CONFRONTATIONS EUROPE

REMOTE RENEWABLE ENERGY HUBS:

A LEADERSHIP OPPORTUNITY THAT EUROPE MUST SEIZE.

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The energy crisis that the European Union experienced in 2022-2023 has once again demonstrated the crucial role of energy in our economies. The war in Ukraine has illustrated how a state, Russia, can use energy as a geopolitical pressure tool on Europe in the context of armed conflict on its borders. Faced with this situation, it became imperative for member states to reduce their significant dependence on certain energy-exporting countries.

Before the war in Ukraine, 40% of the gas consumed in the EU came from Russia (European Council of the European Union, 2024). In order to quickly reduce reliance on this source of supply, the Union urgently increased imports primarily from the United Kingdom, the United States, and Norway (Yanatma, 2023). It also had to accept a drastic reduction in energy demand from industry (International Energy Agency, 2024). Nowadays, the EU imports only 15% of its gas from Russia (European Council of the European Union, 2024).

This episode underscores the importance of EU energy sovereignty, especially considering that its energy supply should preferably meet several conditions. It must align with its commitment to reduce greenhouse gas emissions under the Paris Agreement (United Nations Climate Change, n.d.). It should also enable compliance with the physical constraints associated with energy production, such as the unpredictability of renewable energy production (such as solar or wind) and the time constants required for industry. The energy policy must be conceived on a long-term perspective, especially and the construction of any infrastructure of consequence, such as a new nuclear power plant or a large offshore wind farm, requires years.

This article presents another possibility for diversifying the EU's energy supply using renewable energy in the medium to long term. This solution would involve importing synthetic gas produced in remote Renewable Energy Hubs (RREHs). This new gas, with low carbon impact, could revolutionise the energy landscape in the coming years and would be perfectly aligned with the objectives set by the EU, notably through its REPowerEU plan (European Commission, 2022).

What does an RREH look like?

The main characteristic of an RREH is to harness abundant renewable energy from far away from major consumption centres such as Germany or South Korea (Dachet et al. 2023a). Scientific literature has already studied the example of a hub in the Algerian Sahara Desert (Berger et al., 2021), where the installation of photovoltaic panels and wind turbines takes advantage of the abundance and quality of renewable energy potential. In this example, renewable energy is transported from the desert to the Algerian coast via a high-voltage direct current (HVDC) line. There, it is used to produce hydrogen through water electrolysis, which would be combined with CO2 captured from the atmosphere to produce synthetic methane. This can be exported by pipeline or ship to the European continent. Figure 1 illustrates the technological graph associated with this example. It represents the different production units of the hub and the commodities exchanged between them. This synthetic gas (a.k.a. e-gas or electrical-gas) has the advantage of being CO2 neutral if synthesised from CO2 captured from the atmosphere. The CO2 released during the combustion of this gas corresponds to the quantity of CO2 initially captured, thus offering a net zero CO2 balance in the atmosphere[1]. Furthermore, other synthetic fuels known as e-fuels (for electrical-fuel), such as diesel or kerosene, can be produced in these hubs, making them versatile tools for carbon-neutral fuel synthesis.

[1] The total balance of CO2 emitted into the atmosphere is not totally zero if we include the so-called "grey" CO2 emissions linked to the manufacture of RREHs.

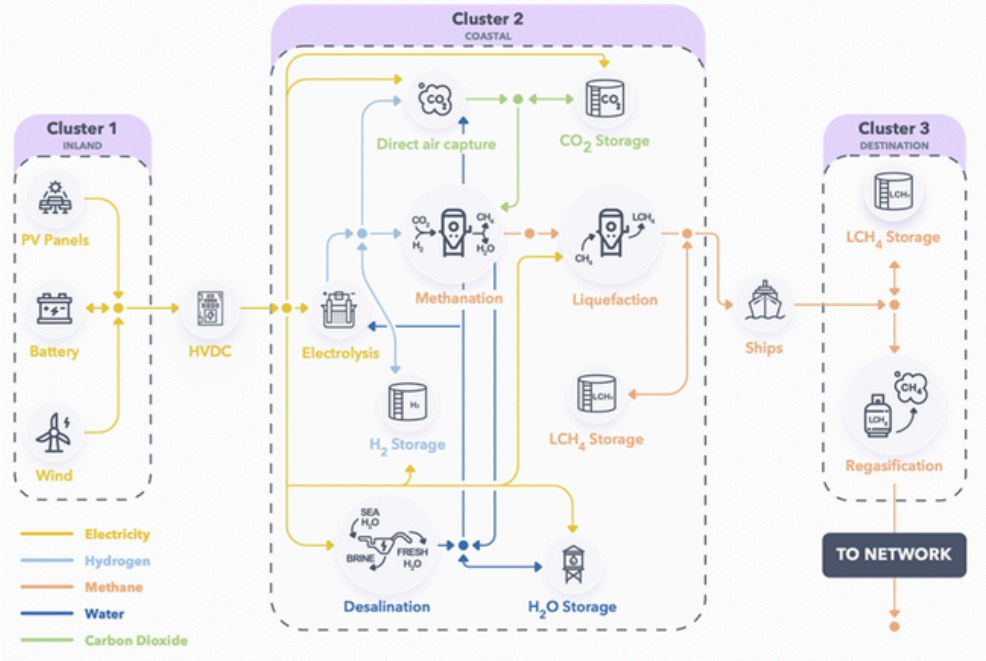

Figure 1: Technological graph of a Remote Renewable Energy Hub. Source: Berger et al. 2021.

Remote Renewable Energy Hubs (RREH): Tremendous Accelerators for Energy Transition

These hubs offer marvellous opportunities for the emergence of renewable energies. Firstly, they would overcome the problem of a lack of space to accommodate renewable energy capture devices near major consumption centres. For instance, the Sahara Desert offers a vast expanse with a very low population density. Installing wind and solar farms there would not inconvenience many people. Such possibilities are scarce or non-existent in countries like Germany or South Korea. Secondly, these hubs can be constructed simultaneously in multiple locations around the world. There is no need to wait for one hub project to finish before starting another. This is a significant advantage because parallelising projects can greatly accelerate the deployment of renewable energies. It is even essential in the context of the rapid energy transition being targeted by the EU, which has set the goal of climate neutrality by 2050 (European Commission, 2020). Thirdly, RREHs do not require major changes to the European energy infrastructure to distribute the energy generated. For example, if methane gas (CH4) were chosen as the synthesis molecule for these hubs—or for some of them—the existing gas transportation or distribution networks could simply be reused.

Remote Renewable Energy Hubs (RREHs): a Project Perfectly Aligned with REPowerEU

RREHs represent an economic, industrial, and strategic opportunity not to be missed by the European Union. They would align perfectly with the first two objectives of its REPowerEU plan (European Commission, 2022), developed urgently during the energy crisis of 2022-2023. Namely, diversifying energy suppliers and accelerating the development of renewable energies (European Commission, 2022). Although this plan was partially successful in the short term, mainly due to the massive importation of liquefied natural gas (LNG) from the United States (Yanatma, 2023), the EU could go even further by investing in RREHs. These would indeed further diversify Europe's energy sources. With abundant renewable resources worldwide (see Figure 2), it would be easy to find partners with vast renewable energy deposits.

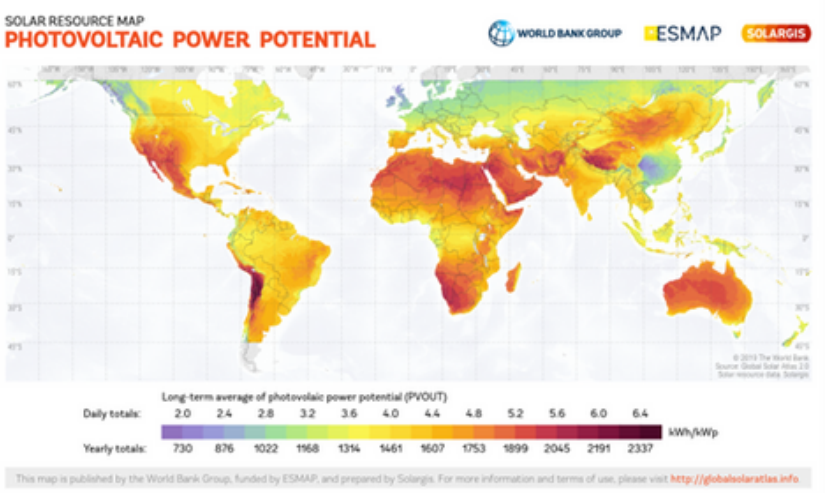

Figure 2: Photovoltaic potential around the world.

The Opportunity for the EU to Regain Normative Power

The proliferation of these hubs worldwide would create a complex network of diversified interdependencies among states. They would address technical constraints, including those related to temporal variations in production and demand[2], and impose new geopolitical constraints, forcing the EU to find new energy allies in its neighbourhood and beyond.

[2] Renewable energy production can be more abundant at certain times of the year. A seasonal effect can also be seen in importing countries, where energy demand is often more abundant in winter than in summer. We could even imagine Europe itself becoming an RREH in summer, when renewable energy production is abundant, and demand is low.

These interdependencies would generate new avenues for collaboration among states. They would offer the European Union the opportunity to establish its leadership in technological innovation (hydrogen industry, transportation, etc.) and to lead in managing the deployment of these production centres on the international stage. As a pioneer in hub development, the EU would expand its sphere of influence as a key partner to host countries in their fight against climate change.

By establishing long-term relationships to establish and consolidate RREHs, the EU would also position itself — once again — as a normative power, as it could choose to encourage democratic regimes by favouring collaborations with partners who respect human rights, democracy, freedom, equality, and the rule of law. It is noteworthy that these collaborations with other countries for the development of renewable energy hubs are also perfectly aligned with the European diplomatic agenda, which places great importance on actions with a positive impact on the environment (Patala et al., 2022; Service européen pour l'action extérieure, n.d.).

Rethinking Regulation on E-Fuels with Low-level CO2 Emissions

To achieve the latter, the European strategy must integrate the possibility of importing CO2-neutral e-fuels from such centres. Currently, the EU Emissions Trading System (EU-ETS) forces certain users of fossil energy to purchase carbon credits equal to their emissions (European Commission, 2020). The EU must clearly distinguish between fossil fuel and synthetic fuel produced from carbon capture and renewable energies. Upon importation, these fuels must also be considered CO2-neutral under the Cross-Border Adjustment Mechanism (CBAM)[3] (Simões, 2021) and should not be accounted for in the same way as their purely fossil counterparts.

Moreover, although the recognition of these synthetic fuels is a step in the right direction at the European level (European Commission, 2023), it is also important to differentiate, upon importation, secondary products whose production would have required fossil or synthetic fuels. For example, steel production using electric arc furnaces currently depends on 38% natural gas as an energy source of (World Steel Association, n.d.).

[3] CBAM is an EU mechanism designed to ensure that the same product is not subject to CO2 quotas if it is imported into Europe, but if it is produced in Europe.

As steel production is included in the EU-ETS and CBAM, steel produced using synthetic gas should not be accounted for in the same way in the CBAM. Therefore, it is necessary to coordinate European policies to prepare the legislative elements required for the recognition of these e-fuels and their derivatives as distinct from their purely fossil equivalents. This exemption from carbon permits will significantly increase the competitiveness[4] of these synthetic fuels, which are still too expensive to penetrate the European gas market[5].

However, particular attention must be paid to quota markets to ensure that the number of permits in circulation decreases at least as quickly as the quantity of CO2-neutral fuel entering the European market. Indeed, an excessive quantity of neutral synthetic fuels on the market could lower the price of CO2 quotas and reduce the cost differential between fossil and synthetic energy. While waiting for carbon prices to create a sustainable price differential between fossil and green fuels, support mechanisms such as "contracts for difference" (CfD) can be implemented (IEA, 2023). This type of mechanism involves covering the costs associated with the price difference between the zero-carbon alternative and its fossil counterpart. Nevertheless, these measures can only be temporary to avoid weakening the European economy.

Beware of Resource Monopoly.

With renewable potential abundant worldwide, multiple locations can be considered for the construction of RREHs. Once a significant number of these centres are completed and operational, the EU can rely on a wide variety of suppliers, thereby avoiding the creation of energy supply oligopolies. This would make it much more difficult to use energy as a geopolitical tool against EU member states, as Russia has recently done (Slakaityte & Surwillo, 2024). Consequently, RREHs would be a means for the Union to foster reliable energy partners aligned with its values.

[4] At the time of writing, the price of CO2 on the EU-ETS is around €80/tCO2 and the emissions linked to the production of one MWh of electricity in Belgium are estimated at 0.508tCO2/MWh (Electricity Maps, n.d.). This creates an additional cost linked to CO2 emissions of (80x 0.508)=40.64€/MWh of electricity produced from a gas power plant.
[5] 149€/MWh of gas synthesised in a CERD and delivered regasified in Belgium is the estimate of (Berger et al. 2021), which is much higher than the prices observed on the Dutch TTF reference index.

However, while renewable energies are abundant worldwide and allow for the emergence of numerous energy supply partners, some actors may concentrate certain technological or mining resources. Therefore, European institutions must remain vigilant regarding the origin of the resources needed for the construction of RREHs. In this regard, it is worth noting that China's share of global photovoltaic panel production increased to 74.7% in 2021, compared to only 2.6% for the EU (IEA, 2022). Diversification remains crucial at all levels, not just in the field of energy supply. Hidden dependencies on certain actors must be considered alongside the industrial opportunity discussed above. The EU must build a strong industry in the field of clean technologies and associated mining resources to truly control the numerous interdependencies between states that will further develop with the expansion of RREHs.

A Risk of Imperialism Not to be Overlooked.

By strengthening the international collaborations of the EU, RREHs represent a strategic and diplomatic opportunity that would enhance Europe's image and role. European influence is often criticised and portrayed as a form of soft imperialism (Hettne & Soderbaum, 2005). There is such a risk of soft imperialism in the project of remote hubs supplying the EU with energy, which could be perceived as a vector of neo-colonial tendencies. As defined by Res Schuerch, neo-colonialism refers to an informal partnership between nations with unequal capacities and powers, seeking to maintain the influence of a powerful state in the subordinate country (Schuerch, 2017). Neo-colonialism emphasizes the ongoing economic domination of the West and its political interference in its former colonies (Schuerch, 2017). Examples of (neo)colonialism in the energy sector have existed. Consider the exploitation of oil fields in Iran, which historically benefited primarily the British Empire through the Anglo-Iranian Petroleum Company (AIPC), of which England acquired most shares in 1914 without giving control of the oil fields to Iran. Moreover, the United Kingdom and the United States orchestrated a coup d'état in 1953 against Prime Minister Mohammad Mossadegh, who had nationalized Iranian oil activities three years earlier (Curtis et al., 2008). This example should serve as a lesson. Such a situation must not be repeated with RREHs, which could potentially monopolize the renewable energy production of host countries. It is essential to learn from past mistakes in colonial development and ensure that RREHs do not contribute to new forms of dependence or exploitation, but rather foster sustainable development and healthy relationships between states.

Strategies to Mitigate the Risk of Imperialism.

The risk of imperialism or neo-colonialism associated with RREHs can be avoided if they engage in a responsible investment plan and beneficial resource-sharing with the host country, considering its needs and aspirations, and negotiating mutually acceptable solutions. To achieve this, at least three avenues seem relevant: ensuring fair sharing of benefits, promoting economic development through the infrastructure created to develop the RREH, and exploiting the inherent local opportunities while respecting local contextual factors.

Regarding the first avenue, it is noted that two means inspired by the oil industry can ensure fair sharing of financial flows. The first means is a proportional rental income based on the surface area required for the hub's infrastructure. The second involves allocating a share of production to the host state. More specifically, the partner creating the hub would sign a contract known as "production sharing" (Hansen et al., 2019), which would ensure a share of e-fuel production to the investor to cover expenses, while the remaining share of production would be shared between the state and the investor. Additionally, besides these two means, the host state of the hub could also capture a portion of profits through direct or indirect taxes (labour tax, etc.).

The second avenue aims to ensure that the local population benefits from the investments made in the hubs. Their creation will require investment in local infrastructure, such as roads, ports, and power grids, which represent significant additional benefits for host countries. Moreover, RREHs could easily provide access to clean and affordable energy to local populations currently deprived of it—in Algeria, for example. And not just in terms of energy! Local populations could also benefit from RREHs to access desalinated water, as suggested by the example in Figure 1. This aspect is particularly important as many sun-rich countries, such as Morocco, have significant water needs (World Bank Group, 2020). Furthermore, the valorisation of by-products from RREHs could provide new income streams. For example, the oxygen produced by electrolysis of water in this same example could be compressed and stored in cylinders to provide oxygen for hospitals. It goes without saying that all these investments would also create numerous local jobs in hub expertise and management, as well as in construction and maintenance of facilities. This would simultaneously stimulate the transfer of green technologies and know-how to host countries, offering them greater energy sovereignty and increased modernisation.

The third avenue, related to respecting local contextual factors is crucial. For example, it should be noted that, although the population density in the Sahara is very low, the NIMBY (Not In My Backyard)[6] phenomena could arise. Some local populations consider the Sahara as a place of cultural importance (Harold, 1979). Ignoring this aspect could compromise RREH projects in the region. To avoid neglecting local contextual factors, it is crucial to ensure and promote fair negotiations respecting international labour and environmental standards established by the UNSDGs[7]. Cooperation agreements for the development of RREHs must be based on fair negotiations with representatives of the local population capable of asserting their rights, and modalities that promote transparency between host countries and investors based on criteria approved by both parties. Furthermore, the participation of local actors from the outset of RREH development will ensure the consideration of their interests and opinions in the decision-making process, thereby strengthening the project's viability.

What hubs for the future?

In this article, we have primarily discussed the example of an energy hub in the Sahara, connected to the European continent. However, other places on the planet are conducive to the development of RREHs. Among them, Greenland could also be an energy hub. It benefits from katabatic winds (Radu et al., 2019) that are both extremely powerful and consistent.

These katabatic winds result from the formation of very cold air (and therefore denser and heavier) at the top of the ice cap, which then flows down its slopes due to gravity. In southern Greenland, this wind adds to the large-scale synoptic wind (over the ocean, for example), which results in part from the presence of the Icelandic Low and the Azores High. The combination of these factors results in a wind that blows on average at ~60 km/h with gusts reaching 180 km/h in winter. An RREH installed in Greenland could also capture waste heat produced there to provide heating to nearby cities via district heating networks.

Other places in the world, such as Cape Horn or Namibia, also have extremely promising wind potential. Namibia also has exceptional solar potential.

[6] This is a phenomenon that often arises during the construction of major infrastructures that benefit the general interest, and which nevertheless sees strong local opposition to the siting of this infrastructure.
[7] United Nations Sustainable Development Goals.

RREHs could offer even more resources by creating a circular economy of CO2. Thus, by using CO2 capture techniques at the exit of gas plants burning synthetic e-methane, this CO2 could be returned to the hub to provide it with the carbon molecules needed for e-methane synthesis. Such a CO2 loop would reduce the price of e-methane synthesis (Dachet et al., 2023c). The development of ships capable of transporting methane outbound and CO2 on the return trip would further reduce costs.

In addition to gas, RREHs could synthesize other molecules, such as ammonia (NH3) as the base of nitrogen fertilizers or even liquid methanol (CH3OH) which could serve as fuel for trucks or boats. We could also see hubs sharing certain parts of their infrastructure, such as renewable energy capture devices, high-voltage lines, electrolysers, or water desalination units.

Finally, it could be imagined that some hubs will be capable, in the future, of flexibly synthesizing methane (CH4), ammonia (NH3), or methanol (CH3OH), as examples, thus allowing them to adapt different production levels to market prices, to ensure increased profitability.

To conclude...

The remote renewable energy hubs project proposes to harness renewable energy where it is abundant and of high quality. This is a project fully aligned with European energy policy and could greatly transform the energy landscape in the decade to come. Yet, it constitutes a blind spot in European policy. The EU should start initiating strategic partnerships with states that could integrate such hubs. Furthermore, the EU should recognize energy molecules imported from these hubs as distinct from their fossil fuel counterparts, so that they are not liable for carbon credits. The development of RREHs must avoid past mistakes and ensure sustainable sovereign development through collective actions between businesses, the public sector, and societal actors. To avoid having to react urgently as during the Russian gas crisis, the European Union should strategically position itself in this future energy network composed of hubs. This is a crucial issue for Europe's industrial development and its energy supply security through diversification of its suppliers. Finally, while these renewable energy centres offer numerous advantages, they should be considered complementary to other energy policies pursued by the Union through its REPowerEU plan.

Remote renewable energy hubs offer such opportunities for the European Union that ignoring them would be equivalent to wasting one of our greatest levers of action in the face of this immense challenge humanity must confront: the necessary energy transition.

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