INNOVATION
NEWS NETWORK

Shift2DC: Transforming the grid with direct current powers

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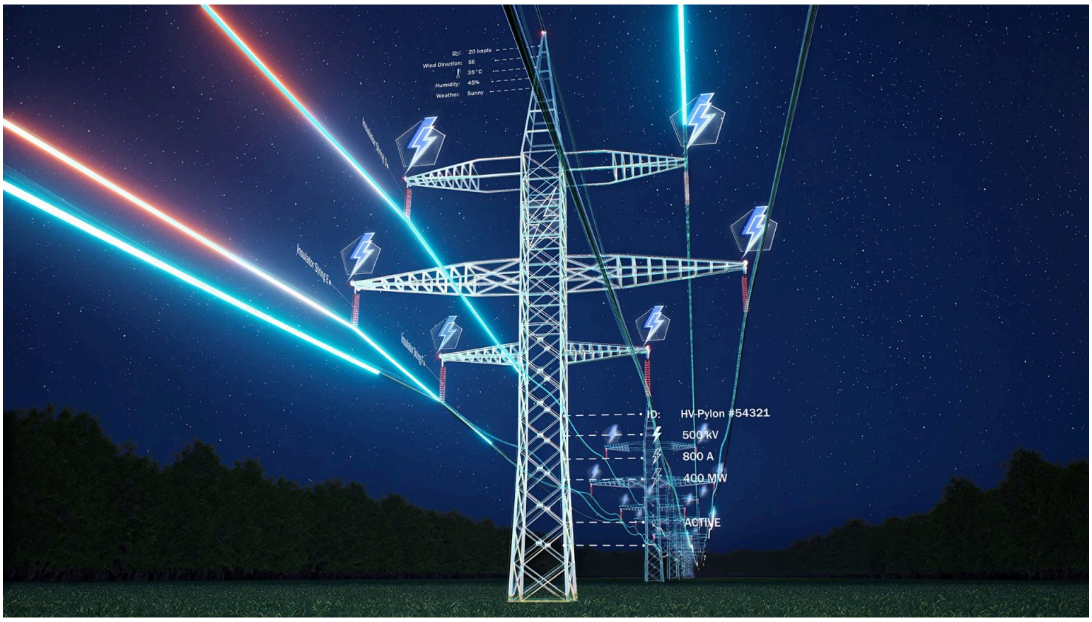

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Led by INESC-ID, the Shift2DC project is working to overhaul our power systems with direct current solutions.

Whilst direct current (DC) powers many modern technologies that are integral in today's world, such as solar photovoltaic cells, batteries, electric vehicles (EVs), and computers, the electricity grid itself is predominantly powered by alternating current (AC). Aiming to transform the way DC solutions are used in our power systems, the Shift to Direct Current (Shift2DC) project is working to create smarter, more efficient, and environmentally friendly energy infrastructures through DC solutions.

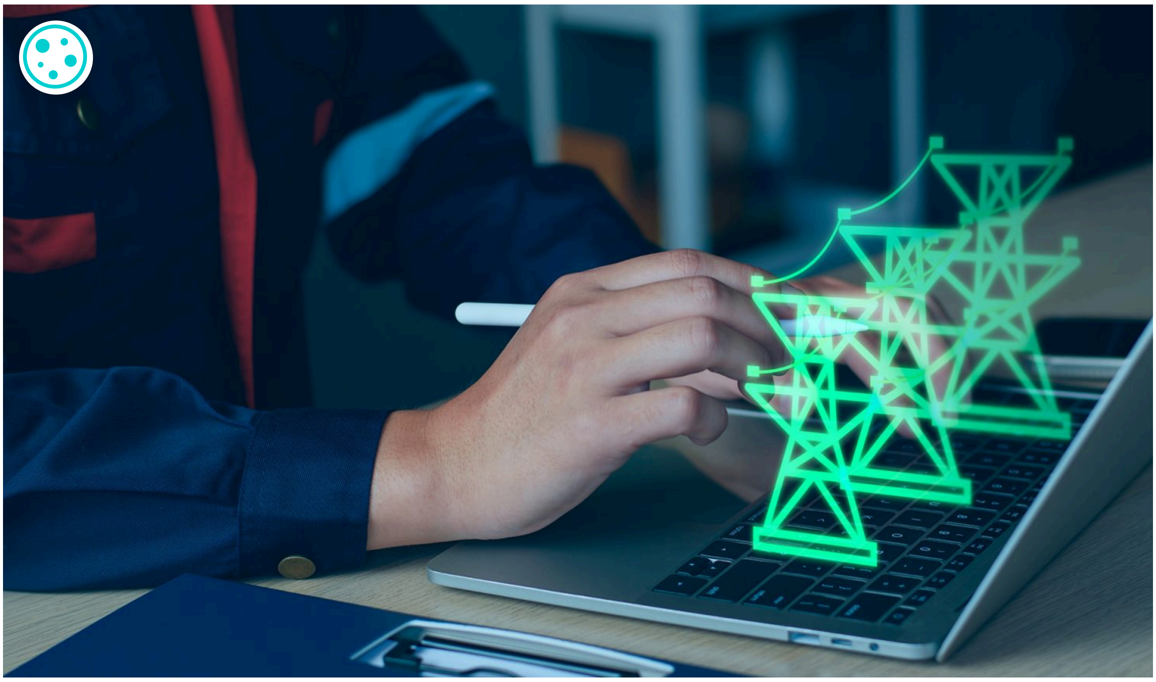
Shift2DC is funded by over €11m from Horizon Europe and is co-ordinated by the Portuguese Research & Innovation Institute **INESC-ID**. The project, which started in December 2023 and will run until May 2027, will implement a top-down, application-agnostic approach to design, simulate, test, validate, and apply DC solutions at both medium (MV) and low-voltage (LV) levels. The solutions will be tested across three countries (Germany, France, and Portugal) in four different demonstrators – ports, industry, buildings, and data centres.

To find out more about the project, its achievements so far, and its overall goals, *The Innovation Platform* spoke to Hugo Morais, Senior Researcher at INESC-ID and Project Coordinator of Shift2DC.

Can you elaborate on direct current solutions and explain how and why the project is working to transform the way that DC solutions are used in our power systems?

We are developing different types of solutions that can be divided into two main categories – software and hardware. We are identifying the main challenges in developing DC technologies and tools while actively designing innovative alternatives to overcome them.

In terms of software, we are focusing on developing solutions for several key areas. The first one is a tool that will support companies and engineers in planning DC installations. There are plenty of tools that support and allow us to design installations of AC, but this is not the case for DC. Therefore, we are working on one to support the design of DC installations considering the specific characteristics of the installations.



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Another tool relates to the design of the protection system, considering the different configurations of low-voltage grids. Then there is the development of an energy management system (EMS) specifically for hybrid grids, considering AC and DC. Compared to a normal EMS, the main difference is that we must consider the deployment of the distributed voltage droop function that is a requirement of DC grids. We are also developing a tool that monitors the system's condition. The goal here is to try to identify situations where faults can occur in the installation and detect these faults before they actually happen.

On the other hand, we have numerous hardware solutions, which make things much more complicated to navigate. We are developing new cables specifically for low-voltage DC grids, as none are currently available on the market. All the cables are optimised to consider the characteristics and needs of DC, making them more efficient in terms of losses and installation. We are also developing a new DC-DC charging station, considering the droop functions.

Other developments include new power distribution units, a new active connector for industrial installations, two different types of protections for low-voltage grid requirements, and a DC-DC battery storage system. We also have a specific power distribution unit (PDU) for data centres that needs to be more concentrated.

Can you explain more about the four key demonstrators for the project and why they were

...osen?

As moving from AC to DC systems is a change, we tried to identify the main use cases where DC can offer an advantage.

The first use case that we identified was data centres, because all the infrastructure in data centres (servers) is in DC. Therefore, having an installation that is also in DC brings various advantages. For example, the number of conversion stages is reduced, in turn reducing the cost of installation.

The second use case we identified was in industry – particularly the automotive sector – where many machines in the production lines operate in DC.

We have also chosen to focus on buildings, largely to take advantage of the connection between production, storage, and electric mobility.

Finally, we considered the case of ports. A new directive now requires that boats or ships, when docked, must have zero emissions. One of the emerging solutions is to connect the ships to the land, but this requires an energy supply that the port cannot support. One of the main challenges is that some of the ships operate internally in DC, while others use AC. Implementing a DC-based system simplifies the conversion process and makes it easier to serve different types of users.

What have been the key achievements in the project so far, and what is next for the direction of your work?

A major achievement is that we have prototypes of most of the solutions, and we have reached the testing phase. The current challenge is integration — bringing all the components together. We are conducting tests in lab environments and, in some cases, evaluating individual devices. The next step is to ensure that these devices and tools work well together and deliver the expected performance and behaviour in real-world applications.

Disclaimer

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Please note, this article will also appear in the 24th edition of our quarterly publication.