and for six years, had been organized in Melbourne, the organizing team of the Prague Convention, “emphasizes the importance of innovative technologies and engineering education”.

The professional program includes congress, plenary session, keynote speeches and 12 oral transmissions focused on the most important technical areas. In addition, there will be two special forums, one for young engineers and the other for women in science and engineering.

The topics that will be covered will be: new solutions for energy, smart cities, concept of urbanization, engineering approach to environmental protection, engineering education and continuous professional development, ecological transport, safe digital world, innovative technologies in the industry, engineering in health, food and fresh products, water supply, natural and industrial disasters, prevention, climate change and mitigation and adaptation of the earth to the universe.

The main benefit of the engineering convention is the mutual exchange of ideas and knowledge and learning from good experiences.

One of the areas, in which the Czech Republic can share an important goal is the global contribution to sustainable and socially responsible business, are the methods developed by the global entrepreneur **Thomas Forum** and included in the professional program, in addition to the presentations of the economic contributions of the countries.

The professional program of the Congress also includes space for the presentation of technical and industrial contributions by the members of the WFEO. The parallel transmissions include the possibility of making presentations, part of the technical program of the presentations of the students of the Congress, in the form of exhibitions of projects, posters and mini oral presentations.

Parallel to the Congress itself, there will be an exhibition of the convention's industrial, academic and professional partners, as well as a demonstration of the high school and university project and the winning hackathon projects.

The target number of Congress participants is 3,000, although there is a capacity of up to 5,000 at the venue, in the Prague Congress Center, equipped with a main conference hall, with more than 2,500 seats, and other rooms capable of holding up to 5,000 participants. The venue of the Congress is practically in the center of Prague, perfectly communicated.

The Czech Republic is a historically important center of science, culture and engineering. The entire historical center of Prague was inscribed on the World Heritage List and registered on the UNESCO Cultural Heritage list as one of the other 15 UNESCO cultural heritage sites.

**Mr. Hanus** ended the presentation of the WEC2023 World Engineering Convention by stating that attending this Convention is “a unique opportunity to show how engineers create a safe and good life for humanity through concrete examples of successful projects. that meet the individual UN SDGs.”

### **Rwanda International Congress 2024 From October 26th to 31st 2024 Kigali**

**Mr. Gen Kil Hangaho, President of the Rwanda Institute of Engineering,** invited attendees to the global meeting of the executive council to be held in Kigali, Rwanda, “a beautiful country in the East African region, one of the 15 places greenest in the world with excellent and reliable infrastructures”.

The theme will focus on engineering capacity building, a key to achieving Africa's sustainable infrastructure movement. Agenda 2030.

The convention center has a capacity for 6,500 people, with an auditorium that can hold 2,600 people, 70 meeting rooms and 10 to 3,900 exhibition spaces as well.



## 18:15 PRESENTATION OF THE WORLD ENGINEERING DAY 2023

**Mr. José Vieira, President of World Federation of Engineering Organizations, WFEO,** was in charge of presenting the World Engineering Day that was celebrated the following day, on March 4, 2023.

He invited attendees to attend the conferences prepared on the occasion of the World Day and to celebrate together the day that represents the profession.

**Mr. Vieira** invited **Mr. José Trigueros, President of Instituto de la Ingeniería de España,** to take the podium to close the Engineering Congress The Cities of the Future.

## 18:30 CLOSURE

**D. José Trigueros, President of Instituto de la Ingeniería de España,** affirmed that “We are all necessary to work in engineering and all these companies are made up of engineers and they are looking for the best professionals to carry out this work.”.



“The important thing is that those who come to universities acquire technical knowledge focused on innovation,” he added.

He said goodbye with the phrase: “Don't let the tree prevent you from seeing the forest”, adding the comment “we are filling the forests with wisdom”.

For his part, **Mr. José Vieira, President of World Federation of Engineering Organizations, WFEO,** thanked the president of the IIE for the organization and assured that the relationship with the UN is very important for the WFEO and briefly reviewed of the topics covered such as energy, raw materials, dependence on the city, engineering in the cities of the future, infrastructures, demographic challenges, the role of women engineers, urban engineering, architecture, sustainability, water, transportation...

**Mr. Vieira** closed by acknowledging that his main role will really be “cooperative work with these national and international associations”.

## CONCLUSIONS

### **Presentation by: World Engineering Convention, WEC 2023**

- World Engineering Convention WEC 2023, to be held from October 9 to 15 in Prague, organized by the Czech Association of Scientific and Technical Societies and the World Federation of Engineering Organizations, WFEO, under the auspices of UNESCO and the Prime Minister, Czech Public Prosecutor Peter Fiala.
- The professional program includes a congress, a plenary session, magisterial conferences and 12 oral transmissions focused on the most important technical areas. In addition, there will be two special forums, one for young engineers and the other for women in science and engineering.
- Topics to be covered will be: new solutions for energy, smart cities, concept of urbanization, engineering approach to environmental protection, engineering education and continuing professional development, green transportation, safe digital world, innovative technologies in industry, health engineering, food and fresh products, water supply, natural and industrial disasters, prevention, climate change and mitigation and adaptation of the earth to the universe.
- The professional program of the Congress also includes space for the presentation of technical and industrial contributions by the members of the WFEO.
- Attendance at the WEC2023 World Engineering Convention is “a unique opportunity to show how engineers create a safe and good life for humanity through concrete examples of successful projects that meet individual UN SDGs”.

### **Rwanda International Congress 2024**

- The theme will focus on engineering capacity building, a key to achieving Africa's sustainable infrastructure movement. Agenda 2030.

### **Presentation of World Engineering Day, WED 2023**

- **Mr. José Vieira, President of World Federation of Engineering Organizations, WFEO**, was in charge of presenting the World Engineering Day that was celebrated the following day, March 4, 2023.



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## ***SATURDAY, MARCH 4TH – WORLD ENGINEERING DAY***

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### 09:00 OPENING

**D. José Trigueros, President of Institute of Engineering of Spain, IIE**, was in charge of opening the day on March 4, World Engineering Day. “Congratulations, congratulations because today we celebrate our day. It is an important day marked with red in our calendar and in our lives.”.

He thanked the WFEO for choosing Madrid to celebrate this day and the representatives of all the world organizations present for attending.

He also took the opportunity to thank the sponsors for their commitment to sustainable development and for communicating, through meetings like this one, their progress and their contribution to climate change.

He stated that “the world advances as engineering advances. Today, no field of activity, medical, industrial or territorial planning, can be understood without the technological advances that come from the hands of engineers, researchers and universities” and added that “other professions, which are very necessary, could not develop in the intensity that they develop without having engineers around”.

**Mr. Trigueros** alluded to the Covid-19 pandemic and “how engineering has become essential to enable hospitals and save lives.” This is a clear example.

“We congratulate ourselves on this day, which we believe has the attention of the whole world, not so that they applaud us, but rather so that they demand that we continue with our advances,” he affirmed.

In these days, he commented that highly qualified speakers have participated, who have made us reflect on the current state of engineering in different fields and have given ideas of where we should direct our future.

We have talked about energy and new materials, disaster prevention, infrastructures and climate change, mobility and communications...

The role of women in engineering is a challenge that we have to address all over the world. Women are qualified to occupy the most important positions in our society and, in the past, they have not been sufficiently supported. “It is our duty, our obligation,” Trigueros asserted. She encouraged women to enter the field of engineering and not be afraid to learn the profession because “the truth is that they are being incorporated, but not with the speed that would be desirable,” she clarified.

The conferences also brought together managers from different cities and continents to talk about urban planning, sustainability, architecture and engineering.

The sustainability of water in the cities of the future has also been discussed. “I say the word sustainability because this issue is more and more within us” assured Trigueros and added that “the objective, in the next world days of engineering, is that the word sustainable and sustainable should be within ourselves”.

With regard to environmental impact, he stated that before there was talk of environmental impact assessment, while today, no one builds infrastructure without first thinking about the environment.

**Mr. Trigueros** produced a first Environmental Impact Guide in 1982. At that time, 40 years ago, the environment was not taken into account. Now we have it “internalized”, he affirmed.

He concluded by wishing to see the attendees in Prague and once again congratulating everyone on World Engineering Day to make way for the next speaker.

It was the turn of **Mr. Guillermo Cisneros, Rector of Universidad Politécnica de Madrid**, wishing a happy world engineering day. “This is a day that aims to raise awareness, appreciate the contributions that engineers make to our daily lives and promote sustainable development to best engineering practices,” he explained.



Politécnica has a long history of excellence in engineering and architecture, education and research, and a vision to educate and train the next generation of engineers and architects who will “guide our world toward a more sustainable and inclusive future”.

UPM professors and students actively participate in innovative research projects and collaborate with industry and society to address the most pressing global challenges, such as climate change, urbanization and digital transformation.

A day like today can be taken as an opportunity to celebrate and showcase achievements in engineering and architecture, exchange knowledge and best practices, and inspire future generations of engineers.

Mr. Cisneros expressed his confidence that this event “will be an enriching experience for everyone and will reinforce our commitment to excellence in engineering and sustainability, every March 4.”

It is expected that on March 4, the organizations and offices of the United Nations system, governments, civil society, the public and private sectors, schools, universities and, in general, citizens “make the international day a springboard for awareness actions and, in this edition, without the restrictions imposed”.

The 21st century presents the engineering profession with a series of complex and pressing challenges. These challenges arise due to the rapid pace of technological advances and the increasing demand for more sustainable and efficient solutions.

In a world of increasingly scarce resources, one of the biggest challenges facing engineering in the 21st century is “guaranteeing sustainable development,” said Mr. Cisneros. It is engineers who must find solutions that meet the growing needs of society without compromising the ability of future generations.

Engineers must embrace sustainable design principles and integrate them into all aspects of their work that they need to reduce the environmental impact of engineering projects. “We, as engineers, must adopt practices that respect the environment and find ways to reduce greenhouse gas emissions in our projects,” he considered.

Engineering must play a fundamental role in the development of new technologies that can meet the growing demand for energy. This includes developing new energy storage solutions, improving renewable energy technologies, and developing advanced nuclear power technologies that are safe and sustainable.

**Mr. Cisneros** recalled that “this new electrification is also conditioned by the distribution and scarcity of certain materials that represent a significant challenge for engineering. Many vital materials, such as rare earth metals, are concentrated in a few countries, which can lead to supply chain disruptions and price fluctuations.”.

Therefore, a challenge would be to find engineering solutions that make use of alternative materials that promote circular economic principles.



Digital technologies have already transformed many aspects of lives and will continue to do so. Technologies like artificial intelligence, big data, information modeling and digital trends "are likely to have a significant impact in the future," she said.

In civil engineering and other disciplines, digital tools are increasingly being used to help with the design and construction of more energy-efficient and environmentally friendly green cities, for example, “building information modeling and Digital twins can be used to simulate the performance of buildings and infrastructure systems and optimize their energy use.”

“We as a technical university in collaboration with other French institutions are developing new economic programs on these issues. In addition to their impact on green cities, these technologies are also likely to transform the way civil engineering is taught.”

For example, digital tools such as virtual reality and augmented reality can be used to create immersive learning experiences that allow students to visualize and interact with complex engineering concepts.

Similarly, online platforms and simulations can be used to deliver engineering courses to a global audience, making education more accessible and affordable than ever before, though not without its risks and challenges.

There are concerns about the potential for artificial intelligence and other digital technologies to displace human workers and about the impact these technologies could have on privacy and data security. Also, about the digital divide.

To meet these challenges, educators, policymakers, and industry leaders must work together to ensure that digital technologies are deployed in a responsible and sustainable manner.

Engineers, "on our World Day, we need to promote the value of engineering in society, highlight the contributions of engineers to the development of new technologies, to the improvement of infrastructure and the creation of jobs," he said.

**Mr. Cisneros** believes that "as engineers, we must also highlight the impact of engineering on society. For example, creating clean energy, reducing waste, and improving healthcare." In addition, he assured that "by promoting the value of engineering to society, we can enhance the prestige of the profession and encourage more students to obtain engineering degrees and become engineers of the world."

He ended by wishing a "Happy World Engineering Day".

**Mr. Antonio Colino, President of Real Academia de Ingeniería de España**, took the turn to speak, making a reflection "if we do not know what we want, it will be difficult to design the cities of the future".



Therefore, first we must know what future we want and it is a reflection that must be done with engineers because they are the ones who create, change and help in progress, affecting culture and customs.

The culture of today is different from the culture of 2,000 years ago because technology and engineering have been changing it with their discoveries. "Scientists discover what the world is like and engineers rely on the discoveries of scientists," he clarified.

A citizen does not know how many engineers are behind each daily action that he performs. You know that there are thousands of engineers who design, build, operate, and maintain power plants, pipelines, transmission, and distribution lines, but in your day-to-day life you do not keep this in mind when you turn on the light, go to the bathroom, kitchen, or take any type of transport.

Nobody knows who is the engineer behind the design of something specific. They are not visible faces; nobody talks to an engineer. "For example, when you buy a car, you don't talk to an engineer, even though there are thousands of engineers building the car," **Mr. Colino** clarified.



Another field that is very important for engineers is that of hospitals, the world of health. If you go into a hospital, all the equipment they have has been designed and operated by engineers. "Nobody knows this in hospitals," he said.

All technological equipment that has been increasing life expectancy is made by engineers. X-ray, CT scan, all these things are done by engineers. "We are not selling what we do. So, we are very bad pillars of our image, so we have to increase, boost the image of engineering", he assured.

There is another problem, women do not participate. In Spain, women and girls are disappearing from engineering schools. "We have an engineering school in Madrid with only 10% women," she pointed out.

It is important to raise the standards in engineering education and train more women engineers with more skills, as well as stimulate young women engineers to create more solutions for the future.

**Mr. Colino** stressed that "the first thing we have to do is convince society that engineering is important. The only objective is to help society".

And he concluded his intervention by emphasizing that "women have to work with us and they have to go to technical schools because if girls want to help humanity, the best way to do it is with engineering."

**Mr. José Vieira, President of WFEO**, took the floor and dedicated a few words to the commemoration of UNESCO's World Day of Engineering for Sustainable Development, on March 4, and assured that "the proclamation of this day has been one of the most significant achievements of the OMS".



For engineers it is a significant recognition of our 50-year association with UNESCO.

**Mr. Vieira** pointed to the context in which it happens as the most significant. "The United Nations and its agencies have correctly analyzed the great risks of adapting to the climate and



environmental crisis in order to mitigate its effects and design new industrial, economic and social models that allow sustainable development."

By creating an event for World Engineering Day, the WFEO continues to show its members and the world its ability to grow and adapt even in the most challenging of times to be recognized as the leading international organization promoting engineering, and engineers from around the world. Sustainability means a better understanding of the impact of productive activities and ways of life, and the creation of technologies, processes and infrastructures that make them possible.

"None of this is conceivable or feasible without putting engineers at the center of a project of this type," he said.

A great deal of advocacy effort has been needed in recent years to get this idea onto the agenda of global institutions. But it is happening now, and this is the true meaning of this day.

World Engineering Day is a celebration of the profession's contribution to resilient systems and communities and improving the well-being of all.

Also, it is a great opportunity for professional engineering institutions to show practical examples of how their members make a difference for the benefit of their cities, countries and regions.

Engineering has always played an essential role in development, human well-being and ensuring that future generations of engineers and scientists can design solutions to local and global challenges is critical.

For this reason, the celebration of this day worldwide promotes the knowledge of engineering as a career, mainly for young students and, above all, for goals. In fact, there are even countries where the number of female students graduating has increased, but this trend has not translated into more women entering the engineering profession.

Engineering, for sustainable development, is especially critical in developing countries to mitigate the effects of climate change, reduce poverty, design relevant infrastructure and create models to achieve capacity development in those countries.

It is essential to raise the standards of engineering education. This is important to arrive at one of the most important recommendations of the UNESCO engineering reports, to train more engineers with the right skills. It is also essential to stimulate the energy and creativity of younger engineers to invent technological solutions for the future. That's why the theme for this year's World Engineering Day is set to be engineering innovation for a more resilient world. The message, he pointed out, "is to leave an opportunity to celebrate engineering and the contribution of innovative and responsible work of engineers to a better and sustainable world."

This goal is a strategic issue for the WFEO as the key aspect of "our contribution to the World Engineering Day celebrations, especially through the International Student Hackathon. It is a competition that we are organizing, for the second year, with the participation of many professors and engineering students in various countries around the world", he clarified.

**Mr. Vieira** wished the attendees to enjoy the World Engineering Day celebration and encouraged them to get involved in the WFEO activity.

He concluded by welcoming the scientific and technological community and expressed his desire to work collectively for a more sustainable future for the benefit of humanity and the environment.

## CONCLUSIONS

- Mr. José Trigueros, president of the IIE, opened the day by congratulating all the attendees on World Engineering Day and thanked the WFEO for choosing Madrid to celebrate it and the representatives of all the world organizations present for attending. He also took the opportunity to thank the sponsors for their commitment to sustainable development and for communicating, through meetings like this one, their progress and their contribution to climate change. He summarized the main issues discussed during the congress: sustainability, transportation, water, housing, education and training, women... In addition, he mentioned the Environmental Impact Guide in which he participated in 1982 when the environment was not taken into account.
- By creating an event for World Engineering Day, the WFEO continues to show its members and the world its ability to grow and adapt, even in the most challenging of times, to be recognized as the leading international organization promoting engineering. engineering and engineers from around the world. This year's World Engineering Day theme is set to Engineering innovation for a more resilient world.
- Engineering, for sustainable development, is especially critical in developing countries to mitigate the effects of climate change, reduce poverty, design relevant infrastructure and create models to achieve capacity development in those countries.
- The Hackathon for international students is a competition that is organized, for the second year, with the participation of many professors and engineering students in various countries around the world.
- La Universidad Politécnica de Madrid has a long history of excellence in engineering and architecture, education and research, and a vision to educate and train the next generation of engineers and architects who will guide the world towards a more sustainable and inclusive future.
- UPM professors and students actively participate in innovative research projects and collaborate with industry and society to address the most pressing global challenges.
- It is expected that, on March 4, the organizations and offices of the United Nations system, governments, civil society, the public and private sectors, schools, universities and, in general, citizens "make the day international a springboard for awareness-raising actions".
- Engineers must embrace sustainable design principles and integrate them into all aspects of their work that they need to reduce the environmental impact of engineering projects. Engineering must play a fundamental role in the development of new technologies that can meet the growing demand for energy.
- In civil engineering and other disciplines, digital tools are increasingly being used to help design and build green cities that are more energy efficient and respectful of the environment.
- Online platforms and simulations can be used to deliver engineering courses to a global audience. There are concerns about the potential for artificial intelligence and other digital technologies to displace human workers and about the impact these technologies could have on privacy and data security.
- Engineers should highlight the impact of engineering on society, such as creating clean energy, reducing waste, and improving healthcare. By promoting the value of

engineering to society, we can enhance the prestige of the profession and encourage more students to pursue engineering degrees.

- There are thousands of engineers who design, build, operate, and maintain power plants, pipelines, transmissions, and distribution lines, but people do not keep this in mind in their day-to-day activities, when they do their daily tasks. On the other hand, all technological equipment that has been increasing life expectancy in medical centers is made by engineers, but people do not take it into account either.
- In Spain, women and girls are disappearing from engineering schools. It is important to raise the standards in engineering education and train more women engineers with more skills, as well as encourage young women engineers to create more solutions for the future.

## 09:45 PROCLAMATION OF HACKATHON RESULTS

**Ms. Marlene Kanga, Former President of WFEO** and one of the Hackathon judges, takes the floor to present the winning projects of this edition, but not before congratulating the attendees on World Engineering Day.

The Hackathon focuses on young engineers, which is why World Engineering Day was chosen to make the awards for the best projects public. This year, the Hackathon has focused on engineering innovation for a more resilient world.

This is an international event that has been possible thanks to the support of international partners, especially Engineers Without Borders, whom **Ms. Marlene Kanga** thanked for their commitment.



She also had words of thanks to the sponsors of the WFEO celebrations because, with their contributions, they allow offering a unique experience to hundreds of engineers and students from all over the world.

Before talking about the Hackathon itself, she thanked the team and the judges who have made the competition possible.

**Ms. Kanga** explained how, in the preliminary round, 40 judges participated who evaluated the projects they received from all over the world. For the next round, 5 Thursdays remained, including the representative of UNESCO and international partners, an example of the "collaborative international effort".

Three UN sustainable development goals were selected to highlight as challenges for the Hackathon. This year, SDG 2 (hunger), SDG 3 (good health and well-being), and SDG 6 (clean water and sanitation equipment). Participants had to choose one of these and deliver and develop an innovative solution.

Challenge one was SDG 2, feed 10 billion people in a changing climate. How can affordable, accessible and nutritious diets be sustainably provided for future populations?

Challenge two was SDG 3, the prosperous city, which is a center of physical and mental health and well-being. How can city design and infrastructure be improved by thinking about new technologies and infrastructure and modernizing existing ones so that urban centers become dynamic and equitable places for people to live and prosper?

Challenge three was SDG 6, it addresses water security for future generations. How can clean water, a resource without which one cannot live, be provided in a future where it is scarcer and at greater risk of contamination?

Solutions were also required to be consistent with the theme of World Engineering Day 2023, engineering innovation for a more resilient world. The challenges were described and developed in collaboration with Engineers Without Borders, "who worked tirelessly on this program with us."

The evaluation criteria were based on the International Engineering Alliance, graduate attributes and professional competencies, and allowed participants to show how their education helped them develop these particular graduate attributes.

1,000 individual entries were received, forming 150 teams, from 23 countries around the world. All participants will receive a certificate of participation from the World Federation of Engineering Organizations.

The prizes offered were a total of 8,000 euros:

- First prize, 5.000 euros.
- Second prize, 2.000 euros
- Third prize, 1.000 euros.

The 40 preliminary judges came from around the world and narrowed the field to 12 entries that the finalist judges had to see.

“As the finalist judge, I, **Ms. Marlene Kanga**, clarify that I would like to now declare the results of the hackathon.”

In 3rd place, the winner of the 1,000 euros, of the **World Engineering Day Hackathon 2023 is Team Aqua Smart from Mauritius**. This team is from the University of Mauritius.

“Our country is defined as having little water and, right now, we are facing one of the worst moments since the late 1990s with our warehouse filled to 31% of its capacity. It is ironic that, at the same time, you can be surrounded by water and, nevertheless, lack it”, thus began the video of the project.

They proposed desalination as a way out, while acknowledging that they lacked the resources and skills to carry it out. For this reason, they considered looking for an economic alternative based on the existing infrastructure.

Investment in rainwater entails a significant loss in sanitation. To reduce this, they proposed using solar water heaters, which are common in homes on the go, as a solution.

Because the region is located in a tropical climate, freshwater systems are expensive and consume a lot of energy, so they looked at how Saudi Arabia was doing it, with high levels of pollution, to reduce working membrane distillation that it is used for wastewater treatment on rivers.

The green water from the roof is collected in the actual water collector, located on the ground, through a drainage system. Therefore, it is proposed to add a soil tank at the outlet of the true water collectors to separate solid waste and the filtered water is stored in 10 others next to it. The water pump then moves the fluid to the water heater on the roof.

According to their calculations, a 150-litre solar water tank, which is the smallest available on the market, requires more energy than the sink can provide. On a normal day, they decided to fill the solar water heater with 100 liters, which would take at least five hours.

Assuming no thermal energy loss to the surroundings, the gas evaporates and passes through the condenser pipe towers where it is good for producing distilled water. They needed a way to control the water flow and functions of the solar water heater.

They used ANB 32 in the part of the system where all the valves, sensors and heaters are located. It comes on every 15 to 20 minutes.

The rainwater, in the tank, acts as a cooling medium to condense the water vapor to a



condensing liquid state. This valve opens to collect it in the tank. Now, if all the rainwater is used, but it is still in the process of distillation, it is turned on to cover it and condense the water by air.

The drawback they found is that if the solar water heater is in use and the user wants to use hot water, the whole process has to be completely stopped beforehand. The user must notify the control system at least one hour before using the hot water.

It would make this process easier to use internet connection and use it as an iot device to control all the valves and so on, through the online dashboard.

When this situation occurs, the microcontroller will open the valve to discharge the rainwater and stop the process. Then there are two valves that open to let in fresh hot fresh water overnight. Slow water heater is in heater mode.

These processes are repeated until all the rainwater that should not be used for drinking without prior treatment is collected. As a result, our team from Mauritius came together to design this solution to provide more continuous and reliable access to clean drinking water.

The overestimated cost of the project is \$300 and the objective is to invest funds from both the government and private organizations. In addition, they want to carry out a pilot test of this technology in companies. The government will also be involved in ensuring the long-term success of the system by providing an educational program, helping users maintain the system, as well as proper savings practices. Using this technology, they hope to build a more resident future.

Ms. Marlene Kanga stated that this project “was tremendously creative and, taking advantage of the resources of a university in a developing country just shows that the creativity of the mind can overcome these difficulties.”.

In 2nd place, the winner of €2,000 of the 2023 **World Engineering Day Hackathon** was the **Quam team** from the **University of British Columbia Canada**. “The judges thought this entry was great for letting it go,” **Ms. Kanga** clarified. Pakistan is just one of many countries experiencing extreme or severe flooding due to climate change.

The irony of flooded landscapes is that it is because of the abundance of water. Most likely, there is a lack of access to safe drinking water. The scarcity of clean water exacerbates the fight with climate refugees. The climate crises serve as a reminder why innovation and clean water technologies are so important to ensure basic human needs for the most vulnerable.

This team has developed the prototype of a device that is intended to provide purified water to people vulnerable to extreme flooding found in rural, but affected areas like Pakistan.

A solution that can be implemented, especially in areas of natural disasters. The judges thought this entry was an excellent and innovative design to address a problem of access to clean water around the world. In addition, it is a low-cost design, easy to implement, portable, and can be shipped to areas affected by natural disasters.

The team well researched the feasibility of the implementation and made good use of digital tools, including 3D printing, to showcase the innovation. They had great diversity in the team, collaboration, communication and group work to address SDG6.

**In 1st place, the prize of €5,000 of the World Engineering Day Hackathon 2023 went to the Philippines, the University of Naga with its project "Sponge".**

The winner of the World Engineering Day Hackathon 2023 provided a solution that addressed

SDG 3 good health and well-being in our cities.

Judges commented that this entry was inventive and innovative, reusing waste materials, including agricultural waste, to produce a pervious road surface that can absorb stormwater runoff and reduce flooding and improve watershed health.

The road surface also improves safety for automobiles and wet weather, and reduces traffic noise, improving the health and well-being of the city's citizens.

The teams made good use of digital tools to demonstrate that their solution delivered an excellent result and they played a video to showcase their solution.

Island noise pollution, greenhouse dust emissions, water pollution, and accidents from wet roads continue to be threats in urban and hive cities.

What can engineers do to improve infrastructure design so that urban centers become dynamic and equitable for people to live as a tribe? How can we move towards a sustainable plan for the future growth and health of our planet?

The solution is here and you can also contribute to SDG 6, SDG 12, SDG 13, SDG 9, and SDG 11, which compromises human health by contributing to general malaise, respiratory distress, and heat-related mortality.

56% of the world population drive in cities. This pavement contains a large connected forest that allows water to drain and evaporate from the pavement, surface and air temperature. On the other hand, this current highway contributes to water stress and affects 2.8 billion people around the world in the natural soil, water and environment.

It doesn't end here. The solution helps mitigate the worst noises that lead to hearing loss and hypersensitivity to sound. It can also help address this problem due to its excellent noise absorption property of up to 50 to 60%.

Why is technology null in many countries? The main reason is because it has no mechanical properties. This is where our innovation comes in. Industrial waste materials researched to maximize economic and environmental benefits to enhance essential properties.

They used automatic learning to analyze the data, to conduct extensive research, and to optimize its use. They decided to incorporate a right-mid-cash hybrid, due to its wide availability and superior performance on demand as a cost material.

So, using these other materials also reduces the cost of addition. Partial replacement with recycled aggregate increases customer costs and increases environmental benefits.

Improving hydraulic property, skeleton and peak based optimization is required to make them volume sub assets and option aggregation based also to help balance strength.

And lastly, the disproportionate method arrives at a potential design list and facilitates the experimental program to verify the design process.

The team also investigated environmental impacts using a concrete life cycle assessment calculator. Results indicated that the setup significantly reduced its environmental impacts across 11 parameters used for the FDA-created analysis: less conventional price and purpose, experimental knowledge and methods, replication model, construction model, and also proposed application.

They recommend incorporating BioCar for carbon identification versus another approach to

achieve structural studies and use alternative sustainable materials available in countries to accelerate the implementation of sponges worldwide for sustainable and resilient growth.

With this first prize, **Ms. Marlene Kanga** concluded the 2023 Hackathon, which she considered "very successful, with winners from three different regions of the world: Africa, America and Asia."

## CONCLUSIONS

- The Hackathon focuses on young engineers and World Engineering Day was chosen to make the prizes for the best projects public. This year focused on engineering innovation for a more resilient world. International event that has been possible thanks to the support of international partners, especially Engineers Without Borders.
- Three were the UN sustainable development goals selected for the Hackathon. This year, SDG 2 (feed 10 billion people in a changing climate), SDG 3 (the prosperous city, which is a center of physical and mental health and well-being), and SDG 6 (addresses water security for future generations.). Participants had to choose one of these and deliver and develop an innovative solution.
- The evaluation criteria were based on the International Engineering Alliance, graduate attributes and professional competencies, and allowed participants to show how their education helped them develop these particular graduate attributes. 1,000 individual entries were received, forming 150 teams, from 23 countries around the world.
- In 3rd place, winner of 1,000 euros in the 2023 World Engineering Day Hackathon was Team Aqua Smart from Mauritius. This team is from the University of Mauritius. Place surrounded by water, but with drinking water as a scarce commodity. Desalination was considered as a way out, but they were not prepared for it. They looked for an economical alternative based on the existing infrastructure. Investment in rainwater entails a significant loss in sanitation. To reduce this, they proposed using solar water heaters, which are common in homes on the go, as a solution.
- In 2nd place, €2,000 winner of the 2023 World Engineering Day Hackathon was Quam team from the University of British Columbia Canada. Pakistan is just one of many countries experiencing extreme flooding or increasing frequency, severity, due to climate change. Country with floods and problems of access to water. This team has developed the prototype of a device that is intended to provide purified water to people vulnerable to extreme flooding. Idea considered excellent for its easy implementation, the use of low-cost and portable materials.
- In 1st place, winner of €5,000 of the World Engineering Day Hackathon 2023 was from the Philippines, Naga University with its "Sponge" project. A project created by reusing waste materials, including agricultural waste to produce a pervious road surface that can absorb stormwater runoff and reduce flooding and improve watershed health.

## MR. JAVIER TARGHETTA, PRESIDENT OF ATLANTIC COPPER



**Mr. Javier Targhetta, President of Atlantic Cooper,** begins his presentation by pointing out that most of the countries in the world have proposed carbon neutrality by 2050.

The world has been improving for the past few centuries, largely due to the announcement of engineering advances over time.

The industrial revolution, universal suffrage and, in general, the approach to

improve, not only care for the individual, but also care for the individual's environment is where significant changes begin to be seen.

Then there is what, perhaps, we could call sustainability. That kind of social development or sustainable development that is taking place today without preventing future generations from developing as well.

Awareness of the planet has been growing, the awareness that there is no plan B for a destroyed planet in which humans could be the cause of climate change.

The world population is growing. There has been talk, during the sessions, of the increase in population in urban areas and this phenomenon is going to occur with more force in Asia and Africa. Every population, between now and 2050, will be urban, which will require approximately 500 new homes in the world.

As a consequence of this, other phenomena will be: the infrastructure between cities, in the city itself and in the homes themselves.

It can be seen how, starting in 1970, materials grew in terms of per capita consumption. But, in absolute terms, combining this per capita increase with the increase in the total world population, it goes from 25 billion tons of materials to close to 100 billion tons.

Now, some talk about the green agreement and support, but it should be said that you have to make a sustainable, responsible use of materials, destruction and treatment of materials to grow.

As in all fields of human activity, we are reaching the city of the future with net zero, through: energy efficiency, electrification of transport, decarbonization and heating and cooling of buildings, whether they are homes or buildings. commercial. And, obviously, with demand optimization.

We see energy efficiency as "everything that makes it much more efficient, in terms of the energy consumption that will be needed to meet the well-being of those who will live there," he said.

Fossil fuels. Engineering will have a lot to do, both with the capture, as well as with the storage or reuse of CO2 in these types of facilities, whether they are power plants or any other type of facility, burning coal or other fossil fuels such as gas, fuel oil or diesel. Still, it will be a fantastic breakthrough if, by 2050, this kind of mix in power generation can be achieved around the world.

The electric vehicle. By 2040 or 2050, the worldwide vehicle stock will still show more than 50% internal combustion engines. So again, fantastic progress in this field that is not even rich in zero neutrality or zero carbon neutrality by 2050.

“We see how aluminum, manganese, copper, zinc, nickel, lithium, cobalt, silver, all of these plus a significant group of additional metals, will be absolutely necessary to cover all these developments which are: solar, wind and nuclear generation, electric vehicle batteries, electric motors and CO<sub>2</sub>, capture and storage”, he explained.

In terms of urbanization and the number of houses that need to be built and equipped, the addition in cumulative terms of all the copper needed, by 2050, will be 215 million tons of copper. In addition to the usual business today, there is 30 million tons of copper a year. So you're talking about dividing this by 30, give or take. About 8 million more tons will be needed per year on average, from now until 2050.

There is an immediate question: is there the capacity in the world to satisfy these needs for metals? “The answer is no”, assured **Mr. Targhetta**.

There is a significant amount of recycled metal that is part of the total, in terms of copper. For example, 3%, 1 third of the total copper consumed in the world comes from recycling. And therefore, recycling will be essential to develop this on all continents.

**Mr. Targhetta** concluded with a forecast “some continents are far from reaching this 3%, but I believe that all these advances will clearly reduce the intensity of the use of these materials, that exploitation will be imperative to meet these needs. And as he was saying, the circular economy could bridge the gap between natural resources and final requirements”.



## MR. FIDEL SÁENZ DE ORMIJANA, CHIEF ENGINEER OF FERROVIAL

**Mr. Fidel Sáenz de Ormijana, Chief Engineer of Ferrovial**, took the floor and began by giving some figures regarding his company. “In 70 years, we have gone from 0% activities outside of Spain in our foundation to, today, having 96% of our patrimonial value coming from outside of Spain”.



Starting in 1952, a young engineer brought technology from outside Spain, adjusted it to Spain and, with all his enthusiasm, started his small business laying railway lines.

In 1999, Ferrovial tendered the 407TRPP in Toronto. A very interesting project that involved a substantial improvement in the length of an existing byway in Toronto. It was the first international highway project that was undertaken by the company. Ferrovial is involved throughout the life of the asset, which includes construction, design, operational management of the facility, financing..., and so on.

In 2006. UK government takeover privatization resumed, again another big quantum leap for Ferrovial.

In the US, managed lanes were built into the highway. At the time the road was built, it was an extraordinary, visionary project and the engineers planned ahead of time, but when it came to updating the road, a managed lane program was added. They have a toll payment system that is constantly changing based on traffic. Depending on the demand, the price is adjusted, before accessing the toll ramp of the managed lane, it notifies you how much you are going to pay at the toll. In Dallas, the highway lanes had overlapping, etc., and Ferrovial assumed lane separation so there would be fewer problems. Engineers are trying to serve the society in the most intelligent way.

In 2016, they took on a project in Virginia, also with a toll, where there were different roads and multiple lanes intersecting and where construction had to be managed with traffic and so on, “it’s complicated as well as interesting. We got management for 50 years.”

In 2022, the subway line in Toronto is still underway, just below the skyscrapers with a cost of more than 6,000 million dollars and it will take 8 years to build.

Ferrovial is present on the 5 continents. 96% of its own capital is already international. The majority is concentrated in North America and the United Kingdom, Spain already represents a smaller percentage, between 10 and 11%.

Internationalization strategy:

**Mr. Sáenz de Ormijana** assures that “we wanted to concentrate on some countries and specific fields. We were looking for a stable, reliable environment, with economic capacity and we think that you always have to look for long-term contracts. We do not want temporary projects. We are in countries to stay. Many have welcomed us and allow us to contribute to the changes in society”.

When we face internationalization and we face change and the speed with which everything is changing, “it is difficult for entities to remain constant in their vision,” he said.

Regarding the “6-21 Manual”, it was written in 1962 and is a manual against waste so as not to waste money. “You have to be rigorous in the analysis and where the money is invested. It allows you to keep track of the accounts,” he said.

**Mr. Sáenz de Ormijana** ended his speech with a confession, “Ferrovial wants to be the first, lead the curve, adapt and be on the path of sustainability”. He assured that “we have a very serious commitment to the fight against climate change and we are interested in using all the necessary technology” and ended by saying that “these modest achievements would not have been achieved without engineers, human capital is the key capital that has the company”.



## MR. JOSÉ OSUNA GÓMEZ, GENERAL DIRECTOR OF TYP SA



**Mr. José Osuna, General Director of TYP SA**, considers it important to organize workshops for young people because "we have to attract talent". I don't know about other countries, but in Spain we need people who become future engineers".

TYP SA is a design and civil engineering company, founded 60 years ago, a mature company in Spain. The owners are the engineers who work in the company, it is not in any group industrial concession group.

So, "we own our own people, our own engineers." In addition, "we are well positioned in the international ranking, a ranking that classifies all the different construction and engineering activities that" will place us in position 46, according to our international business," he assured. "We are ranked 106th in our global business," he added.

For TYP SA "the important thing is not the design, the important thing is how you design, how you make efforts to reduce the carbon footprint, how you think about mobility, transport, sustainable mobility, it is the way you have to do things. It is not only what you are doing exactly at that precise moment, but thinking about the durability of your assets, of your infrastructure" clarified **Mr. Osuna**.

What, now, is totally integrated is the way of thinking, how to do the work in TYP SA, whereas, years ago, we had to think about making the infrastructure more relevant and sustainable.

So, you had to invest in innovation and research. "The pillars of our activity are: thinking about sustainability, innovation, how to make our investor more feasible and avoid wasting sources, materials and energy that were not necessary," said **Mr. Osuna**.

TYP SA is a global company and, of course, "we are civil engineers who work in transportation and water, building cities, rental energy, the environment, and helping countries develop. We are certified in our environmental safety and quality rivalry research and, now, we have 50 ongoing projects in the research department," he detailed.

The points that help to understand how they do work at TYP SA are: people, quality, environment, community, integrity, innovation, research and stability because they need to



combine all these different things to make sure they are doing, in fact, what society expects.

**Mr. Osuna** added that "of course, we have good practices and a great commitment to sustainability, we have recognized it, we practice it in our work and, therefore, we have 16 practices recognized for our work by the Global Compact organization", he listed.

"For us, it is very important to align our activity and our practice with the direction in which the world is moving," he added.

TYPSA has a Foundation to help people in the third world. It's not just a matter of providing them with money, we want to transform society.

What is our vision? At TYPSA it is clear that "we have to invest in education. Through the foundation, we have created a university in a Democratic Republic of the Congo in Africa, we believe that it is the best way to help people improve their lives, through education. So, we are focused on this project by funding our engineering city in Africa."

**Mr. Osuna** shared the vision of TYPSA, how engineering can change the world. "We have many competent prices and we have won many quality contests..."

TYPSA is in Spain, in North America... This last fiscal year, 2022, has been the most important year in history. In Spain they invoice 19%, in Africa 5% or in Brazil. You may see a slight difference between the billing figures and the personnel figures.

**Mr. Osuna** assured that "we can transfer works from one center to another. So, we can be very active in Mexico and provide services to Mexico from Spain" and, he adds that "our main percentage of activities is in transportation, hydraulics, buildings and environmental energy and others."

TYPSA is working very hard on the higher speed train which is now being developed in the UK and, in Africa, on the metro.

Mr. Osuna concluded by repeating that "what we do is not so important, but how we do things".

## MR. ALBERTO ALONSO POZA, FINANCIAL AND STRATEGY DIRECTOR, CFO



**Mr. Alonso** began his presentation by explaining what EMT Madrid is. “It is the company that manages surface transport in the city of Madrid. Not only public transport refers to buses, but it also has BiciMAD, 20 underground car parks, manages the municipal crane and the Casa de Campo cable car” and added that it has “10,000 workers and has a dimension of 800 million euros”. In economic terms.

When we began to design the company’s strategic plan, which is fully aligned with the Strategic Transport Plan for the city of Madrid, we wanted to influence the main corporate objectives. One is very focused on the decarbonization of public transport, logically, supported by a circular economy, and another would be the innovation that comes from engineering.

The EMT bus fleet is 2,100 buses and the project that has been undertaken has been the replacement of the diesel bus fleet and progress towards the electrification of the fleet, in such a way that it has ceased to have diesel buses in 2022.

The EMT’s electric bus purchase program is quite ambitious. So much so that, when the strategic plan ends in 2025, 25% of the fleet will be electric.

By 2027, the EMT will have, more or less, two thirds of the fleet made up of natural gas buses and one third of electric buses.

Another of the great future projects of the EMT in the city of Madrid are the new operations centers called SPOT, one of which is located in the neighborhood of La Elipa, where it will be dedicated to a fleet of electric buses for more than 300 buses. It is expected to be built in two and a half years, that is, by the end of 2024, beginning of 2025. This center has an execution budget of around 120 million euros.

The center of the tables is a larger center, with a capacity to house 513 buses, almost double that of the center of La Elipa. This is going to be a mixed center to accommodate natural gas buses and electric buses and it is the largest center and has an execution budget of 150 million euros.

Another project is the construction of a hydrogen station in the center of Entrevías. It is not a very large facility because it is a pilot facility, it has a production capacity of approximately 450 kilos of hydrogen per day, and this is enough to manage a bus line in the city of Madrid, about 20 buses.

The facility is completely green. That is, it is designed from the beginning with the installation of photovoltaic panels. A photovoltaic installation that generates energy for the electrolysis station. Then, the dissociation of the molecules occurs right there. There compression takes place, feeding the 20 buses that also rest in the operations center itself. It is expected to be operational within a year and a half.

The fundamental technology of the EMT is electrical technology, but it has been decided to bet on electricity and natural gas. And to the extent that diesel has been left behind, it will be seen to what extent hydrogen is interesting for the company.

For the EMT, strictly electric buses would suffice because the range of these buses is 300 kilometers per day and their average circulation is around 200-220 kilometers per day. Therefore, it would not be necessary to go to technological solutions such as hydrogen, which gives more autonomy, because the entire service in the city of Madrid is already covered with electric buses.

The same would not happen with other companies that operate in the metropolitan area. But, in any case, it is a very interesting project because EMT wants to advance in the investigation of new technologies.



On the path of decarbonization and energy transition, for the EMT it was important to find a solution to how natural gas buses are powered. And, in this sense, what has been done is to reach an agreement with the Valdemingomez solid waste treatment plant. This is indeed a pure circular economy, in such a way that "we are obtaining enriched biogas, biomethane, for the natural gas bus fleet," he assured.

In principle they have begun to buy six gigawatts, from the plant, per year. The plant has a production of approximately; 190 gigabytes a year and that would not be enough, because EMT's fleet of natural gas buses consume approximately 750 gigabytes of bioethanol a year. Therefore, new sources of supply are needed, but it is an interesting initiative. The idea is to move towards bioethanol as a component for the automotive industry of natural gas buses.

Another project is the expansion of the number of bikes within the BiciMAD project from 3,500 to 7,000 units and from around 300 stations to more than 600 stations. With this, all the districts of the city of Madrid would be covered, so that it can be considered a public service of general interest.

80% of the financing of all the renovation of the bike park and stations comes from the European Union. In other words, the approximate cost has been around 50 million euros, of which 40 million come from European Union funds. Therefore, it is a clear example of public-private collaboration. "In this case, I would say quite successful", stated **Mr. Alonso**.

The EMT is also going to put into operation a BRT, which is a Rapid bus, a line that goes from Valdebebas, crosses through Sanchinarro and reaches the Ramón y Cajal Hospital. It has a total distance of 31 kilometers, with segregated lanes for a little more than half of the kilometers of circulation, and it will be implemented in the coming months.

An example of the HUBS that are being undertaken is in Canalejas, under the Four Seasons Hotel and where there are not only charging points, but also parking spaces for carsharing, motorcycles, sharing and spaces for electric bicycles. The idea of underground parking is being conditioned or changed by mobility HUBS and this is the first and most emblematic that the EMT has today in the city of Madrid.

The rest of the 23 car parks have not completed the transformation into mobility HUBS, but the idea is to move towards this model.

In the end, all these projects are focused on engineering and innovation and decarbonization of public transport.

To conclude, **Mr. Alonso** cited some figures, "there is a budget that is quite ambitious, the strategic plan runs from 2021 to 2025 and the idea is to invest around 1,000,000,000 euros, 1 billion US, of which 500 million Euros will be for the transformation and renewal of the bus fleet and the other 500 million for construction, technical installations, information systems and technologies".

## MR. ÁLVARO ARESTI, CHAIRMAN OF THE BOARD OF CREA MADRID NUEVO NORTE

**Mr. Aresti** introduced us to Madrid Nuevo Norte, "the greatest transformation that is taking place in Europe", he stated.



Factors such as the digital revolution or the growing environmental awareness pose a great challenge for society. The answer to these challenges lies in the knowledge and talent of engineers.

The changes that are already taking place have a substantial impact on the way we live, work, move and consume. Therefore, it is a phenomenon that is having an impact on cities and that requires them to adapt quickly and efficiently, because only cities that do so will be able to offer the best quality of life and the best opportunities to their inhabitants.

The main cities of the world are fully aware of this situation and are immersed in transformation processes. Madrid is doing so, to a large extent, thanks to the Madrid Nuevo Norte project. This is the urban action that will regenerate more than 3 million square meters of underused land in the north of Madrid.

It represents a great opportunity for the city to reinvent itself and position itself in the group of cities best prepared to face the future.

For this reason, it is not approached as a simple real estate action, but as a strategic project for the city and for all of Spain. As an action that has the capacity to transform Madrid and position it as a true city of the future and as the best model of a smart and sustainable city, a Spain brand, which can be exported to the world.

This shared vision is what has allowed this project to be articulated through an exemplary public-private collaboration model, capable of arousing the broadest social, institutional and political consensus. A consensus to which the endorsement of the Justice has just been added, which has just overwhelmingly endorsed the urban planning of Madrid Nuevo Norte, dismissing the new appeals that were filed against its final approval in March 2020.

Therefore, and after more than 30 years since this action was conceived, today we finally have all the necessary instruments to be able to start the urbanization works and start up this Madrid of the future.

**Mr. Aresti** showed his interest in highlighting two elements of the project that concentrate this great transformative potential, "the large business center that is going to be built in the vicinity of the Chamartín station and the strategic infrastructures that are going to be built".

Regarding the first of them, Madrid Nuevo Norte has configured a large space for tertiary activity with the aim of attracting the most advanced economic activities to our city, allowing Madrid to compete with the main European capitals when it comes to attracting investment. For this, a large-scale business center has been designed, but different from those that have been built in recent decades.

Opposite to the classic Anglo-Saxon central business district model in which there are only offices, MNN has designed a space in which the most modern offices will share space with a

wide range of affordable housing, with local shops and lots of green areas. quality. Thus, a vibrant and lively urban space will be created every day of the week and at all hours of the day. All this, with unique accessibility, by public transport and less than 15 minutes from the airport.

In this sense, it can be said that Madrid will have the most modern, sustainable and accessible business district in all of Europe. But, if it is called to transcend this project for something, it is because it is the key infrastructure that it will contribute to the city, the entire region and the whole of Spain. Infrastructures as decisive as the new Chamartín station, which is going to become an architectural emblem of the city and the main railway infrastructure in the country, key to the expansion of Spanish high speed.

Two new multimodal public transport interchanges and a new metro line will also be created, which will be the first fully automated in the country.

These infrastructures are part of an unprecedented commitment to urban development for public transport and sustainable mobility, and will allow 5 million people to access Madrid Nuevo Norte in less than an hour using public transport.

In this way, public transport will not only contribute to breaking down physical barriers in the city, but also social ones, making the opportunities that will be generated in Madrid or the North accessible to all Madrid residents, regardless of where they live.

Mobility will also be improved thanks to other very important actions such as the remodeling of the two main traffic hubs in the north of Madrid and the construction of five bridges and two tunnels, which will solve the inefficiencies caused by the historic gap created by the train tracks in this part of the city.

Precisely, the rail yards to the north and south of the Chamartín station are going to be the object of the largest civil engineering work that is going to be carried out in this city and which, with all certainty, is going to be the best reflection of the transformative power of this project. On them, a huge covering will be built on which the future Central Park of the Business Center will be installed. What today is a railway infrastructure that divides the city will become a quality public space for the meeting and enjoyment of all citizens.

For this, a covering of more than 175,000 square meters will be executed, which will require the construction of 1,800 concrete piles of one and a half meters in diameter, on which beams of up to three meters in depth and 40 will be installed. meters of light, allowing the creation of a large slab, which can support up to a meter and a half of earth, for the planting of a true urban forest.

These colossal works began last year and, to date, 74 of these piers have already been erected on the South Beach, which has meant the historic start of the Madrid Nuevo Norte Project.

**Mr. Aresti** did not want to fail to refer to another very relevant civil works action, "in this case, critical for the efficiency in the management of the most valuable resource, such as the complete renovation of about 13 kilometers of the pipelines of the Isabel Segunda canal, through which 80% of the water we drink reaches the city".

"I want to value the coordination plan for the execution of singular actions that we signed last year and that, surely, has become the best example of public-private collaboration that has ever been achieved in this city," he highlighted.

This is a document in which all the administrations and public companies involved, as well as MNN, have committed to developing all these strategic infrastructures within a specific period and with a budgetary commitment.

The role of engineering will be decisive in the construction of this city of the future. But it will not only be so because of these major works, but it will also be key when it comes to designing and implementing all the urban innovations that MNN is going to implement with the aim of becoming a sustainable and neutral city in carbon.



Topics such as the deployment of a broad data infrastructure, the installation of district air conditioning networks, the integral management of the water cycle or the construction of a green infrastructure to naturalize the city and everything related to buildings and construction materials, are going to position Madrid as one of the most advanced European cities in the

race towards decarbonization.

**Mr. Aresti** finished by inviting their collaboration: "All these actions will require the best ideas and solutions that engineering professionals are capable of contributing".

**MR. AGUSTÍN DELGADO, INNOVATION DIRECTOR AT IBERDROLA**



**Mr. Agustín Delgado, Iberdrola's Director of Innovation**, took his turn to speak, and announced that his intervention would be conceptual and future vision and raised a question: is it really necessary to burn things to obtain energy in the 21st century?

Until the 16th century, human beings used animal or wind power to move ships and burned wood for construction, iron and so on.

In this same century, the 16th century, there was a crisis in London. There is no wood and they discovered that coal was good for energy. And, from that, the heat machine, oil, natural gas...

We come to the Industrial Revolution and the energy system we have today, 80% fossil fuels and only 20% comes from renewables or nuclear electricity degeneration. It is a system with which we feel comfortable because it has given us a lot of comfort and development.

As engineers, security of supply is one of the flaws that this energy system has to fix. There is competitiveness because of the fact that fossil fuels are very competitive when they are abundant, but when there are crises, the cost of fossil fuel technologies and energy increases a lot, and there are polluting environmental effects. "But it's not just about pollution, it's also about climate change," he said.

**Mr. Delgado** asked the audience a question: can we change this energy system? According to Iberdrola's Director of Innovation, in just 1 hour, the earth receives the amount of energy that humans use in a year thanks to the sun. After solar energy, he assured that "there are other resources" such as energy generated by the wind.

Now the question would be, do we have the technology to convert this resource into usable energy? "The answer is yes," he stated.

With the energy crisis of the 20th century, there have been programs dedicated to creating new technologies that could help eliminate dependence on fossil fuels.

**Mr. Delgado** highlighted two technologies that "seem to be very successful":

\* Solar energy. It was the one developed by NASA for its missions, in order for the astronauts to have energy in space. Solar energy is the cheapest source of electricity we have today, hence its exponential growth. Although, he clarified, "it is not that today it is the cheapest, but that R+D projects are increasing and it is a global industry with billions of euros, which means that the cost will continue to decrease and the efficiencies increasing".

\* The eolic energy. Today, wind is the second cheapest source of electricity we have in the world. "It is the largest source of electricity and the cheapest when the sun does not shine," he clarified.

If, in addition, these two are combined with hydraulics, "we would have a stable and quality supply in an energy system based on renewable energies," he assured.

This means, for example, that here in Spain in 2030, 75% of our electricity will come from the sun, wind and water. The rest will be nuclear and a part of natural gas. So, it can be said that the power system can divert the carbonization with the renewable resources.

Investments in electrical infrastructure are going to be very high, but they are assets that last between 50 and 70 years. The cost for the final consumer, due to the construction of these assets, "will be about 1.5 euros per megawatt hour or three euros per megawatt hour," he calculated. This is very small compared to the reduction in cost that renewable energy brings to the consumer.

In summary, it can be said that together, the construction of the infrastructure plus the competitiveness of technology will generate savings for customers.

Iberdrola's director of Innovation assured that, "in terms of investment in the construction of



this infrastructure, it is a very good opportunity for companies like ours, if there is enough technology to convert resources into electricity, transmission and power lines that are not going to add a lot of cost to the system”.

**Mr. Delgado** also explained that there are three types of energy use: residential, industrial, and transportation. Only 1% is related to transportation, 99% depends on fossil fuels. Can this be changed? Transport is an example of this, the electric vehicle is going to change the way of getting around. "For me the answer would be yes," he answered to the question asked.

The battery has increased its performance a lot and the cost has decreased a lot. So, it is close to having electric vehicles that are cheaper than operating with a combustion engine. And, this equilibrium point will arrive in this decade, before 2030, he predicted.

Mr. Delgado listed four things that he thinks will make this easier:

1.- The cost. Battery costs are above 100 euros per kilowatt/hour. It is expected to go to 65 euros per kilowatt/hour, in the future. It will be cheaper. Within 10 years, the electric car will be the cheapest option from the dealer.

2.- The autonomy. Today, we have models that have 400 or 500 kilometers of autonomy, four hours of driving. After 4 hours driving, you have to stop and rest, time that is used for charging. Today, “we are building an infrastructure that can charge 400 kilometers in 15 minutes. The charging infrastructure is being developed”, he announced. By 2030, there will be 200 million electric vehicles in that year, and it will be exponential growth from there.

3.- The heating. 50% of the needs are hidden. For example, a system that uses a heat pump to heat houses with operating coefficients of three or four. This means an efficiency of 400 and the possibility of truly decarbonizing homes.

4.- The largest green hydrogen plant being built in Europe in Puertollano (Ciudad Real). It will convert electricity into molecules and then use these molecules for those core sectors.

With time, this 20% exclusive use of electricity will become 60 or 70%, with energy being the new energy carrier of the future, not gas, not coal, not oil.

Iberdrola is a public utility company that is currently building wind and marine energy infrastructures, affordable pumps, hydroelectric batteries, and hydrogen. This is what Iberdrola wants to do in 2030.

**Mr. Delgado** concluded with Iberdrola's intentions for the future, “we are going to spend our product portfolio providing solutions not only at the generation site, but also on the demand side. We are going to give our clients the possibility of decarbonizing their processes, their homes and their transportation with this new, cleaner and cheaper energy”.



## D. PEDRO TOMEY GÓMEZ, MANAGEMENT DIRECTOR OF FUNDACIÓN AON

Speaking time for **Mr. Pedro Tomey Gómez, Management Director of Fundación AON**, to talk about the importance of celebrating World Engineering Day and the importance of engineering for society. In addition, "I have been entrusted with a task, to motivate young people to study engineering," revealed.



Celebrating World Engineering Day allows us to remember the work done by engineers every year. The energy, water or food that we consume, the vehicles that transport us by air, sea or land, ports, airports, railways, communications, the materials of our homes and a long etcetera, are the result of engineering processes that have provided technologies for millions of people to use, enjoy.

The work of engineers is sustainable, inclusive and focused on the progress and well-being of people.

The creations and contributions of engineering, throughout history, are innumerable and cannot be summarized in a few words. Engineering has always made an effort and will continue to make an effort to raise our standard of living, through sustainable development and considering all conditions to protect the environment and ecosystems.

Engineering is becoming more necessary and urgent today in order to meet the Sustainable Development Goals of the United Nations 2030 Agenda. At the last Climate Summit, the power of engineering and science to find solutions to the climate crisis was highlighted and engineers around the world were encouraged to design and build infrastructure with eco-friendly materials, using the latest and greatest technologies.

The weather is one of the crises that society is facing today. But humanity has suffered different crises throughout history. And, in this process of continuous transformation towards the well-being, safety and resilience of society, engineering has played and continues to play an important role. The engineer learns from the past to rebuild the future.

Insurers need engineers because “you are the ones that allow them to assess the risk they are facing, for example, ensuring an infrastructure or certain machinery”, **Mr Tomey said**.

Likewise, engineers “are essential when making assessments when damage occurs to these infrastructures or any insured asset. In other words, your expertise is essential for the insurance in the protection of the national productive fabric and the infrastructures of a country” he added.

At a time when, unfortunately, we have become accustomed to the sinister extremes caused by the proliferation of catastrophes, engineers are having to face that correlate of extreme conditions that you have been trying to master and understand for centuries.

People, especially the most vulnerable, are being victims of the consequences of extreme atmospheric phenomena and, today, it is already mandatory for the insurance sector to take them into account.

The problem with catastrophes is that their accident rate is chaotic and very difficult to understand. "Engineers face critical moments when you create something and it fails," he said. However, that critical moment is also a driver of change and a driver of the creative process to learn from the event and look for formulas to rectify and find solutions.

But engineers alone cannot be drivers of change. Therefore, the construction of a set of regulations and framework conditions is essential for the development of a flourishing and sustainable engineering.

Likewise, more cooperation at the international level and the promotion of global governance are still needed, especially so that the work of engineers is effective and "you can face overwhelming challenges such as cyber security, environmental problems, privacy, safety, equity or inclusion", he pointed out.

Now, more than ever, engineers, scientists, civil society and governments must join forces and make a joint effort to maximize the benefits of new technologies for society.

Engineering, as a whole, is defined as the point where the pure and social sciences converge for the development of society in different ways, to build a better world and to plan a sustainable future. And "I think that being participants in the construction of a better world and being agents of change towards a more sustainable future should be enough motivation for our young people", he affirmed.

In addition, today's world is moved by technology and, "many of today's youth are digital natives, so no one better than them will be prepared to live with intelligent machines in a cyber world," he pointed out.

On the other hand, we must not forget that "we are seven years away from reaching the end of the 2030 Agenda for Sustainable Development and, in many countries, engineers are being demanded to be able to comply with them and solve problems such as access to clean water and sanitation, clean and affordable energy, resilient infrastructure, economic growth and decent work, etc. And, it is that, the great challenges and problems of humanity have to continue solving with engineering", he assured.

According to the Economist, the number of engineers graduating in each country is not enough to meet its needs. In Spain, according to a report from the 2022 Engineering Observatory, the economy must incorporate at least 200,000 new engineers in the next ten years. "It is clear that the world needs engineers," he said.

And, to conclude, with a curious note in compliance with the entrusted task of motivating young people to study engineering, "I will say that if you are an optimist, you see the glass as half full, if you are pessimist, you see the glass as half empty and, if you are an engineer, you see that the glass is twice as big as necessary".

**Mr. Tomey** said goodbye making a request: "Be brave and encourage yourselves to study engineering. If you are an engineer, go out with a new mission, that of being an agent and promoter of new vocations".

## DR. MARLENE KANGA, EX PRESIDENT OF WFEO

Speaking time for **Ms. Marlene Kanga, Former President of the WFEO**, who announced that she was going to change the subject to talk about International Engineering Day and how it came about.



**Ms. Kanga** shared her story with the audience. “When I decided to study engineering, I chose the profession mainly because I was good at math and science and I wanted to work in a field that was practical, that made a difference. It took me some time to realize that engineering and engineers impact the world”.

Engineering is everywhere. “Almost every engineering discipline has a presence here in this room today,” she noted.

It is a profession that connects everyone and can also empower people. It is the profession that can address the effects of climate change and also power the world, clean water, save lives, entertain, create entirely new forms of intelligence, grow more food in less space, help people live longer and better. And, of course, build the most sustainable cities in the world.

However, “few in society, in general, especially young people, boys and girls, understand the power of engineering,” he stressed.

Engineering is the foundation of modern society. “It helped us evolve from cave man and the older use of stone tools, including burning fuels,” said **Ms Kanga**.

Currently, engineering is developing space, vehicles going to the moon... Engineering is, of course, essential to solve future global problems and all kinds of challenges.

Engineers have made it possible for billions of people to connect to the Internet, there are those who have connected to the event via streaming and they are also the ones who have created the smartphones that have become essential for most people.

People using creations that don't know where they come from or who made them possible. The reason, in part, “is because we engineers are not very good at articulating the impact that we have on society,” said **Ms. Kanga**.

Young people do not consider engineering as a career option. Society rarely sees engineering as a good thing. A disaster, collapse, accident... causes a negative impact.

“World Engineering Day provides an invaluable opportunity to talk about these aspects, the positive aspects and the contribution of engineering, and engage the community in the work we do,” he said.

World Engineering Day, for sustainable development, is an important moment where engineers can individually and collectively tell their story and change the narrative.

The UN General Assembly announced in September 2015 the 2030 agenda for sustainable development and the 17 sustainable development goals in the World Federation of Engineering



Organizations, which recognizes the global importance of engineers in achieving these goals.

“As part of our 50th anniversary celebrations, we decided to have engineers and engineering recognized at our celebrations,” **Ms. Kanga** reported.

In addition, he added that “when I had the privilege of being president, we signed the Paris Declaration with UNESCO committing ourselves to promoting the UN sustainable development goals through engineering. We also decided to lead the proposal to declare March 4, the day of the founding of the WFEO, as World Engineering Day for Sustainable Development”.

And he confessed that “at first, none of us had any idea how to do this. We got some bits of information from UNESCO and the science sector that had declared several international days for science.”

Then, “we talked to various ambassadors to UNESCO, from member states, and got more bits of information that we support and seek support from our members and from international organizations around the world,” he added.

80 letters of support were received from institutions, academies and national commissions before UNESCO. Support from these groups represented some 23 million engineers from around the world.

The key, however, was to get UN member states and UNESCO to put this issue on the agenda of the executive board and to get member states from all continents to come together to do this. Ultimately, 40 nations came together and asked the UNESCO Executive Board to review the proposal and recommend it to the UNESCO General Assembly.

**Ms. Marlene Kanga** thanked all the nations that supported them and are members of the federation, “especially China, Nigeria, the United Kingdom, France and many African nations. We couldn't have done it without you.”

UNESCO member states formally and unanimously approved World Engineering Day for sustainable development on March 4, at their meeting on November 19, 2019, one day before the inauguration of the WFEO World Convention of Engineers 2019, in Melbourne, where this decision was announced.

The role of engineers in engineering is widely recognized, through World Engineering Day for sustainable development. A day that tries to promote engineering as a career and explain how it provides the opportunity to change the world for the better.

Engineers have a long way to go to achieve the UN sustainable development goals and ensure that everyone has access to clean water, sanitation, reliable energy and other basic human needs. And, also, “we must deal with the impacts of climate change, environmental problems, our growing cities and the challenges of new technologies such as artificial intelligence,” he said.

Ms. Marlene Kanga also explained the meaning of the WFEO logo, “it is a design that reflects the UN's 17 sustainable development goals, it is in all languages” and added, “our message is: if you want to change the world, become an engineer,” he said.

She concluded by expressing her wish “my hope is that this will continue to grow and help us all address the current shortage of engineers, so crucial to developing the strategic frameworks for the implementation of engineering solutions for sustainable development”.



## PROF. GONG KE, EX PRESIDENT OF WFEO

**Mr. Gong Ke, Immediate Past President of WFEO**, took over the floor. that he began by talking about the importance of resilience and assured that "without resilience, there will be no sustainability".

The world's resilience has been seriously challenged from all aspects. Climate change, crises, disasters, and extreme poverty, broader global armed conflicts such as the war in Ukraine or geopolitical divisions, are damaging society and undermining global stability and sustainable development and "bringing the world to brink of a new recession and that is why I highlight resilience at this time," he said.

**Mr. Gong Ke** said he felt ashamed to see the disasters in Turkey and Syria and believes that action is needed as engineers, although resilience related to food, housing, transport and energy are essential.

As the immediate past president of the WFEO he indicated the information activities that the organization has been doing.



### Food resilience.

For example, the Tunis Declaration, which deals with food engineering and safety and identifies the main challenges and international collaboration to strengthen innovations in engineering.

The new United Nations estimate puts 90 million people at risk of being pushed into extreme poverty. These, added to those that already existed, made the leaders of the WFEO make an official visit to the United Nations organization to discuss food and agriculture and meet with the director general of the FAO, its executive and team, with in order to discuss, in depth, the participation of engineering in their missions.

The objective was to explore the possibility of establishing a pilot product to use emerging technologies such as the internet of things, big data, artificial intelligence, etc., to make agriculture more productive, lower carbon and intelligent.

### Infrastructure resilience.

The global construction forum was convened to address the challenges of buildings and other infrastructure resilience and exchange good practices, from different parts of the world, and lessons learned. Another declaration for the resilience of buildings and infrastructures is published. In addition, there are different forums and committees to address the issue of construction engineering, innovative technologies and green, resistant, sustainable and ecological constructions.

### Energy resilience.

The energy system faces two serious challenges. On the one hand, the poverty for which 8 million people lack access to electricity and more than 3 billion people, according to the World Bank Report, depend on pollution, polluting solid fuels for cooking, which causes an estimation of 3.8 million premature deaths each year.

On the other hand, energy-related greenhouse gas emissions reached their all-time high of 331 gigatons in 2018, accounting for more than 73% of the world's total carbon emissions. What is

far from meeting the Paris targets.

The WFEO has made a statement on energy and climate, as a speaker to the engineering community, to expound the comprehensive considerations of all relevant issues such as accessibility, efficiency, carbonization resistance and energy security.



Transport resilience.

Seen here is the United Nations Global Sustainable Transport conference, which is the top-level platform for transport convened by the United Nations. “The WFEO General Secretary is an active player on this stage,” he pointed out. In addition, he clarified that “every three years there is a

conference on sustainable transport”.

**The Secretary General of the United Nations, Mr. Antonio Gut,** stressed that, in the next nine years, until 2030, there must be a global shift towards renewable energy. Sustainable transport is essential for that transformation.

Together with the United Nations Department of Economic and Social Affairs, the WFEO has organized the Scientific and Technological Innovation Session on Sustainable Transport. In it, the importance of adopting digital technology was emphasized, for sustainable transport, and the crucial role of engineering and engineers, for resilient, efficient, accessible and decarbonized transport.

**Mr. Gong Ke** mentioned the three requirements to act on the implementation of the SDGs and to carry out engineering innovation for more resilience in the world.

Increased execution capacity is needed to accelerate the implementation of the SDGs, especially digital transformation, the use of big data and artificial intelligence as a general-purpose technique, such as electricity.

Capacity building is a must for engineers. Also, the collaboration to face, as a team, the current challenges of sustainable development. In fact, **Mr. Gong Ke** noted, “WFEO, the World Federation of Engineering Organizations, is a platform for engineering collaboration between different engineering districts, between different countries, continents, genders, ages, experience, cultures, etc.”.

**Mr. Gong Ke** concluded his speech by stating that “this is not engineering, it is not efficiency, it is ethics. There is a need to behave more ethically and responsibly, to ensure that engineering practice is good for everyone, leaving no one behind. They are also good for the earth and the planet”.

**Mr. Andreas Brandner, President of the European Council of Civil Engineers,** intervened to thank the organization, congratulate World Engineering Day and officially deliver the manifesto of collaboration, in Spanish and English.

## MANIFEST WFE0 MADRID 2023

**Mr. José Vieira, President of the WFE0**, requested that, before the closing ceremony, **Mr. Shankar M. Krishnan, from the International Federation of Medical and Biological Engineering**, took the podium to read the Manifesto.

**Mr. Shankar M. Krishnan** took the floor to read it.

In this statement, the Federation of Engineering Organizations (WFE0) reiterates its commitment to foster exchanges between civil society and engineering leadership at the federal, state, and local levels. “We support and encourage engineering societies and elected leaders such as mayors, councilors and appointed officials to back projects like the Atlas Initiative in the Climate Resilient Infrastructure Initiative. This action encourages bilateral exchanges that produce national climate resilient infrastructure assessments to reduce climate risks, emissions and disasters, incentivize public and private investments to protect the environment and leave no one behind.”

In this statement, “We recognize the increased investments and better infrastructure insurance, as called for by the Association for Global Infrastructure and Investment.”

It calls for “trust in the expertise of engineers with the unwavering support of city leaders to reduce weather disasters by raising engineering and procurement standards.”

The statement, “recognizes that engineers and infrastructure professionals must be invited to the decision-making table, from the outset, to optimize infrastructure planning, engineering, and design to improve climate resilience for avoid catastrophes”.

He went on to say: “We see the need to combine technical expertise with those who know the needs of the city to build the right projects. In addition, we will welcome city leaders and engineers to join us in working with the Coalition for Disaster Resilient Infrastructure, multilateral development banks and development finance institutions, and capital markets to raise prices. standards, reduce project risk to encourage investment, operationalize policies and further progress towards the implementation of sustainable, climate resilient, equitable and inclusive quality infrastructure for all”.

**Mr. Shankar M. Krishnan** stated, after reading, that “we have many leaders and we appreciate the opportunity to be here and serve the rest of the world, but we also need to be at the decision-making table to make good decisions for good projects.”

Taking the podium for the signing of the Declaration were **Mr. Mustafa Shehu, WFE0 President-Elect, Mr. Gon Ke, WFE0 Immediate Past President, Mr. Shankar M. Krishnan, International Federation of Medical and Biological Engineering and Mr. José Vieira, President of the WFE0.**



## CONCLUSIONS

- **Atlantic Cooper.** Most of the countries in the world have proposed, by 2050, carbon neutrality. The urban population will continue to grow, especially in Asia and Africa. Every population between now and 2050 will be urban, which will require approximately 500 new homes in the world. In the same way, the volume of materials increases from 25,000 million to 100,000 million, so it would be necessary to make responsible and sustainable use of them.
- We are reaching the city of the future, with net zero, through energy efficiency, electrification of transport, decarbonization, and heating and cooling of buildings, whether they are homes or commercial buildings. And, obviously, with demand optimization. Engineering will have a lot to do, both with the capture and with the storage or reuse of CO<sub>2</sub>, be it power plants or any other type of facility. Materials such as aluminum, manganese, copper, zinc, nickel, lithium, cobalt, silver, etc., will be absolutely necessary to cover all these developments: solar, wind generation, nuclear, electric vehicle batteries, electric motors and CO<sub>2</sub> capture and storage. By calculating, about 8 million more tons per year will be needed, on average, from now until 2050. There will be no capacity to meet the demand for metals and recycling will be essential.
- **Ferrovial.** 96% of its patrimonial value comes from outside Spain while Spain represents 10-11%. Ferrovial seeks projects in a stable, reliable environment, with economic capacity and long-term contracts. In 1999, Ferrovial tendered the 407TRPP in Toronto, the first road project at an international level. Ferrovial wants to be the first, to be the first, to lead the curve, to adapt and to be on the path of sustainability. They have a very serious commitment to the fight against climate change and are interested in using all the necessary technology.
- **TYPSA.** It is a design engineering and civil engineering company, founded 60 years ago. For TYPSA, the important thing is not the design, it is how you design, it is how you make efforts to reduce your carbon footprint. It is how you think about mobility, about transport, about sustainable mobility. It's the way you have to do things. The pillars of TYPSA's activity are: thinking about sustainability, innovation, how to make your investor more feasible and avoid wasting sources, materials and energy that are not necessary. They work in transport and water building cities, rental energy, environmental and in aiding the development of countries. They are certified in their environmental safety and quality rivalry research. Now, they have 50 ongoing projects in the research department. They have 16 practices recognized for their work by the Global Compact organization. In addition, TYPSA has a Foundation to help people in the third world. Through this foundation, they have created a university in a Democratic Republic of the Congo in Africa. Its highest percentage of activity is in transportation, hydraulics, and buildings and environmental energy.
- **EMT.** It is the company that manages surface transport in the city of Madrid. Not only public transport referred to as buses, but also BiciMAD, 20 underground car parks, a municipal crane and the Casa de Campo cable car. It has 10,000 workers and has a dimension of 800 million euros. It has two objectives, the decarbonization of public transport and innovation. It has 2,100 buses that have ceased to be diesel in 2022. In 2025, 25% of the fleet will be electric. In 2027, the EMT will have more or less two thirds of the fleet made up of natural gas buses and 1/3 of electric buses. They have new operations centers called SPOT, one in Elipa with a budget of 120 million euros and another in Las Tablas with a budget of 150 million euros. Also, a hydrogen station in the center of Entrevías. They have entered into an agreement with the Valdemingomez solid waste treatment plant, so that they are obtaining enriched biogas, biomethane, for the natural gas bus fleet. The idea is to move towards bio, towards bioethanol as a component for the automotive industry of natural gas buses. BiciMAD increases the number of bicycles and stations. 80% of the financing of all the renovation of the bike park and stations comes from the European Union. A BRT is also going to be put into operation, which is a Rapid bus, a line that goes from Valdebebas. An underground car park for mobility HUBS and this is the first and most emblematic



that the EMT has today in the city of Madrid.

- **Madrid Nuevo Norte** is the urban action that will regenerate more than 3 million square meters of underused land in the north of Madrid and represents a great opportunity for the city to reinvent itself and place itself in the group of cities best prepared to face the future. It would be positioned as the best model of smart and sustainable city, brand Spain, which can be exported to the world. Example of a public-private collaboration model. MNN has designed a space in which the most modern offices will share space with a wide range of affordable housing, with local shops and high-quality green areas. It will have a new Chamartín station, the country's main railway infrastructure, key to the expansion of Spanish high speed. In addition, a new metro line, which will be the first fully automated in the country. The two main traffic junctions in the north of Madrid will be remodeled and five bridges and two tunnels will be built. The rail yards, to the north and south, of the Chamartín station, will be the object of the largest civil engineering work to be undertaken in this city, where a large business center will be built. In addition, the installation of district air conditioning networks, the integral management of the water cycle or the construction of a green infrastructure to naturalize the city will be carried out.
- **Iberdrola.** In just 1 hour, the earth receives the amount of energy that humans use in a year thanks to the sun. Therefore, they comment that there are two energies that are quite successful in sustaining the energy supply: solar and wind (wind is the second cheapest source of electricity that we have in the world. It is the largest source of electricity and the cheapest when the sun doesn't shine). These two, combined with hydraulics, would allow for a stable, quality supply in an energy system based on renewable energy. In 2030, seven years from now, 75% of our electricity will come from the sun, wind and water. Regarding transportation, the change will be to an electric one, where the cost will tend to decrease and the autonomy of the vehicle will increase. Regarding heating, combustion boilers will be replaced by heat pumps. Iberdrola has the largest green hydrogen plant in Europe.
- **Fundación AON.** Engineering is becoming more necessary and urgent today in order to meet the Sustainable Development Goals of the United Nations 2030 Agenda at the last Climate Summit. The power of engineering and science to find solutions to climate crises was also highlighted. Insurers need engineers because they are the ones that allow them to assess risk and damage. Engineers alone cannot be drivers of change. On the other hand, the construction of a set of regulations and framework conditions is essential for the development of a flourishing and sustainable engineering. Now more than ever, engineers, scientists, civil society and governments must join forces and make a joint effort to maximize the benefits of new technologies for society. According to a report from the 2022 Engineering Observatory, the Spanish economy must incorporate at least 200,000 new engineers in the next ten years. It is clear that the world needs engineers.
- **WFEO.** Engineering is the profession that can address the effects of climate change and also power the world, clean water, save lives, entertain, create entirely new forms of intelligence, grow more food in less space, help people live longer and better, and, of course, build the most sustainable cities in the world. The UN General Assembly announced, in September 2015, the 2030 agenda for sustainable development and the 17 SDGs in the World Federation of Engineering Organizations that recognize the global importance of engineers in achieving these goals. The WFEO signed the Paris Declaration with UNESCO committing to promote the UN sustainable development goals through engineering. On the World Engineering Day declaration, 40 nations came together and asked the UNESCO Executive Board to review the proposal and recommend it to the UNESCO General Assembly.
- Without resilience there is no sustainability. Regarding food resilience, we can say that: The United Nations estimates that 90 million people worldwide will be pushed into extreme poverty. Regarding resilience in infrastructures, we see: construction engineering, innovative technologies and green, resistant, sustainable and ecological



constructions. On energy resilience: The WFEO has made a statement on energy and climate, as a speaker to the engineering community to expose the comprehensive considerations of all relevant issues, such as accessibility, efficiency, carbonization resistance and safety of the energy. On Resilience in Transport: The United Nations Department of Economic and Social Affairs, WFEO has organized the Scientific and Technological Innovation Session on Sustainable Transport. Collaboration will be essential to achieve resilience.

- **Reading of the Manifest.** In this statement, the Federation of Engineering Organizations (WFEO) reiterates its commitment to foster exchanges between civil society and engineering leadership at the federal, state, and local levels. Recognizes that engineers and infrastructure professionals need to be brought to the decision-making table early on to optimize infrastructure planning, engineering and design to improve climate resilience to avoid catastrophes.

## CLOSING

**Mr. Mustafa Shehu, President Elect of the WFEO**, took the floor. He began by thanking **the President of the WFEO, Mr. José Vieira**, for the organization and the host, **Mr. José Trigueros**, for the hospitality offered. He thanked the international organizations present, their representatives and attendees. Later, he announced that he would summarize what happened during the World Engineering Day event.

He cited the opening speeches of the presidents of the Spanish engineering institutions, whom he thanked for their attendance.

Afterwards, the Rector of the Technical University of Madrid gave a very good and inspiring speech. Later, **Mr. Antonio Colino, President of the Royal Academy of Engineers of Spain**, asked what the future is in cities of the future, in relation to engineering, and he answered by assuring that "it is up to us to define what the future is before start talking about how to design the cities of the future".

He was followed by the **president of the WFEO, Mr. José Vieira**, who made reference to World Engineering Day and showed the need for engineers to echo their contributions to solutions for global society. No one will express our contribution for us. "Certainly, we have to learn to talk about ourselves, about our successes, so that people know that we are willing and ready to offer solutions to global problems," said **Mr. Shehu**.

Show up to the political class so leaders know engineers are available and willing to solve problems facing their nations, continents, and global populations.

**Mrs. Marlene Kanga**, for her part, announced the result of the Hackathon. The results were as follows: Aquas Mat from Mauritius won third prize of €1,000; Aqua SOI from British Columbia (Canada) won second prize of €2,000 and first prize of €5,000 went to Team Sponge from the Philippines.

In this regard, **Mr. Shehu** commented that "we also have to identify these young talents, but then, what do we do with what they have developed? The WFEO will have to keep track of these innovations that they have developed so that we find a way to commercialize it and probably produce it to be of real benefit to the community."

Then, some sponsors, such as the representative of Iberdrola, made their presentations. This one, she spoke of alternatives to fossil fuel as an energy source, "now we have solar energy, wind, hydroelectric source and, in most of the world, solar energy is the cheapest source". In addition, she assured that, in seven years, here in Spain, 70% of the energy will come from solar and wind energy, since it also has the largest hydroelectric power station in Europe. Electric cars will also be cheaper in 10 years.

**Mr. Pedro Tomey**, was in charge of motivating the youngest engineers and said "it is enough motivation to know that engineering is the vehicle to solve global problems". Many engineers are needed in almost every country. There is no country sufficiently designed, so a young person who studies engineering will have many job opportunities and solve problems for the world.

Atlantic Cooper's representative, **Mr. Javier Targhetta**, made a statement about the 6 21 manual, which is against waste. "To me, honestly, it's a very good document for all of us to see. Although it may seem outdated, from statements read, it is undoubtedly a very valuable document," said **Mr. Shehu**.

**Ms. Marlene Kanga** gave an overview of what made her an engineer. She also talked about the processes to get World Engineering Day endorsed by UNESCO. "I am proud to be

associated with that success because I was on his executive board at the time,” said **Mr. Shehu**.

“It reminded me of a statement from our women engineers in Nigeria that said if you want to change the world, if you want to help make Nigeria great, be an engineer. If you can't, marry an engineer,” he added.

Afterwards, **Mr. Gong Ke**, emphasized the importance of resilience, engineering innovation for a more resilient world. He emphasized that word resilience. “And honestly, prior to this speech, I didn't make a big deal out of the word resilience, but when he actually mentioned it, I start to agree with it 100%. You have to have resilient housing, resilient energy, resilient food and resilient transportation. If we keep this in mind, it will help us bring the right solutions to the problems,” said Mr. Shehu.

At last, they mentioned the capacity development, something that the Committees do permanently. All to meet the objectives of World Engineering Day, and meet the goal of the WFEO to solve global problems. Cooperation and collaboration were discussed because “we cannot solve global problems with engineering alone.” Engineering needs to cooperate with politicians, administrators and other engineers: electrical, mechanical, civil, robotics engineer, etc.

They also mentioned the need for collaboration between countries and between engineers of different ages to combine wisdom and talent.

In addition, the gender balance was discussed. Women are needed who, together with young people, with engineers of all nationalities, with the leaders of our countries, (executive leadership, legislative leadership and local leadership), “cooperate to solve the problems facing our global society,” she clarified.

“Happy World Engineering Day 2023”. Thus, **Mr. Shehu** closed the celebration of this day.

## WORLD ENGINEERING DAY TESTIMONIALS



“For me this day is very important because it reminds us that we can always keep bringing new information and new technological things to solve the problem, because that is what engineering needs”.



“I think this morning has been very inspiring and very interesting for engineering companies like mine. For example, in planning. Architecture and planning towards a sustainability plan. It will also be super interesting because there will be many projects that will be implemented in Madrid next year”.



“As president of the Engineers of Portugal, this World Engineering Day is important because there is engineering in everything. So, I think we should celebrate”.



“I think that this type of initiative makes perfect sense and should be more frequent, because engineering has a lot to say with the set of techniques dedicated to creating systems and providing solutions for society. In the same sense, we from the school and the Association of Industrial Engineers of Madrid, are going to celebrate on April 24 and 25 the 5th edition of the Ibero-American Congress of Engineering and Technology, which aims to promote engineering and, above all, establish links with our sister countries in those places”.



“It has been wonderful. We're really doing something to change the world, to make sure the world is a better place. And we believe that sustainable development is really possible with joint efforts”.



(World Engineering Day, March 4), "It is an important date because it makes society aware of the merger of work, actions and all the contribution, especially to the well-being and social development that our colleagues make engineering professionals. In these conferences, we are having the opportunity to share experiences, share different ways of seeing, of raising social problems and different ways of solving them, from all the countries of the world. And taking advantage of the celebration of engineering day, I would like to make an appeal, especially for the participation of women in this type of career, because really, we are still a predominantly male sector".



"Yes, so tomorrow, the 4th, we will celebrate the World Day of Engineering for Sustainable Development and what has seemed evident, in these times, is that it is not possible to achieve that sustainable development that is referenced in the 2030 Agenda of the Development Goals Sustainable. It is not possible to achieve it without engineering support, and that is seen in the different objectives. And these days, we have had the opportunity to see examples of applications in specific projects, of how sustainable development has already reached different objectives, such as the issue of water, electricity, renewable energy, culture, that of sustainable cities, etc., since it is not possible without a very relevant contribution from engineering".



"It has been a very interesting, very important day. We need to come together to make our world very sustainable. In terms of making sure it's green and clean and self-sufficient, and that it's powered by everyone, in terms of effort by everyone. So, as professionals, we need to get in touch with other professionals, not just engineers, but environmentalists, architects, and any other professional body. So, I'll do that".



## FINAL PROGRAM WED2023

# ENGINEERING THE CITIES OF THE FUTURE

*Thursday, March 2nd 2023*

**8:30** *Registration*

**9:00** *Opening*

- **Mr. José Luis Martínez-Almeida**, Mayor of Madrid.
- **Prof. José Vieira**, President World Federation of Engineering Organizations, WFEO
- **Mr. José Trigueros**, President Instituto de la Ingeniería de España, IIE
- **Ms. M<sup>a</sup> Jesús Prieto Laffargue**, Past President of IIE. Past President of WFEO

**09:30** *Key Note Speaker*

**Mr. Xing Qu**, Deputy Director-General of UNESCO

**10:00** COFFEE BREAK

**10:30** *Energy and raw materials, dependency of cities*

Presenter: **Víctor M. Fuertes**, General coordinator of MWCC

- **Ms. Esther Alonso**, General Director of Energy and Sustainability of Atlantic Copper
- **Ms. Pilar González**, Innovation Manager at Iberdrola
- **Mr. Alfonso Sánchez**, CEO EMT Madrid
- **Mr. Eric Ohaga**, President of Engineers of Kenya, IEK
- **Mr. Jean Eudes Moncomble**, Chairman of the Energy Committee, WFEO.

**12:00** *Great urban challenges: Disaster Prevention*

Presenter: **Mr. José Trigueros**, President Instituto de la Ingeniería de España, IIE

- **Mr. Pedro Tomey**, Managing Director Fundación Aon España.
- **Dr. José Macharé**, Chair of Disaster Risk Management Committee WFEO.
- **Prof. Kenichi Tsukahara**, Director of the Disaster Risk Reduction Research Centre in Japan.
- **Prof. Shankar M. Krishnan**, International Federation of Medical and Biological Engineering.

**13:00** LUNCH



### 15:00 *Infrastructures and Demographic Challenge*

Presenter: **Mr. David García Nuñez**, President of Madrid World Capital of Construction MWCC.

- **Ms. Irene Campos**, Former Minister of Housing and Human Settlements. Costa Rica.
- **Mr. Ling Wen**, President, Shandong Association for Science and Technology, China.
- **Ms. Rosalia Gonzalo**, CEO Madrid Calle 30
- **Eng. Martin Manuhwa**, Chairman of the WFEO Capacity Building Committee

### 16:00 *Mobility and Communications*

Presenter: **Mr. José Trigueros**, President Instituto de la Ingeniería de España, IIE

- **Mr. Manuel Sánchez Cachero**, IT Support & Communications Manager of EMT Madrid.
- **Mr. José Ángel Tamariz**, Director de Europa y Nuevos Mercados & Asset Management Director, Ferrovial
- **Mr. Firas N Bou Diab**, Chairman of the WFEO Youth Committee

### 17:00 *Role of women engineers*

Presenter: **Mari Cruz Díaz Álvarez**, President of Ingenium Committee of IIE

- **Prof. Dawn Bonfield**, Deputy Chair of Women in Engineering, WFEO
- **Ms. M<sup>a</sup> Teresa Pino**, Former President of Pan American Union of Engineering Associations, UPADI
- **Ms. Lidia Santiago**, Vice president of Ordem dos Engenheiros of Portugal
- **Dr. Ania López**, National Council of Engineers of Italy
- **Ms. He Jing**, Deputy Chief Architect, China Institute of Building Standard Design & Research

20:30 *GALA DINNER*  
*Sign in and More Information*



## ENGINEERING THE CITIES OF THE FUTURE

*Friday, March 3d 2023*

8:30 *Registration*

09:00 **KNS: Mr. José María García Gómez**, *Viceconsejero de Vivienda y Ordenación del Territorio de la C. Madrid, Spain*

09:30 *The Cities of the Future*

Presenter: **Patricia Torres Moneo**, Subdirector, Instituto de Ingeniería de España, IIE.

- **Mr. Ricardo Río**, Mayor of Braga, Portugal.
- **Excmo. Sr. D. Allen Sellers Lara**, Ambassador of Panama in Spain.
- **Mr. Jorge Serrano**, Technical Director MNN
- **Dr. Nahla Ahmed Alqasimi**, Vicepresident of the Society of Engineers, United Arab Emirates.

11:00 **COFFEE BREAK**

11:30 *Urbanism: Engineering, Architecture and Sustainability*

Presenter: **Mr. Mustafa Shehu**, President Elect of WFEO

- **Ms. D<sup>a</sup> Raquel Bravo Rubio**, Head of the Department of Dissemination and Institutional Cooperation of the General Directorate of Strategic Planning of Madrid.
- **Mr. Davide Stronati**, Chair of Engineering and the Environment Committee, WFEO.
- **Mr. Andreas Brandner**, President of European Council of Civil Engineers
- **Mr. David Muñoz García**, Director of Business Development for Urbanization Solutions - Europe en CEMEX
- **Mr. Alfonso Vegara**, President Fundación Metrópoli SP

12:30 *Water in future cities*

Presenter: **Mr. Ignacio González Castelao**, Chair of Water Committee, WFEO.

- **Dr. Abou Amani**, Director of the UNESCO Water Science Division
- **Mr. Pascual Fernández Martínez**, Managing Director Canal Isabel II
- **Dr. Marlene Kanga AO**, Non-Executive Director and Board Member, Sydney Water Corporation Chair Planning and Infrastructure Committee.
- **Ms. Sara Perales**, CEO Green Blue Management (TYP SA Group).
- **Mr. Michael Toh**, Industry Director and Technology Collaboration PUB, Singapore's National Water Agency

14:00 **LUNCH**



### 16:00 Round Table International Organizations

**Presenter: Prof. José Vieira**, President World Federation of Engineering Organizations, WFEO


- **Mr. José Trigueros**, President Instituto de la Ingeniería de España, IIE
- **Mr. Fernando de Almeida Santos**, President Ordem dos engenheiros Portugal, OdEP
- **Prof. Song Yonghua**, Executive Board Member of CAST and Rector of University of Macau
- **Mr. Salvador Landeros**, President Pan American Union of Engineering Associations, UPADI.
- **Mr. Ralph Appel**, President Federation Engineers Europe, FEANI.
- **Mr. Papias Kazawadi**, President Federation of African Engineering Organizations, FAEO.
- **Mr. Kamel Sahnoun**, President Federation of Arab Engineers, FAE.
- **Mr. Adil Al-Hadithi**, Secretary General Federation of Arab Engineers, FAE.
- **Prof. Dr. Huang Wei**, President Federation of Engineering Institutions of Asia and the Pacific, FEIAP.

### 18:00 Presentation of the World Engineers Convention, WEC 2023

**Mr. Daniel Hanus**, President of the Czech Association of Scientific and Technical Societies

### 18:15 *Presentation of the World Engineering Day, WED 2023*

### 18:30 *Closure*

- **Mr. José Trigueros**, President Instituto de la Ingeniería de España, IIE
  - **Prof. José Vieira**, President World Federation of Engineering Organizations, WFEO
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## WORLD ENGINEERING DAY 2023

*Saturday, March 4th 2023*

8:30 *Registration*

9:00 *Opening*

- **Mr. Rector Magnificent Guillermo Cisneros**
- **Dr. Antonio Colino**, President Royal Academy of Engineers of Spain.
- **Prof. José Vieira**, President of WFEO.
- **Mr. José Trigueros**, President of IIE.

09:45 *Proclamation of the Hackaton results*

10:00 *Key Note Speakers*

- **Mr. Javier Targhetta**, President of Atlantic Copper
- **Mr. Fidel Saenz de Ormijana**, Ingeniero Jefe de Ferrovial.
- **Mr. José Osuna Gómez**, General Director of TYPESA
- **Mr. Alberto Alonso Poza**, Chief Financial Officer EMT Madrid

11:00 **COFFEE BREAK**

11:30 *Key Note Speakers*

- **Mr. Álvaro Aresti**, Chairman of Crea Madrid Nuevo Norte, MNN
- **Mr. Jesús Casas**, President of TRAGSA
- **Mr. Agustín Delgado Martín**, Chief Innovation and Sustainability Officer at Iberdrola
- **Mr. Pedro Tomey Gómez**, Managing Director Fundación Aon España
- **Dr. Marlene Kanga**, Past President WFEO
- **Prof. Gong Ke**, Immediate Past President WFEO.

13:00 *Closure*

**Mr. Mustafa Shehu**, President Elect of WFEO.

13:30 **LUNCH**





## BACKGROUND

Cities are the points where economic and social activity is centered at a global level, bringing together the population, organs of power, companies, economic and educational institutions, among many other aspects. It is estimated that 80% of the world's gross domestic product is generated in cities and that 750 cities represent approximately 60% of Global GDP, according to Oxford Economics.

56.2% of the global population lives in urban environments and this figure is expected to increase, according to the United Nations, to 60.4% by 2030 and 70% by 2050, when the global population will be of about 9 billion people.

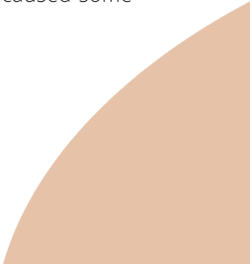
It is expected that the most urbanized areas will reduce their urban growth rate, however, urban growth in those less urbanized countries, especially in some of Africa, Asia and Latin America, is growing exponentially, where they proliferate significantly, megacities with more than 10 million inhabitants, already 16 worldwide. 96% of urban growth will occur in the less developed regions of East Asia, South Asia and Africa. The rapid growth of cities and their population poses numerous challenges linked to essential aspects for urban life which represents a real challenge to meet the Sustainable Development Goals, fight against climate change and ensure the circular economy.

Urban expansion also has impacts on the natural environment in which they are located. The expansion of urban land exceeds that of population growth by 50% and it is expected that in the next three decades 1.2 million km<sup>2</sup> of new urban area will be created.

Cities also have an environmental impact, through the consumption of approximately 75% of natural resources (such as water) and around 70% of energy globally. Furthermore, urban environments generate approximately 70% of greenhouse gas emissions and 50% of global waste. Therefore, it is essential that the cities of the future are designed according to the Sustainable Development Goals, and thus mitigate their impact on Climate Change.

Urban emissions have numerous impacts, but it is especially worth highlighting the one that occurs in the health of its inhabitants. According to the WHO, 91% of people who live in cities do not breathe clean air. In addition, cities clearly suffer the impacts of climate change and are more vulnerable to it. It is estimated that some 500 million inhabitants live in coastal areas, with great exposure to sea level rise and around 90% of urban expansion in developing countries will take place in risk areas.

The impact of natural disasters (due to climate change) or other conflicts has caused some 33.4 million internal displacements in 2019 globally, from urban to rural areas.



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**“ENGINEERING THE CITIES OF THE FUTURE” &  
DÍA MUNDIAL DE LA INGENIERÍA 2023**

