OFFSHORE RENEWABLE ENERGY

Resilience Preparedness Report

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RISE AB Research Institutes of Sweden

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1. Summary

According to European Green Deal Agenda, more than 50% of the electricity should come from renewable offshore energy sources as to ensure sustainable energy transition to fossil-free energy system in Europe by 2050. Europe has large offshore energy potential from wind, wave and tidal that can contribute to its energy independence and ensure energy security in the future, but the offshore renewable sector (ORE) needs to become more resilient to deliver on these targets.

The impact of unexpected events such as Covid-19 pandemics and energy crisis in 2021 have made the sector additionally vulnerable and slowed the investments of critical projects across Europe.

The current report investigates critical gaps and challenges affecting the resilience of ORE sector and what are the elements for business preparedness needed to cope with the crisis.

Report represents deliverable 2.1 and is developed within ELBE EUROCLUSTER project funded by EISMEA COSME Program (Call SMP-COSME-2021-2021-CLUSTER).

Even though ORE sector is viewed as strategic economic /industry sector in Europe, there is a lack of specific support measures or mechanisms on EU/national level that can strengthen sector´s resilience during the crisis.

2. Aim & Scope

The aim of the report is to identify existing challenges and gaps in the European ORE sector (in terms of innovation, skills and supply chain) in order to better understand resilience measures needed for sector preparedness. For the purpose of this work, we will focus on Hight Impact Low Probability (HILP) events caused by external, uncontrollable factors (such as natural cataclysm, COVID 19-pandemics, armed conflict, etc.) and not a crisis caused by misjudgments within the company. (Carmeli & Schaubroeck, 2008).

The report will first provide an overview of ORE importance from the aspect of the achieving Green Deal Agenda and climate neutrality of Europe by 2050. Secondly, it will assess the critical risks and challenges that affect the sector during the HILP events. Finally, it will describe elements that can strengthen resilience preparedness and provide recommendations on policy level.

The scope of the work and survey findings is limited to ELBE Eurocluster members and not entire ORE sector. However, since ELBE Eurocluster is to large extent covering majority of ORE value chain, it represent a good indication of the trends, challenges and opportunities related to resilience aspects investigated herein.

In terms of subsector, the report will primarily focus on bottom fixed offshore wind, as a most commercially advanced subsector compared to other subsectors, namely, floating offshore wind, wave and tidal which are still in pilot and pre-commercial validation phase.

The report shall serve as a reference material to companies to help them understand challenges caused by HILP events (referred also as unexpected events) and how to develop resilience preparedness plan/actions within their own organization to be able to address these events.

3. Research Methodology

1. Desktop review of existing literature

2. Online survey conducted in collaboration with 47 companies members of ELBE EUROCLUSTER

3. Reference and alignment with European Support Networks, ECCP and EEN

ELBE Eurocluster online survey

The survey was conducted online in May-June 2023. It covered 47 companies from Spain, Poland, Denmark, Belgium, France, Norway and Sweden. 81% were active in offshore wind, 15% in wave and 4% in tidal energy. The survey included a mix of experienced companies and new-comers with majority of companies being mid-sized (from 11-49 employees).

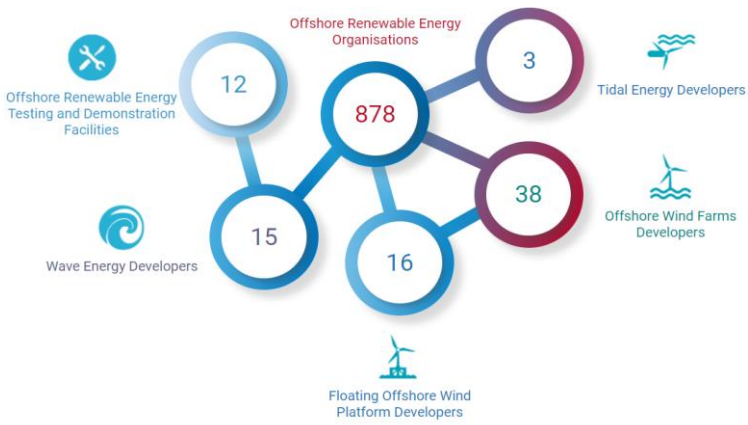
The following companies contributed to the survey:

24SEA; Alerion; Bota Green Offshore; CorPower Ocean AB; Cspect; DECO Subsea; Einar Øgrey Farsund AS; Elmark Sp zoo Sp k; Energy Market Observer sp. z o.o.; Fairplay Towage Polska; Flint Systems Sp. z o.o., FORSSEA ROBOTICS; Freja Offshore AB; GAINZA FORGE , S.L; Gradius Tomasz Dębiec; Green Ducklings; Hexicon AB; HR INVEST Energy; HWS CONCRETE TOWERS S.L.; Inalia; ISATI ENGINEERING SL; JASO EQUIPOS DE OBRAS Y CONSTRUCCIONES S.L.; LUMIKER APLICACIONES TECNOLOGICAS S.L; Nava Engineering Gdańsk Sp. z o.o.; Navitest sp. z o.o.; Nekkar ASA; NOVELTIS; Novige AB; Ocean Harvesting Technologies AB; Ocean Ventus AS; OCEANIDE S.A.; Ocergy; PRINCIPIA; PROTEA; SeaTwirl; SolarinBlue; SOVERIN CONTROL; Subsea Tech; TALLERES AMENABAR S.A.; The Gdynia Maritime School; Tubes International; Vulcan Training & Consultancy; W4P Waves4Power AB .

ELBE Eurocluster

ELBE Alliance was initiated in 2016 to support internationalization and supply chain development among European renewable offshore energy clusters. In 2022, Alliance became EU funded Eurocluster to support collaboration of Blue energy clusters from 8 countries: Spain, Norway, France, Belgium, Sweden, Denmark, Poland, UK. With around 1000 members spread all over value chain, 12 test and demo sites and 72 technology developers in offshore wind, wave and tidal energy it represents one of the leading European Blue energy clusters. More info: http://www.elbealliance.eu/home

ELBE ALLIANCE GATHERS THE MOST ADVANCED REGIONS IN THE EUROPEAN OFFSHORE RENEWABLE ENERGY SECTORS, WITH WELL-KNOWN KEY INITIATIVES IN A GLOBAL SCALE



CONSORTIUM

LEADER

Cluster Energía

BASQUE ENERGY CLUSTER

BLUE CLUSTER

ENERGY CLUSTER DENMARK

GCE NODE

OFFSHORE VÄST

POLE MER MEDITERRANÉE

POMERANIAN PLATFORM FOR OFFSHORE WIND

areg

ABERDEEN RENEWABLE ENERGY GROUP - Associated partner

4. Strategic importance of ORE Sector in Europe

The energy sector is essential for maintenance and development of all aspects of modern life and industrial activity. Fossil fuels (coil, oil, natural gas) have been dominant energy sources ever since Industrial revolution, but this type of energy system was characterized with volatile and insecure supply and hazardous impact on global warming. Renewable energy sources (RES) are recognized as safer and cleaner alternative that can deliver a sustainable energy system in Europe by 2050. In particular, offshore renewable energy sources such as wind, wave and tidal have enormous potential to generate green electricity from European sees. (EU offshore renewable energy Strategy, 2021)

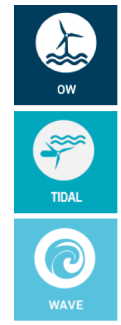
Renewable energy sources have strategic importance for Europe as a key driver to mitigate global warming and achieve climate neutrality by 2050 (Green Deal Agenda ,2019) . Since its launching, European Commission has introduced number of policies and measures to implement the Agenda and strengthen the renewable energy sector , such as Fit for 55 (2021) to include at least 40% of the RES in overall mix 2030. In 2022, RePower plan Europe (including Recovery and Resilience Facility) was presented following Russia-Ukraine war to reduce European dependency on supply of Russian gas and provide energy security and independence via increasing targets of RES to 45% including set of policies to simplify permitting process. In 2023, European Commission introduced Green Deal Industry Plan (GDIP), a set of policy proposals to further enable clean energy transition and make Europe leader in clean technology sector.

The Plan is based on 4 pillars:

1. Predictable and simplified regulatory environment
2. Faster access to funding
3. Enhancing the necessary skills
4. Facilitating open and fair trade

Together they should enable reliable, affordable and sustainable energy in European based on increased use of renewable energy.

In particular, renewable offshore energy and more specifically, offshore wind has enormous potential to generate emissions free and renewable electricity for European cities and industry. EU Strategy of Offshore Renewable Energy sets out 60 GW of installed capacity for wind and 1 GW for ocean energy target by 2030, and at least 300 GW and 40 GW respectively by 2050. This should be achieved by mass investment of at least 800 billion EUR in technology development, scaling up components, as well as adjusting and developing value chain.



However, with a first offshore wind farm established in 1991 in Vindeby (Danmark), ORE is a relatively ”new” industry compared to traditionally established sectors. There is a big gap between currently installed and the targeted capacities of offshore energy to be deployed by 2030 and 2050. Currently, total installed offshore wind capacity is 29 GW, mainly bottom fixed, with few exceptions of the pilot floating wind farms. Similarly, ocean energy wave and tidal converters are also in the validation phase with few prototypes totaling 55.1 MW of installed capacity in 2022. Hence, the entire sector is not yet ready for mass scale commercialization due to discrepancies within technology readiness level among wind, tidal and wave energy with most of the concepts being still in test and demo phase, apart from bottom fixed offshore wind.

In order to reach the 2030 offshore energy targets, both offshore wind and ocean energy need to start growing rapidly every year increasing volume of orders and production scale. Besides 800 billion EUR of financial investments needed, there are other issues that create hurdles for this sector such as access to critical raw materials, availability of mature value chains, port infrastructure, scaling up production, etc. Currently, most of the critical raw materials and production value chain including major shipyards for offshore renewable energy projects are located in China and Asia, which makes the sector highly dependable on these markets.

The Green Deal Industry Plan represents in this sense an EU attempt to minimize these risks by introducing a set of reforms that should address growing concerns from industry which is calling for protection of renewable energy sector. The protective measures could help make the sector more resilient to external uncertainties associated with permitting procedure, inflation, access to raw materials, value chains disruptions, etc. (Siemens Gamesa, Why we need European wind industry and how to safeguard it, 2022). However, the legislation proposed under the GDIP still needs to be enacted and ratified by European Parliament before the Members States can start with national implementation, expected earliest in second half of 2024, if not later. Furthermore, the expansion of wind supply chain would require from EU and national governments to implement measures related to CAPEX support via state aid; a tailored made EU public funding instruments targeting RES focusing on developing promising technologies for zero net gas emissions and scaling up clean tech supply chains; support establishing new critical raw materials trade routes and EU alternative manufacturing to decrease current dependency on non- EU suppliers. (Rystad Energy, 2023).

Meanwhile, until all these policies and legislation come into force, how can the ORE sector become more resilient to cope with risks and unexpected events?

4. Why resilience is needed?

SMEs running their businesses within offshore renewable energy are already facing several challenges during the usual, non-crisis periods of operation. However, in times of unexpected events, the ORE sector is additionally exposed to risks that can undermine their survival. Being one of the most vital sectors in Europe, the resilience of ORE sector is hence of utmost importance to help sustain and strengthen the robustness of industry during the unexpected events.

HILP events interrupt supply chain and create long term problems to wind farm developers who had to deal with unexpected costs as well as logistic hurdles. For example, Covid-19 pandemics have created supply chain disturbances, lack of wind turbine components supply, delays in manufacturing as well as created backlog at the ports. Energy crisis caused by Russia-Ukraine war in 2021 has raised prices of raw materials and delayed delivery of components and materials.

In this sense, resilience is understood as an ability to handle unforeseen changes and keep developing businessesin a long-term perspective. There are different aspects of resilience: on one side there are companies that go back to "business as usual" after the crisis, on the other there are companies that can adapt and develop during crisis. The latter is important when facing long term disruptions (Muhammedamin Hussen saad, 2021).

Saad et al. states that resilience should cover both operational and dynamic capability, where operational capability focuses on firm growth whereas dynamic capability means the ability to adapt and seize business opportunities "amid challenging business environment".

Research has shown that SME's are not as well equipped as larger corporations to handle crisis, mainly due to lack of resources. In the wake of the COVID-19 pandemic, SME's had been implementing number of actions including: upgrading digital services, diversifying suppliers, improving employee well-being, shifting or downsizing the business. (Kerry Brown, 2022).

The study *Factors Impacting SME Business Resilience Post-COVID-19* found that uneven demand, supply chain disruption and financial shortage are the largest risks when it comes to business resilience. Other identified risks are shortage of staff, border restriction, extreme weather conditions and difficulties reaching out to customers (Kerry Brown, 2022).

Finally, resilience cannot be achieved by one SME acting on its one, meaning that partnership and clusters are necessary in order to reach resilience within organizations (Erica Seville).

The following sections summarizes major challenges and gaps the sector is facing in time of crisis events.

5. Critical challenges and gaps

1 . Predictability

Offshore wind is characterized by single but very large orders with high investment costs, making it difficult to manage cash flow. Total investment orders in wind industry in Europe fell by 47% as compared to 2021 due to inflation and market interventions. (Wind Europe, 2023, "Investments in wind energy are down"). Across EU members states, there are differences in plans and actual announcement of tenders /auctions for offshore wind zones that gives uncertainty to entire value chain about the expected construction time. That is often due to regulations governing the offshore permits in view of socio-economic risks.

Hence, the predictability and permitting process pause significant challenge to the sector, but interruption in times of HILP events can easily lead to loss of business for most of them as they face difficulty to raise capital, due to longer lead times and lack of access to quick support incentives and financial instruments.

2. Disruptions in supply chain

Majority of materials and components for offshore wind farm / ocean energy pilots have been produced outside Europe, the unexpected events create severe interruptions in delivery of supplies and make sector vulnerable. The delays in orders and deliveries have been heavily affected by both Covid-19 pandemics and Russia-Ukraine war. This has primarily reflected in stock rupture, components piling up in ports, and down delivery time due to stopping of the logistic operations.

Currently, most of the raw materials used in manufacturing for wind industry comes from outside of Europe. In 2022, the largest share of the materials used for wind turbines were iron and steel (65%) followed by cement (20%) (Rystad Energy, 2023). China is world largest steel producer. In 2021, 50% of steel plates were imported from Ukraine to EU and both Russia and China contributed to 93% of slab import to EU. All these imports have been interrupted due to the Russia-Ukraine war and delayed offshore energy proejcts. Furthermore, Rare Earth Elements (REE) which are used for permanent magnet generators in direct drive-in wind turbine are imported solely from China (98%).

3. Technology challenges

Renewable offshore energy is high-tech innovation driven sector with large costs investment in demonstration and validation of the technology (simulation hardware, test beds and lab infrastructure , high-end engineering, etc.). Innovation in new materials and components for offshore energy devices can significantly reduce the CAPEX in commercial projects . It requires specific set of labour skills that is hard to find in the market, which in turn increases investment costs and requires training programs to educate labour force for this new industry. During Covid-19 pandemics, the technology challenges were augmented by quarantine and isolation that slowed the pace of innovation, trials and validation of the technology concepts.

4. Logistics & Installation

In general, offshore energy projects are often taking place in environments that are complex and demanding in many ways. Establishing power plants at sea is logistically challenging and expensive because the plants are exposed to large environmental loads and often located in inaccessible areas. Subsea installations put high demands on the facilities not only during installation phase but also during operation and maintenance phase. Some building techniques also require high demand on the personnel, for example when there is subsea technical equipment with maintenance needs.

Logistic bottlenecks are another complication that become critical challenge during unexpected events. Associated problems are unavailability of labor due to quarantine and isolation, interruptions in operations due to waiting on major components, stockpiling at harbors etc.

5. Inflation

Offshore wind contracts are characterized by long time between contract award, permit and final investment. This reflects in inflation which is ongoing challenge to sector during the normal operations but augments business risk in time of unexpected events. During Covid-19 pandemics as well 2021 energy crisis in Europe, the prices of raw materials, production, manpower costs, capital costs across entire value chain of wind industry went up. This created delays in project completion and led to uncertainty in subcontracting across entire value chain.

In some countries (France, Poland, UK) high prices increase is offset by inflation indexation (dynamic inflation compensation), but more aligned and coherent measures are needed across Europe to strengthen sector´s resilience and ensure the contracts are delivered as planned (Siemens Gamesa, Why we need European wind industry and how to safeguard it, 2022).

6. Feedback from the industry

6.1. Impact of the crisis

The online survey was conducted on a representative sample from ELBE Eurocluster to investigate what was the impact from Covid-19 pandemics and energy crisis on their business operation and how did they deal with these challenges? Majority of companies (60%) said they have been affected by the crisis while 18% stated to some extent, hence majority of them have been been exposed to business operation risks.

Overall, there were no peculiar difference in responses between companies operating in subsectors of offshore wind, tidal and wave energy – in this sense the entire offshore renewable sector has been struggling with similar issues during the crisis events and has response and resilience needs.

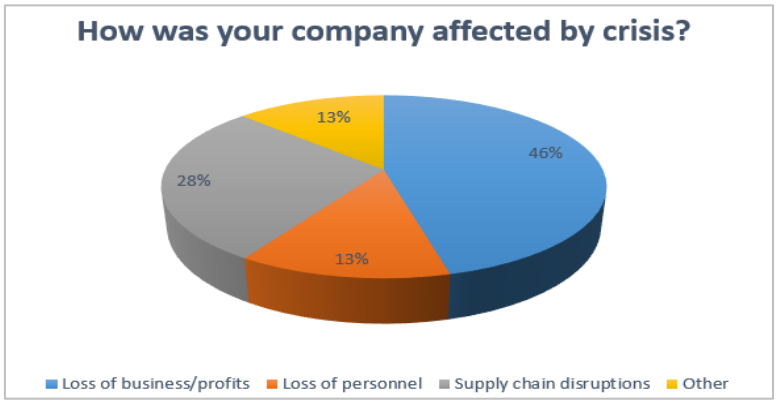


Figure 1: Impact of the crisis (ELBE Eurocluster survey, 2023)

In respect to challenges, companies pointed out that largest impact from the crisis was loss of business /profit followed by disruptions in supply chain and loss of personnel (Figure 1). Companies faced costs increase and challenges with project finance and operation which is in line with desktop research findings identified above. Largest impact of crisis on technology was price increase, lack of materials and electronic components, lack of qualified suppliers, lack of investors willing to finance, serial production interruption, delivery times delays and reduced government announcements of tenders.

Overall, companies received none (66%) or limited support from EU/State/Region level to alleviate effects of crisis. Of those that received some support, 74% stated that it did not help them recover their business after the crisis.

6.2. Response to the crisis

The companies have responded to the crisis mostly by changing the business/market strategy and supply chain, but also applying other measures such as training and new skills, technology changes, loans, personnel cuts and reorganization. (Figure 2). More specifically, they pointed out following resilience actions they can take to cope with the crisis: Diversify business services to include the sectors that can secure contracts, Ensure larger financial buffer (affordable loans, raise additional investments, EU grant funding, etc.), invest in training, new knowledge and technologies and have resilience preparedness or business continuity plan in place.

On policy level, the most important support measure would be having quick access to financial incentives that can be available in times of crisis to offset price increase and disruptions in supply chain. Besides that, companies have indicated that internationalization and government support to access alternative markets can contribute to strengthen resilience (Figure 3).

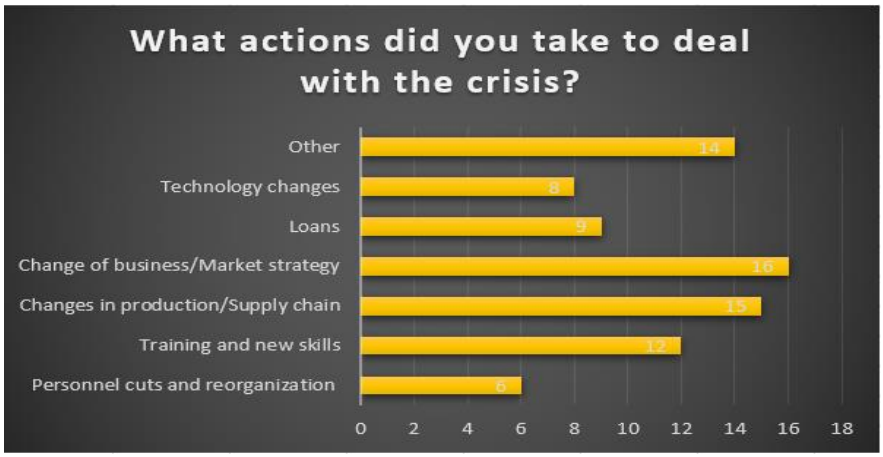


Figure 2: Response to the crisis (ELBE Eurocluster survey, 2023)

Figure 3: Measures to support resilience (ELBE Eurocluster survey, 2023)

8. Business Continuity Plan

The risk response and mitigation strategy of organization is usually summarized in a document Business Continuity Plan (BCP) which ideally covers the elements of prevention/mitigation, preparedness, response and recovery (State of Queensland, 2022). The Plan is seen as a tool to organization to identify potential risks, analyze their impact , and plan resources for response and recovery. It should help the companies design the actions to take before, during and after the crisis. The survey showed that 32% of the companies currently do not have Resilience strategy or Business Continuity Plan, but 51% stated they were working on it which means they see the urgency of having the plan in their organization to be able to cope with crisis in a systematic way.

Business Continuity Plan should ideally include following elements:

RISK ASSESSMENT	Identify HILP events threatening the business e.g. natural disasters, extreme weather, cyber attacks, power outages etc.
BUSINESS IMPACT ANALYSIS	Evaluate impact of the identified events on the entire business supply chain. Include aspects as reputational and legal impact.
RECOVERY OBJECTIVES	Describe how to recover in the event of disruption, how to restore essential functions, mitigate financial losses and minimize impact on customers and employees
EMERGENCY RESPONSE PLAN	Describe evacuation procedures, communication protocols, and emergency contacts.
CONTINUITY PLAN	How the business will continue to operate during the disruption, including alternative locations, backup systems and key personnel roles and responsibilities.
COMMUNICATION PLAN	Develop a plan for communicating with employees, customers, suppliers, and other stakeholders during the disruption.
TESTING AND MAINTENANCE	Have procedures to review the BCP regularly, making sure it is up to date.
TRAINING AND AWARENESS	Train employees on the BCP, this also raises awareness on the importance of BCP and will bring feedback to the BCP review.

9. Key recommendations

1

Increase resilience knowledge

Develop Business Continuity or Preparedness Plan. Invest in strong team of employees, support them with innovative solutions skills, capacity building and updated knowledge on trends and developments in the industry .

2

Access to financial incentives

Apply for EU grants or low-interest loans or regional projects to bridge the gap between financing.

3

International cooperation and networking

Via cluster collaboration identify alternative suppliers in Europe and outside of Europe. Enterprise Europe Network (EEN) can help companies to assess their resilience preparedness, provide advices on EU funding , supply chain diversification and adaptation of business strategy.

4

Invest in R&D and Technology

Alternative materials produced in Europe reduce dependencies on non-EU production and import. Investment in digital systems back up the business and create potential alternative services that can save the company during the time of crisis.

10. Conclusions

Offshore renewable energy represents the vital sector to deliver clean energy supply and energy independence of Europe. It is therefore of strategic imperative for companies to develop resilience to cope with ongoing challenges and in situation of unexpected events and crisis.

Green Deal Industrial Plan (GDIP) has been proposed to solve some of the critical challenges facing European clean high-tech industry , including renewable offshore energy. It represents a roadmap for new industrialization wave in Europe – the one where future EU industry will be based on net zero green house gas emissions that would require adjustment of industrial technology and process for production built on domestic (EU) sources of critical raw material as to reduced dependency from Asia. Specific actions would be required to support renewable energy supply chain in forms of direct financial support, tax credits and accelerated depreciation. However, it will take some time before the reforms and legislation under GDIP are adopted and transposed into national level and adequate financial and regulative mechanisms introduced to support the implementation of the Plan.

Even tough ORE sector is of strategic importance, the ELBE Eurocluster survey showed that majority of companies didn´t receive any specific support during the pandemics and energy crisis. The report concludes that in order for the sector to deliver on European 2050 Green Deal targets the following key measures are needed:

- Introducing specifically designed and dedicated financial incentives and mechanism to support critical projects in renewable offshore energy in Europe;
- Increase public investments in research of new materials, products and processes that can enable predictive and mass scale development of renewable offshore energy projects;
- Strengthening European cluster collaboration is of vital importance for diversification of the suppliers and value chain so that the companies can have access to extended network they can use in case that their own suppliers become non - operational or inaccessible.

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