The Inga 1 dam in the Democratic Republic of Congo. The government is planning a massive expansion of hydropower in order to produce hydrogen for export.

The hydro-to-hydrogen nexus

How the hydrogen hype is driving new hydropower dams

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CounterCurrent

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From green to blue to gray and other colors—hardly any of the current discussions about the future of industry, heating and mobility in Germany fails to mention hydrogen. The Federal Ministry for Economic Affairs and Climate Protection describes hydrogen as a "key element for the energy transition"[1], while the lobby association Zukunft Gas describes it as the "energy source of the future"[2]. Critical voices, however, see the hype as an attempt by the gas industry to save its business model and a new edition of the neo-colonial energy system[3].

The hydropower industry is participating in this debate, too. This factsheet looks at how the trend towards hydrogen is being used by the hydropower industry to push new dam projects—and the social and environmental consequences of these projects.

Hydrogen imports—the German government's plans

The German government assumes a hydrogen demand of 95 - 130 TWh for the year 2030, which could possibly increase significantly in the following years[4]. 50 - 70 percent of this demand is to be imported[5]. A separate import strategy is currently being developed. The government is already pursuing extensive diplomatic efforts and has cooperations in this area with at least 26 countries worldwide[6].

The hydrogen strategy emphasizes that sustainability criteria such as environmental and human rights standards as well as local value creation should be taken into account for imports[7]. However, there are already reports of human rights violations in hydrogen projects supported by the German government or the European Union or implemented by German companies. For example, in Saudi Arabia satellite images show the disappearance of entire villages, a local activist was shot dead by security forces and two others were sentenced to death[8]. In Argentina, 600,000 hectares of indigenous land were transferred to investors without consultation[9]. Hence, there are serious concerns that the problems of displacement, loss of livelihoods and brutal repression against critics, which are well known from other large-scale projects, will also be repeated in the case of hydrogen projects.

Explainer: The different types of hydrogen

Different colors often appear in the debate about hydrogen, in particular gray, blue and green. Chemically, it is all the same (colorless) gas. The colors refer to the way in which hydrogen is produced. This is because the chemical element H_2 usually occurs in nature in compound form and must therefore be extracted from these compounds in an energy-intensive process. Hydrogen is therefore mostly an energy carrier rather than an energy source.

Most of the hydrogen currently produced is obtained from fossil gas through so-called steam reformation. Greenhouse gases, in particular methane, are produced during the extraction and transportation of the fossil gas and CO_2 during hydrogen production. This is referred to as "**gray**" hydrogen. Pilot projects are currently testing the capture and storage of the CO_2 produced. This is known as "**blue**" hydrogen. This is slightly less harmful to the climate than gray hydrogen but is still more greenhouse gas-intensive over its entire life cycle than fossil gas[10].

Besides steam reformation, hydrogen can also be produced from water and electricity through electrolysis. If the electricity for this is obtained exclusively from renewable energies, this hydrogen is greenhouse gas-free and is called "**green**" hydrogen. Large amounts of energy and water are required, the latter can be a problem, especially in dry regions and in view of increasing water shortages.

Many open questions

Despite the omnipresence of hydrogen in the debate on the energy transition, there are still many unanswered questions about the practicability and reasonableness of its use.

Two cases can be distinguished in the use of hydrogen: Chemical use (e.g. in steel production or the chemical industry) and energetic use (either through the direct combustion of hydrogen or after further processing, e.g. into synthetic fuels). There are often currently no technical alternatives for chemical use. In these cases, (predominantly gray) hydrogen is already being used[11]. If the industries concerned are to continue to exist and the use of fossil fuels is to be ended, green hydrogen is needed here[12]. However, there are often alternatives for energetic use. Electrification is often much more efficient and cheaper, especially for heating and for most means of transportation—because the renewable electricity is used directly instead of first being converted into hydrogen[13]. Despite the foreseeable shortage of green hydrogen, lobby groups and some politicians are pushing for the use of hydrogen for these applications[14]. Critics see this as an attempt by the gas industry to maintain its profits: Once the infrastructure is geared towards hydrogen and green hydrogen is not sufficiently available, blue or even gray hydrogen produced from natural gas will be used[15].

There are also numerous doubts regarding the convertibility of existing infrastructure (terminals, pipelines, gas-fired power plants), the transportation of hydrogen over long distances and its economic viability[16].

Making hydrogen with hydropower?

Hydropower is associated with serious ecological and social consequences. Nevertheless, the hydropower industry continues to proclaim that there can be no energy transition without it. The International Hydropower Association (IHA) sees itself as a beacon of hope for the hydrogen economy and promises that hydropower can play a "transformative" role in the development of high electrolysis capacities[17]. Other players such as the German company Voith, one of the world's largest manufacturers of turbines for hydropower plants, is also "betting on green hydrogen" and emphasizes its own role in the hydropower sector in this context[18]. In an interview from 2022, Voith CEO Toralf Haag mentions possible projects in Africa and South America[19].

A closer look at the hydrogen partners of the German government also shows the potential importance of hydropower. There are concrete projects in Angola[20], Australia[21], Norway[22] and Canada[23]. German companies are involved in the implementation in Angola. In Ukraine[24], Columbia[25] and Brazil[26] potentials are being

examined or hydropower already plays such a large role in the electricity mix that it is very likely that hydrogen producers will also make use of this energy source.

An important player on the international hydrogen market is the Australian company Fortescue Future Industries (FFI), which is also planning various hydrogen projects with hydropower[27]. FFI is operating or planning hydrogen projects with hydropower at a minimum in Norway[28], Indonesia[29], Papua New Guinea[30] and the Democratic Republic of Congo[31]. FFI has concluded cooperation agreements in the hydrogen sector with several German companies, including E.ON, thyssenkrupp, Linde and SAP[32].

Grand Inga

The Grand Inga project in the DR Congo is particularly controversial. FFI would like to expand the existing Inga dam complex by adding several new dams. “Grand Inga” would be the largest hydropower plant in the world. However, it is not intended to serve the 90 percent of the Congolese population who have no access to electricity. Instead, the plan is to produce hydrogen for export. The communities in the dam area fear displacement and the loss of their livelihoods. They have still not received adequate compensation for the losses they incurred from the Inga 1 and 2 dams, which were completed in 1972 and 1982 respectively. Affected people and local civil society organizations are fighting against the project. Neither the government nor FFI provide them with precise information about the plans or involve them in the decision-making process[33]. According to local activists, Germany’s hydrogen policy is so powerful that FFI is successfully referring to it to promote its project to the Congolese government, even though there is no political hydrogen partnership between Germany and the DRC.

Congolese activists Salomé Elolo und Emmanuel Musuyu at a panel discussion about hydrogen imports from the DRC in Berlin in September 2023. © GegenStrömung

The consequences of mega dams

In the debate on hydrogen, civil society voices continue to emphasize that hydrogen projects must meet the highest social and environmental standards. This is the only way to avoid reinforcing the same exploitative structures that exist in the global trade in coal, gas, oil and other raw materials.

This is because large-scale projects are almost always associated with social and ecological risks. This applies in particular to hydropower projects. The most important problems are:

- **Methane emissions:** Methane, a powerful greenhouse gas, develops in hydropower reservoirs. Depending on environmental factors, a hydropower plant can therefore have a similarly poor carbon footprint as coal. Most countries in the world do not systematically measure and account for these emissions, so they are easily overlooked[34].

- **Destruction of climate-relevant ecosystems:** Hydropower plants often flood forests, which are then no longer available as carbon sinks.

- **Biodiversity and food security:** The river ecosystem is massively disrupted by hydropower plants. This leads to a loss of biodiversity and can have an impact on food security if fertile river valleys are flooded or people are dependent on fishing[35].

- **Extreme weather events caused by climate change make hydropower inefficient and unsafe:** In recent years, many countries that are heavily dependent on hydropower have already experienced power shortages due to droughts. On the other hand, hydropower plants can exacerbate the consequences of floods, for example when dams have to release more water from their reservoirs; in the worst case, there is a risk of dam breaks[36].

- **Displacement and threats:** To make room for reservoirs, people are usually resettled or lose their land and income. Compensation is often inadequate or non-existent. Time and again, participation rights, in particular the right of indigenous peoples to free, prior and informed consent, are disregarded and activists who oppose this are threatened or even killed[37].

- **Cementing energy poverty:** 45 percent of people worldwide do not have reliable access to electricity[38]. The expansion of energy production capacity should first and foremost benefit these people. If electricity is used for hydrogen production and exported, however, it is primarily the industry in the importing countries that benefits from the best, most cost-effective locations for renewable energy.

Conclusion

In view of the many uncertainties surrounding hydrogen and the potentially serious consequences of production, particularly when using hydropower, financial and political support should be provided with careful consideration. Strong human rights and environmental standards for production are just as essential as prioritizing and limiting consumption. In order to enable a globally equitable energy system, energy demand in Germany must be massively reduced through efficiency and sufficiency measures.

Imprint

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Endnoten

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