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Water Scarcity and Green Hydrogen Production in Spain]



Agriculture accounts for 80 percent of the water consumed in Spain. Green hydrogen production will likely compete for an already scarce environmental resource.

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With one of the highest renewable energy potentials in the EU, Spain has strong ambitions to become a key player in the emerging green hydrogen economy. It recently adopted the target of installing 12 GW of electrolyzer capacity for green hydrogen production by 2030, which makes it the most ambitious producer country in Europe (Collins, 2024). According to government estimates, around 20% of green hydrogen projects worldwide are located in Spain (Spain, 2024). However, these ambitions could exacerbate conflicts over environmental resources due to the vast quantities of water required for the production of green hydrogen.

Green hydrogen is produced via electrolysis, where water is split into hydrogen and oxygen using an electrolyzer powered by renewable energy. The production process thus demands large amounts of water. Nonetheless, water management and availability are not discussed in the Hydrogen Roadmap, Spain's hydrogen strategy. A national strategy for water usage and climate change, adopted in 2022, also does not include any references to hydrogen production. So, is the Spanish government underestimating the risks for water availability posed by large-scale green hydrogen production?

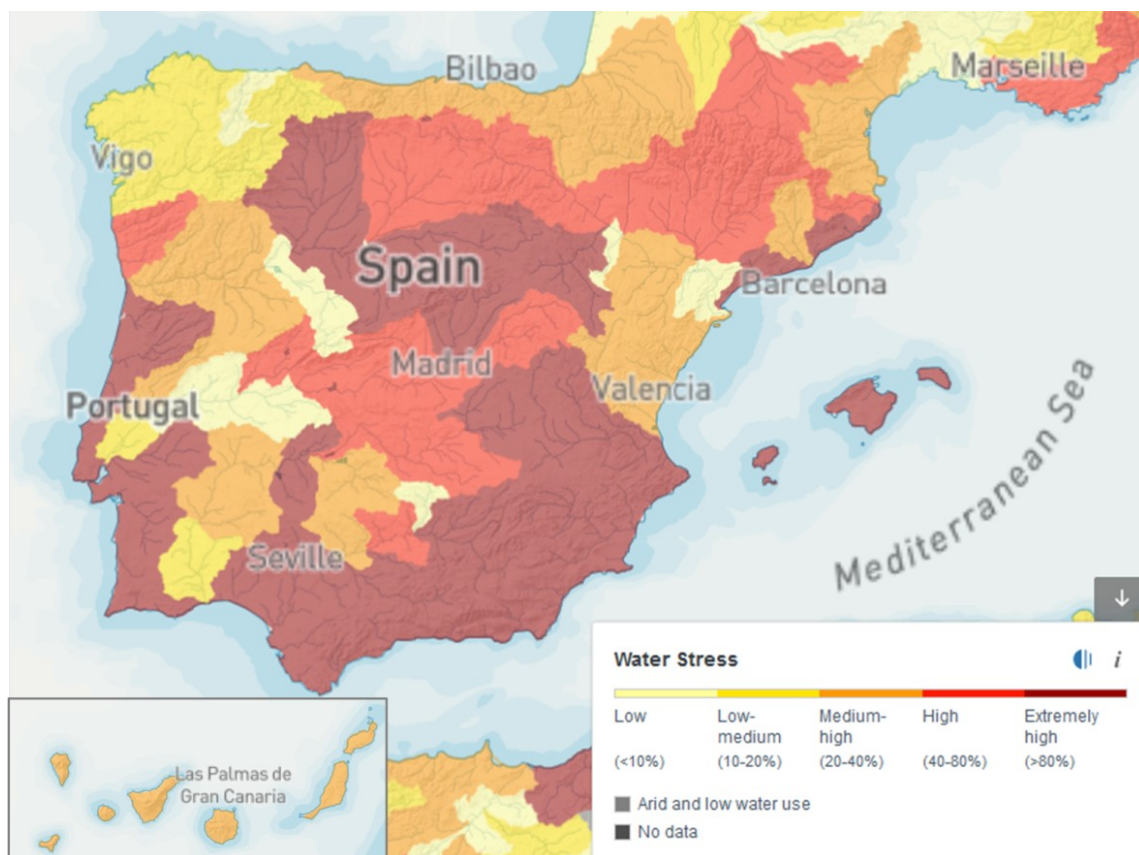
Water scarcity is already a huge problem in Spain. In 2023, many parts of the country experienced a particularly strained summer (Sánchez, 2023). While some municipalities in Andalusia temporarily had no access to running water at all, others limited water access to certain hours of the day. In the future, the country will face even more stress due to the effects of climate change. This could induce a serious conflict between the agricultural and tourism sectors, both of which are important for the Spanish economy, and the emerging green hydrogen industry. Currently, more than 70

percent of all Spanish resources are consumed by irrigated agriculture (Macher, 2023; Montoriol Garriga, 2022). In many places, tourism places additional stress on water resources (Perez et. al., 2020).

However, precipitation and water availability vary greatly by region (see Figure 1). The Atlantic coast is the region with the most annual rainfall, while the South and Mediterranean coast is the country's driest region. The Guadalquivir and Ebro depressions in particular frequently grapple with severe water shortages.

Figure 1. Map illustrating Spanish regions facing water stress (created using the World Resource Institute's Aqueduct Tool)

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Green hydrogen production projects and ambitions are also not evenly distributed across the country. Some regions, such as

Aragon, the Basque Country, and Catalonia, are particularly ambitious, and have published their own hydrogen strategies and targets. Together with Navarra, these autonomous communities initiated the Ebro Hydrogen Corridor, a private-public initiative, covering the northeast of Spain. Another hydrogen hub is planned by Cepsa, a Spanish oil and gas company, which aims at building a large-scale green hydrogen valley in Andalucía, the most southern region of Spain. As of October 2024, over 160 projects in Spain were registered in the [IEA Database](#), which tracks planned or operational low-emission hydrogen production projects worldwide, Andalucía is the region hosting the largest number of these projects, followed by Galicia, Aragon, and Castilla-La Mancha (see Figure 2). Thus, many projects, particularly those in Andalucía and Castilla-La Mancha, are located in regions with a high level of water stress, raising concerns about regional conflicts over water usage.

Figure 2. Regional distribution of low-emission hydrogen production projects in Spain.

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Is this overlap necessarily a problem? Although freshwater is ideally used in the production of green hydrogen since electrolysis requires high-quality water ([Tækker Madsen, 2022](#)), often referred to as ultrapure water ([Lenntech, 2012](#)), it is also possible to produce green hydrogen from sea- or wastewater. Both alternatives, however, come with certain complications.

As seawater is abundant, it is one of the most promising types of water for green hydrogen production. However, it must be desalinated to make it suitable for industrial purposes such as hydrogen production. Despite advances in the technologies used for desalination, it remains a challenging process. First, there is a great deal of energy involved: about 1kWh of renewable electricity per m³ of purified water ([Collins, 2021](#)). Second, seawater desalination can have detrimental environmental consequences, as it co-produces waste that is typically discharged into the marine environment ([Panagopoulos & Haralambous, 2020](#)).

The use of wastewater or recycled water also requires intense purification. There are already some initiatives that use water from a wastewater treatment plant (WWTP) for hydrogen production. One plant harnessing this option is the hydrogen plant of Cepsa in San Roque Energy Park in Cádiz, which uses treated wastewater from the surrounding communities ([Cepsa, 2022](#)). Another plant that will use recycled wastewater is situated in Madrid next to a water treatment plant ([Sánchez Molina, 2023](#)). This option seems promising as long as sufficient water quality for hydrogen production can be ensured. However, the technology is still at a nascent stage and costs need to be further assessed to determine whether treated wastewater can be used at scale for green hydrogen production.

Even if desalinated seawater or recycled wastewater is provided, this does not resolve the competition between communities and

industries over water use ([Borge-Diez, 2024](#)). Desalination plants could also be used to provide freshwater for other purposes. Thus, concerns over the aggravation of local water scarcity in Spain are more than justified. So far, they have found no serious consideration in the country's hydrogen strategy and have been dismissed by government agencies ([Collins, 2024](#)). In light of this, it is essential that clear guidelines and regulations on water usage be established in order to ensure that communities' access to water is not compromised by expanding hydrogen production. Such guidelines should prioritize regions with a low risk of water scarcity and incentivize research and development in hydrogen production methods that rely on sea- or wastewater. With adequate incentives, oversight, and education, water sustainability might be achieved in the country while also meeting green hydrogen targets.

