



Gustavo Guzman,  
CEO, Fives Steel Spain.

# Out with the old, in with the new

*Steel Times International* travelled to Barcelona to discuss the TWINGHY decarbonization project with Spanish steelmaker Celsa Group and Fives, supplier of a walking beam furnace at the centre of the project. **By Matthew Moggridge\***

ACRONYMS are funny things. They're fine if they work, like NATO, meaning North Atlantic Treaty Organization, or ASAP being short for As Soon As Possible, but sometimes, like personalized licence plates, they simply don't add up. Or rather they do, but you need to be a little flexible in your thinking. Take TWINGHY, for example. Yes, I know it sounds like the name of a new children's television programme – the Twinghys – but in reality, it means Digital Twins For Green Hydrogen Production. So, where's the 'D' for digital? Call me a pedant, but it matters. Or perhaps it doesn't.

Despite its rather cute name, TWINGHY is a serious project, as, indeed, is green hydrogen production in the quest for zero-

carbon steelmaking.

One of the project's industrial partners is Fives Group. The company is developing a new reheating burner capable of injecting a blend of hydrogen and natural gas in a range from 0 to 100% hydrogen. The burner will be tested at leading Spanish steelmaker CELSA's furnace number three in Barcelona, Spain.

Replacing traditional burners with hybrid technology is a big challenge as the quality of the final products must be guaranteed and NOx emissions reduced while maintaining the same productivity.

The TWINGHY consortium consists of nine partners – Celsa Group in Barcelona (Spain); Swedish steelmaker SSAB; Fives Stein, a Fives Group subsidiary (France);

Nippon Gases Espana (Spain); Barcelona Supercomputing Centre (Spain); RWTH Aachen (Germany); Oulun Yliopisto – Uoulu (Finland); Calderys Iberica Refractarios SA (Spain); and Swerim (Sweden).

The TWINGHY project was started in early 2023 and is one of many initiatives led by Celsa Group that form an important part of the Spanish steelmaker's decarbonization strategy and will contribute to its ambition of becoming net positive by 2050.

"Which means we need to be at least zero carbon and fully circular by then," said Celsa Group's head of innovation, Anna Domenech.

*Steel Times International* had been planning to visit Celsa to discuss TWINGHY for some time and embarked upon a



Anna Domenech Abella,  
head of innovation, CELSA Group.

train journey from London to Barcelona in early December 2024. Editor Matthew Moggridge sat down with Celsa Group's Anna Domenech, the rolling mill plant manager Ramon Garriga and Gustavo Guzman, CEO of Fives Steel Spain, another subsidiary of Fives Group, involved in this project.

"When it comes to zero carbon, one of the most important things we need to do is to replace natural gas and to do that we currently consider three alternatives," said Domenech. The options are biofuels, hydrogen and 'not combusting for induction', the latter meaning electrification.

"We are not the ones that are going to select which one is happening in the future, what we are doing is trying to keep all doors open. So, we are investing into knowing a bit more about every one of these possibilities," she said, adding that there are no innovation projects concerning biofuels because their composition is similar to natural gas, but more sustainable. The third option involves electrifying the process of beam reheating 'because that is the main part of the process where we consume

natural gas', said Domenech.

Celsa is a recycler so most of its energy is generated by electricity used to melt the steel.

TWINGHY is a hydrogen project, started in early 2023 and, therefore, almost two years in development. Celsa uses natural gas for reheating and currently has many hydrogen-focused projects underway for reheating furnaces across the group. Domenech highlighted other planned Celsa projects testing the consumption of hydrogen in EAFs and ladle furnaces.

In Spain, however, the challenge is to make the reheating furnace in Barcelona 'hydrogen ready' and, according to the plant manager, Ramon Garriga, that means making many improvements to the company's existing reheating furnace, supplied by Fives.

The aim of TWINGHY, according to RWTH Aachen, one of the project consortium's nine participants, is to 'demonstrate an optimized heat transfer process based on hybrid burners in reheating furnaces, progressively decarbonizing the reheating process through the increase of H<sub>2</sub> in combination with O<sub>2</sub> and by monitoring and controlling it through a digital twin'.

Celsa's Barcelona facilities constitute a true steelmaking hub. It has two electric arc furnaces (EAFs) in the melt shop, three rolling mills and several final transformation plants. The TWINGHY project is focused solely on one of the plant's rolling mills and a Fives walking beam reheating furnace. "We have three rolling mills in Barcelona," said Domenech, but only one of them is being used for the project producing merchant bars. The others produce big

profiles, wire rod and rebar.

A great deal of research has gone into energy efficiency, 'which is a critical first step', says Domenech, 'and then we will move forward in order to prove that it's possible to make the switch towards hydrogen'. The timelines are simple: this year [2025] will see the installation of the required pipes and instrumentation, which can only be done after the plant has been shut down – the facility runs 24/7 all year round but closes for maintenance for three weeks in the summer and two weeks in winter. In 2026, the trials with hydrogen will begin.

Domenech said that energy efficiency was crucial. "You cannot use hydrogen in a process that is not efficient," she explained, stating that hydrogen will need a lot of energy to be created. "And that's also the power of the digital twins as they allow us to not only simulate the situations that we will have in the future, but also to find the most optimal situation for every specific moment or scenario".

The plant will be shut down for around three weeks during the coming summer to install the special burners, which are bigger than the existing ones and, therefore, require new holes to be made. The summer is the only season when it is possible to completely stop the furnace. The rest of the installation procedure (pipes and instrumentation) can be carried out during plant operation. The new burners can run with 100% natural gas and that's good because when the plant restarts there won't be any hydrogen available.

The reheating furnace has 24 burners in total, 10 of which will be repurposed for use with hydrogen.

There are also two burners from Nippon Gases, a consortium partner, and these are capable of working in hybrid mode, i.e. natural gas and hydrogen, but they are located in the less efficient soaking zone of the furnace, which comes after the heating zone. Oxy-combustion is generally more efficient since there are no additional air particles to be heated during the combustion process. This is why CELSA is interested in exploring this solution further. However, the furnace was not originally designed for this technology, and when combined with H<sub>2</sub> combustion, it could create an imbalance in air pressure. This imbalance may allow cold air to enter the furnace, potentially reducing the overall efficiency of the process, therefore Nippon's



From left: Gustavo Guzman, Anna Domenech Abella, Raquel Torruélla Martínez, innovation manager/TWINGHY co-ordinator; Natalia Artemieva, Fives Group; Matthew Moggridge, editor, Steel Times International; Gustavo Guzman, CEO, Fives Steel Spain.

oxy burners are located in the less efficient soaking zone of the furnace, which comes after the heating zone. The eight burners from Fives are inside the heating zone, which is the most important part of the reheating furnace. In total, including the Nippon burners, there are 10 out of 24 burners being repurposed. All 10 (including the two from Nippon Gases) can handle hydrogen and will not have an adverse effect on the function of the reheating furnace.

Fives Steel Spain's Gustavo Guzman said that the company's contribution to the TWINGHY project was the development of the new burners which, he claimed, were fully compatible with all blends of hydrogen from zero to 100%. Fives was brought into the project by Celsa with the express purpose of developing the burners, said Domenech, as they are also the suppliers of the furnace. The two companies have enjoyed a long and fruitful working relationship for many years, she added, and Fives was very much interested in participating in the project.

Fives has up to eight furnaces working within the Celsa Group of companies, the last installation being at Celsa Atlantic's new rolling mill in Bayonne, France. He said that Fives was working on increasing the efficiency of other furnaces in operation at Celsa, not just the TWINGHY furnace in Barcelona. From Celsa's perspective, having a trustworthy furnace supplier is important when dealing with a new, disruptive and risky product such as hydrogen. "You need guarantees," asserted Domenech.

Celsa's Ramon Garriga said that, when operational, the burners will be the first

industrial-scale hydrogen burners in Europe on a reheating furnace, with a capacity of 180 tons/hr. Each burner will have a capacity of 4MW or 32MW in total across the eight burners developed by Fives. Guzman believes the total useful power of the furnace is around 55MW.

The burners are currently 100% natural gas, but it can be 100% hydrogen or a combination such as 20% hydrogen, 80% natural gas. The burners can be set to work with whatever blend combination is applicable at the time.

The overarching challenge, of course, is hydrogen supply and that, says Domenech, is why the digital twin approach is so good. "Because it will allow us to adapt to different market situations in terms of availability."

Challenges presented by hydrogen supply issues have been a constant concern prompting Celsa to consider installing its own electrolyser or to partner with a hydrogen supplier. A third option was to buy hydrogen from the network. "We were in discussions with many stakeholders, we are part of networks in different regions of Europe that are promoting hydrogen including one in Catalonia. We are doing everything we can to push for hydrogen production," said Domenech. It looks likely that buying from the network will be pursued. "So, we keep being part of these networks at European and national level," she said. "We expect this to happen at some point, I don't know when, but it looks like the availability of hydrogen, or the feasibility of producing it, will depend on the geographical location of your plant. Spain seems to be a good country to

produce hydrogen in terms of renewable energy capacity because we can install a lot of it, but I don't think we considered the issue of water enough. We tend to treat it like an infinite resource and it's not," she explained.

Domenech spoke of water shortages in Catalonia and how, at times, Celsa was almost pushed to stop production. There are now, however, many projects funded by the European Commission that are focused on water circularity. Celsa is involved with two projects related to developing membrane technologies for water cleaning.

Where TWINGHY is concerned, however, the premise is simple: is it or is it not valid to reheat billets with hydrogen? Answering that question is the project's aim, its end game. It's then a case of being ready for the right market conditions to prevail.

"We need time to make all the trials," said Ramon Garriga.

Domenech says it's not so much about what is there, but for plants to invest further into energy infrastructure. "At the end, Celsa is guided by the politicians. Everything is about politics, but the European Commission says we should get ready for hydrogen because they will make it a reality, so we say okay, let's get ready. Even if hydrogen is not available in the future, TWINGHY will have been a useful project because it has increased the energy efficiency of our furnaces and opened the door to using new fuels," she explained.

The relationship between the participants of the TWINGHY project is good, says Domenech. "It doesn't always happen in European projects, but when you have good personal connections, you just learn

more and want to do more," she said.

Fives is confident about its new burners which have already been tested, qualified in mid-2024 and are ready to go. "We want to be ready for the opportunity that may come," said Guzman. "There will be other potential clients interested in having these burners when hydrogen becomes available."

Celsa's Domenech cites Fives' burners as one of the two main achievements of TWINGHY so far. "They have developed the burner and proved it in the lab, that's the first thing. Second, we have the first high-resolution simulations of combustion in this type of furnace in Europe, albeit with natural gas, and we will do the same with hydrogen," she said.

So, what's next? This year the burners will be installed and next year trials will be conducted. "The most important thing is that, at the end of the journey, we will know if our furnace can work with hydrogen and for us it's already a goal which can be applied to other furnaces. Here in Barcelona, we have three reheating furnaces and one of these is the same



Ramon Garriga, rolling mill plant manager, CELSA Group.

[as the TWINGHY furnace] in terms of capacity," said Ramon Garriga.

Where hydrogen availability is concerned right now, it's uncertain how things will unfold going forward, says Celsa's Domenech and Fives' Guzman, but one thing is certain: the nine participants in the TWINGHY project are working well together. According to Guzman, "The

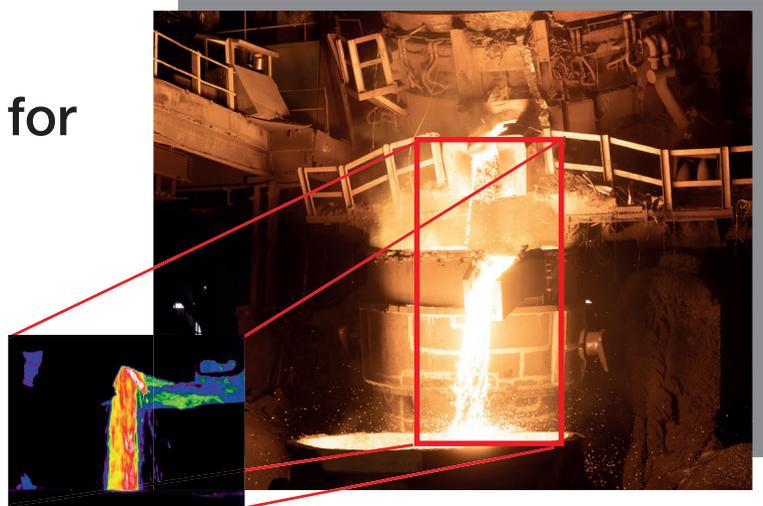
starting up of such a programme is always a challenge, bringing people together, signing NDAs between us, it's difficult to put these people together and work for the same objective, but it's working pretty well," he said.

Domenech agrees, stating that 'every partner has a clear role and a clear reason why they are there'. She believes in small consortiums like TWINGHY as opposed to some of the increasingly larger ones being funded by the European Commission.

Celsa's Ramon Garriga extolls the virtues of the consortium, agreeing with Domenech's point about exploiting synergies between the partners. "To use the knowledge of all the people in a collaborative team is good, it's best to be with a group rather than going it alone," he said.

"It's been a good experience for us," said Fives' Guzman. "Learning from each other and reaching for a target that we set together. I think what will happen will happen. We don't know the future for hydrogen, but what we agreed to be done with this project is done." ■

## Smart temperature measurement solutions for the steel industry



**LAND**<sup>®</sup>  
**AMETEK**<sup>®</sup>

[WWW.AMETEK-LAND.COM](http://WWW.AMETEK-LAND.COM)

See degrees differently.