Offshore Wind Farm Development: Contractual Structures, Risk Allocation and Regulatory Challenges with a Focus on Croatia

Ratko Brnabić

Offshore wind farms combine engineering ingenuity with complex legal frameworks that must endure harsh marine conditions and intricate international contracts. They are built upon advanced technology, significant market potential, and precise legal regulation, spanning national laws and international standards. While countries like the UK, Denmark, Scotland, and Germany rapidly expand their offshore capacities, Croatia is just beginning to explore this renewable energy frontier. This article examines the contractual landscape for offshore wind farm construction, focusing on contract types, including EPC, turnkey, multi-contracting, and project contracts, as well as risk allocation strategies and the intersection of private contract law with public regulatory frameworks. Drafting of such contracts includes analysis of technical, market, and legal considerations relevant to offshore wind projects. Multi-contracting models dominate in this field, due to the high-risk nature of offshore developments, emphasizing meticulous risk allocation through negotiations concerning force majeure, interface risks, liability caps, and performance guarantees. The article recommends that Croatia establish a specialized offshore wind regulatory framework, adopting best practices from EU countries and standardized contract templates like the FIDIC model contracts. Clear regulatory structures and robust contract management are vital to attracting investment and ensuring successful offshore wind project implementation.

KEYWORDS
~ Offshore Wind Farm Contracts
~ Risk allocation
~ EPC and multi-contracting
~ Legal framework
~ Croatia renewable energy
~ EU offshore regulations

University of Split, Faculty of Law, Split, Croatia
e-mail: rbrnabic@pravst.hr
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1. INTRODUCTION

The development of offshore wind farms is an impressive saga of technological progress. From the first pioneering turbines near the shore to today's offshore wind parks in open seas, with prototypes and new generations of turbines exceed 10 MW per unit and rotor diameters measured in hundreds of meters. Offshore wind farms are often grouped in large parks of fifty to eighty units; the total installed capacity of a single park can exceed 500 MW, requiring extensive grid infrastructure, from subsea cables to offshore transformer stations. Unlike onshore projects, offshore farms must also include offshore grid connection stations, and all components, from foundations and towers to nacelles and blades, must be transported by sea and assembled on-site in the open sea (Fthenakis et al., 2025). Such undertakings require specialized crane vessels, precise planning of weather windows, and coordination of engineers from different disciplines. Turbine foundation methods have evolved. In shallow waters, monopiles, steel cylinders several meters in diameter, are driven deep into the seabed. For greater depths (typically above 30–50 meters), multiple-jacket steel lattice structures secured with piles, as well as gravity-based concrete foundations, have been developed. Floating foundation platforms are among the most advanced technological developments, with deployments in Norway and Scotland. Their long-term economic viability has yet to be fully established (Manwell et al., 2024). However, the potential to move wind farms to offshore locations without depth constraints allows coastal states with deep waters, like Croatia, to rely more on wind energy.

2. THE OFFSHORE WIND MARKETS

The European Union has recognized offshore wind as a key pillar of its energy transition and supply security. Germany, which entered the race slightly later, has since caught up with the frontrunners through ambitious capacity expansions in the North Sea and the Baltic Sea. The EU is advancing its renewable energy ambitions to attain climate neutrality by 2050. Directive (EU) 2018/2001 (RED II), revised by Directive (EU) 2023/2413 (RED III), sets a 2030 objective of 42.5% renewable energy in EU gross final energy consumption. Member states are obliged to implement changes in their legislation with the aim of speeding up and simplifying the issuance of permits for renewable energy sources - Directive (EU) 2022/2577. This will be partly achieved by the Member States with designating special zones for the construction of infrastructure of renewable sources, for which a summary analysis of the environmental impact will be carried out beforehand, thus shortening the time for issuing concession permits to applicants. This directive simplifies renewable energy project approval and reduces red tape scenarios. The European Commission's Guidelines on State Aid for Climate, Environmental Protection, and Energy 2022 regulate state aid, which supports renewable sources through market premiums through a tendering system called Contracts for Difference (CfD). Moreover, renewable energy projects have to undergo a thorough environmental impact assessment in line with Directive 2011/92/EU, changed by Directive 2014/52/EU, which suggests higher impact assessment criteria, especially in relation to marine ecosystems and biodiversity. Croatia, also an EU member state, is still in the exploratory stage for possible offshore wind farm development (or floating wind farm), which is currently difficult given the depth of the Adriatic Sea. Croatia offers excellent prospects for offshore wind energy development due to its windy and indented coastline. Croatia's windy coastline offers potential for offshore wind energy development, but environmental concerns arise from these projects. Despite these concerns, Croatia could consider offshore development to achieve climate neutrality and diversify energy sources. Croatia does not have a single offshore wind farm to date. Although each further step should be taken with caution, especially due to environmental and marine ecosystem protection issues, the harmonisation of the legislative framework for the full implementation of the offshore wind farm project is still ongoing. (Pleić et al., 2023). With the application of EU best practices, it is assumed that initial, pilot projects will be of a smaller scale and that comprehensive environmental impact assessment studies will be carried out, rather than the immediate abbreviated procedures advocated by the EU. (Duić et al., 2023).

3. REGULATORY FRAMEWORK FOR OFFSHORE WIND ENERGY PROJECTS

3.1. Germany

A key instrument for regulation is the area development plan, which, at the national level, provides long-term plans for zones at sea designated for wind farms, aligning them with installed capacity targets. For each of these zones, the state conducts a centralized preliminary site investigation, detailed studies of wind potential, geological conditions of the seabed, distances of migratory bird routes, impacts on maritime traffic, etc. Once a zone is confirmed as suitable, an auction process follows. The subject of the auction is, metaphorically speaking, a "bundle of rights" related to that location, including the right to use maritime property, grid connection, and later obtaining a construction permit. The bidder offering the best conditions (which in recent times is often the premium over the market electricity price) wins the right to further develop the project. After the auction, the winner must obtain the final construction permit. This central model approach, introduced by WindSeeG in 2017, represents a shift from the previous decentralized system. Recent amendment to this Law (WindSeeG, 2023), has further improved this framework in line with new EU policies to accelerate green investments. The law has been specifically aligned with EU Regulation 2022/2577, the so-called emergency regulation for speeding up renewable energy permits. Higher target quotas have been set, as well as different criteria for allocation, such as the share of local industry or ecological innovations. This alignment is evident in the new Article 72a of WindSeeG, which has received attention in the legal community (Lutz-Bachmann & Zywitz, 2023). The clause in Article 72a, effective from March 2023, temporarily exempts certain offshore wind projects (auctioned in 2022 and 2023) from standard environmental impact assessments (EIA) and nature conservation evaluations. Legal experts acknowledge significant time savings (up to two years) but remain cautious about risks to environmental protection and potential legal disputes arising from „by-passing“ of standard procedures (Himstedt, 2024).

3.2. Croatia

In recent years, Croatia has taken actions to align its national legislation with European standards. The approval of the Act on Renewable Energy Sources and High-Efficiency Cogeneration, which replaced prior feed-in tariffs with market premiums through tenders (CfD tenders), was a significant legal reform. With these reforms, renewable energy projects improve market access and competitiveness in both the domestic and European energy markets. Moreover, renewable energy providers were permitted to compete on an equal footing when the deregulation of Croatia's electricity sector was made possible by the Energy Act (Zakon o energiji). This led to the Power Market Act (Zakon o tržištu električne energije), which solidified Croatia's incorporation into the common power market of the European Union. Despite the elimination of the guaranteed electricity purchase regime, renewable energy projects continue to have preferential access to the grid under law. The Spatial Planning Act (Zakon o prostornom uređenju) has made it easier to plan offshore wind farms by eliminating earlier spatial restrictions based on distance from the coast and islands and opening up new opportunities for the expansion of marine capacities. Furthermore, the Law on Concessions (Zakon o koncesijama) provides investors with the legal assurance they need to realize offshore projects by outlining precisely the requirements for awarding concessions on maritime property. Project execution is further facilitated by the Maritime Domain and Seaports Act (Zakon o pomorskom dobru i morskim lukama), which specifies in detail the requirements for using marine space for renewable energy sources.

Finally, the Environmental Protection Act (Zakon o zaštiti okoliša) sets clear and stricter environmental standards, ensuring the preservation of the marine environment and biodiversity, especially in offshore wind farm projects. In accordance with Directive 2014/89/EU on maritime spatial planning, Member States, including Croatia, are required to develop national maritime spatial plans to regulate the use of the sea for offshore renewable energy sources. The obligation to develop a National Maritime Spatial Plan arises from Article 49a, paragraphs 1 and 2, and Article 68, paragraph 1 of the Spatial Planning Act. The decision on the development of the Spatial Plan of the Exclusive Economic Zone in the Adriatic Sea initiated the process of developing the aforementioned plan. However, Croatia has not yet fully implemented the mandatory National Maritime Spatial Plan (NMSP), which currently limits the further development of offshore wind farms. For any major energy project in Croatia, the Environmental Protection Act requires an environmental impact assessment (EIA), which is in line with the EU's Environmental Impact Assessment (EIA) Directive (2011/92/EU, as amended by 2014/52/EU). Such requirement would undoubtedly apply to any potential offshore wind farm (Kinder, 2024). The complexity of such a study in a marine environment is significant—it would need to assess impacts on marine ecosystems, fisheries, bird migrations (e.g., bird migration routes across the Adriatic), landscape aspects in coastal areas (visibility of turbines from the shore), etc.

3.3. National Civil Law Codes - Lex Contractus

The German Bürgerliches Gesetzbuch (BGB) and the Croatian Law on Obligations (ZOO) are the main civil codes that govern offshore projects. They say what contracts are, who is responsible for damages, what warranties are given for defects, and other legal issues. Practically, this means that contracts for wind farm construction (whether concluded under the FIDIC model or otherwise) are subject to the dispositive norms of BGB or ZOO unless the parties agree otherwise. Both BGB and ZOO contain rules for construction contracts (§ 633-638 BGB) liability for the breach of obligations, for construction defects and general liability for material defects, after the work is handed over. Both legal frameworks generally prescribe that the contractor is liable for the durability and solidity of the structure for a specified period (10 years). Article 635 of the Croatian ZOO prescribes that contractors are liable for stability of the building (Crnić, 2018). The German BGB does not have an identical provision *per se* but ensures similar protection through a combination of contractual warranties and tort rules (Dannemann et al., 2022). Also, both follow the principle of dispositiveness, which says that parties can control many things through a contract as long as they don't go against what the law says. For example, Article 106 ZOO and § 276 BGB provide that parties cannot avoid liability for intent or gross negligence. Thus, when investors and contractors negotiate offshore contracts, they must consider the governing law: a contract subject to German law will be interpreted and supplemented according to BGB, while one under Croatian law will be governed by ZOO. Both BGB and ZOO are flexible and broad enough to support complex contractual arrangements for offshore construction, and where specificity is needed (such as subcontractor relations, insurance, liability for maritime accidents, etc.), parties can comprehensively regulate everything through contracts, relying on international practices as well.

4. FIDIC MODEL CONTRACTS

Among globally accepted standards in construction projects, particularly infrastructure projects, FIDIC model contracts stand out. The Yellow Book is designed for "design and build" contracts, which are common in offshore wind farms: the investor (employer) sets the basic requirements and criteria (such as the required capacity of the park, location, and reliability standards), while the contractor presumes responsibility for detailed design, equipment supply, and construction (including turbine installation at sea). The Yellow Book, like other FIDIC forms, standardizes many clauses, from mechanisms for work variations (changes in scope at the employer's request with corresponding adjustments to price and schedule), force majeure circumstances, and handling unexpected physical conditions to advance payment, progress payments, and final account settlement (Robinson, 2023).

Offshore projects often rely on consortia of companies from different countries, are financed by international banks, and source equipment from global suppliers—having a neutral, globally recognized contract such as FIDIC is therefore a huge advantage. Particularly in large financial arrangements (where loans exceed a billion euros), international banking consortia insist on high-quality and well-established contractual documentation (Beaumont, 2018).

FIDIC contracts can be used in offshore wind farms in two ways: as an EPC contract if the investor engages a single general contractor for the entire project (the so-called turnkey approach) or for individual contracts in a multi-contracting framework (Robinson, 2023). In offshore wind farm practice, the latter approach—multi-contracting—is more common, which we will discuss in more detail in the following chapter. However, FIDIC is still used. For example, the Yellow Book model can be used to make a contract for the construction of foundations and subsea structures, where the contractor designs and builds the foundations. A different contract for the supply of turbines may use an FIDIC-based model for equipment supply, which is often called a Supply and Installation contract because it combines elements of the Yellow Book and EPC model. Finally, the FIDIC Green Book model, which is a short-form contract with extra technical addendices, can be used for laying subsea cables. In all of these, risk allocation remains a central issue (Hughes, 2020).

Offshore projects are inherently full of risks—from weather delays and geotechnical uncertainties of the seabed to the synchronization of different contractors' work. FIDIC contracts have built-in ways to deal with these risks. For example, the Yellow Book regulates that if a contractor runs into unplanned physical conditions during execution that a reasonable contractor could not have predicted based on the information available, the contractor can get more time and be reimbursed for costs (sec. 4.12. of the Yellow Book: Unforeseeable Physical Conditions). Such clauses provide the contractor with a degree of protection from completely unknown risks (e.g., encountering unexpectedly hard rock when driving monopiles at a location where soil investigation was limited). Conversely, the contractor must comply with standard quality assurance obligations and deadlines, facing contractual penalties in the form of liquidated damages for any delays. In addition to technical and performance risks, offshore projects carry significant safety and liability risks due to hazardous working conditions. Contracts, therefore, often include special liability-sharing regimes such as knock-for-knock clauses adopted from the oil industry. This regime is based on the principle of "each party bears its" own"—each party (whether the employer, contractor, or subcontractors) is responsible for damage to its property or injuries to its workers, regardless of the fault of the other party (Beadnall & Moore, 2021).

However, the use of FIDIC contracts in offshore projects assumes a "classic" structure of one employer, one main contractor, and several subcontractors. However, in the multi-contracting approach, the employer enters into multiple parallel contracts and assumes the role of coordinator. In these circumstances, the employer can still use FIDIC, but they must ensure strict alignment and consistency across all contracts. For instance, the deadlines in the foundation contract must be synchronized with those in the turbine supply contract; if the foundation installation is delayed, who bears the cost of the demurrage for the vessel waiting with the turbines? The FIDIC standard cannot preemptively resolve this—this is where particular conditions and overarching agreements between contractors (so-called interface agreements) come into play (Soliman, 2024). Meanwhile, FIDIC has established a task force to create a new standard contract specifically designed for offshore renewable energy projects, expected by late 2025. This form aims at balancing risks more equitably between owners and contractors, addressing key offshore wind challenges such as weather delays, interface management, and liability limits.

5. FINANCING OF THE OFFSHORE PROJECTS

Entering the construction of an offshore wind farm is an investment measured in hundreds of millions, often exceeding a billion euros. Very few companies can finance such projects independently—hence, investor consortia are formed, with a key part of capital coming through project loans from banks or other financial institutions. In such project financing structures, the contractual framework of the project becomes the foundation upon which banks decide whether to release funds (Hirschmann, 2020). The term "bankability" of a contract refers to the extent to which project agreements meet banking requirements in terms of security, predictability, and risk allocation. One of the first questions that arise is precisely the contracting model: multi-contracting or the EPC/EPCI approach. As previously mentioned, the offshore industry over the past 15 years has shifted from the general contractor model (EPC—Engineering, Procurement, Construction, or EPCI when installation is included) to a model where the investor enters into multiple contracts with different specialized contractors for individual segments of the project. Investors have started to divide projects into packages and seek contractors for each package (turbines, foundations, electrical installations, transportation, substation construction, etc.).

The dominance of the multi-contracting approach has both advantages and disadvantages. The advantage is greater competition—for each individual work package, several potential bidders emerge, leading to lower costs for the employer. However, the downside is the "interface" problem"—coordination between contractors. For example, it is very important to perfectly time the work on the foundation with the delivery and installation schedule of the turbines. If the vessel carrying the foundations is late, the vessel carrying the turbines will also be late, which could cause financial losses (loss of expected profits, daily rental costs of a specialized vessel, contractual penalties, etc.). In the multi-contracting model, such responsibility falls on the employer. Under this contracting approach, each contractor is formally responsible only for its own work, with no joint liability for completing the entire project on schedule and on budget (Loots & Charrett 2019).

Project sponsors (investors) must provide finite corporate guarantees or completion guarantees to banks. Essentially, a guarantee is a promise that if the project is not completed on time and in the projected costs, sponsors will cover any shortfall in loan repayments—meaning they assume the risk until project completion. Such guarantees may be limited to a specific amount or percentage of the loan or even be unlimited (which effectively means that project financing up to commissioning becomes resort financing, secured by the sponsors’ assets rather than the project itself). Banks also protect themselves by requiring sponsors to contribute additional capital in the case of cost overruns—known as cash-call or equity cure obligations, where sponsors must inject fresh funds to complete the project. As for risks and their mitigation, financiers are highly meticulous. From the outset of project structuring, each risk is identified, and a plan is devised for its coverage—whether contractually, through insurance, asset pledges, or reserve funds. For example, the risk that a wind farm will not achieve its planned production (due to insufficient wind or technical difficulties) is mitigated through conservative wind potential estimates and maintenance contracts guaranteeing turbine availability. Delay risk is mitigated by contractual penalties imposed on contractors and the completion guarantee from sponsors. Cost escalation risk can be reduced by using fixed-price contracts and emergency funds. Banks often include a reserve line in the project budget (usually 5–10% of the investment budget) that stays untouched except for unexpected costs so the project.

Offshore projects are financed either corporately (on-balance-sheet borrowing by large utilities that build the park themselves) or through project financing via a dedicated project company. The trend in Europe is shifting toward project financing as it opens the market to independent power producers and investment funds. Banks then primarily consider the project’s cash flow, as the source of repayment, rather than relying on parent companies. Non-recourse or few-recourse financing means that once the project is finished, all risk moves to the project itself (future revenue from electricity sales). Sponsors don't have to do anything else once the project is finished successfully; loans become fully non-recourse. They guarantee the project's completion, and once it successfully operates, the financing shifts into a fully "non-recourse" phase, when they reap the equity returns. Banks, on the other hand, rely on the project’s long-term revenue streams. Historically, offshore wind farms in Germany secured a great deal of revenue through feed-in tariffs under the EEG scheme, but today, market mechanisms and power purchase agreements (PPAs) play a growing role (Marhewka, 2020). The stability of the regulatory framework for electricity sales is also crucial for bankability. Banks closely monitor risks related to legislative changes or price fluctuations. Consequently, Germany’s reliable EEG system provided security for financiers (a contractually guaranteed price over 20 years).

Another key aspect of "bankability" is project insurance. Offshore wind farms require extensive insurance coverage: construction insurance, third-party liability insurance (due to potential maritime incidents, ship collisions, and pollution), and business interruption insurance to cover revenue loss due to operational downtime. As standard in the industry, all policies must be backed by a "brokers' letter of undertaking" that protects banks (Kraft *et al.*, 2013). This means that the broker and insurer promise the banks that policies will not be canceled or changed without their permission and that any claim payouts will go to an escrow account set up for project repair or debt repayment. Finally, banks always analyze legal risks: whether all permits have been obtained, whether there is a risk of litigation (e.g., from environmental protection groups) that could invalidate permits, and the stability of the judicial system. Germany has a well-established legal protection system and relatively swift administrative litigation processes (e.g., injunctive relief is restricted in some energy infrastructure cases to prevent abuse). The economic viability of a project depends on realistically weighing its risks. If the risk is too high, investors and banks will not commit to the investment, no matter how promising offshore wind energy may seem.

6. DISPUTE RESOLUTION MECHANISMS

Large and complex projects, such as offshore wind farms, often rely on inevitable disagreements or disputes—whether between contracting parties, with government authorities, or between partners. Hence, during the contracting phase, much attention is given to dispute resolution mechanisms. Traditionally, construction disputes were resolved through litigation or arbitration, often after project completion. However, this method doesn't work for changing projects that need to solve issues quickly to keep working.

This is where FIDIC's Dispute Avoidance/Adjudication Board (DAAB) steps in. Contracting parties may consult the DAAB preventively, obtain non-binding opinions, or assist in resolving tensions before they turn into formal disputes. If a dispute does arise, the parties present their case to the DAAB, which reviews it (often through written submissions and short on-site hearings) and issues a "temporarily binding" decision, meaning that the parties must immediately comply with the DAAB's decision (e.g., the employer must pay a specified amount to the contractor, or the contractor must perform specific work), but either party is entitled to file a Notice of Dissatisfaction within a set period (usually 28 days) if they believe the decision is incorrect. If no objection is filed, the decision becomes final and binding (Klasen, 2018).

DAAB, as a permanent body, often helps resolve disputes on-site—board members periodically visit the construction site, are familiar with the project's progress, and, through their authority, can influence the parties to reach a settlement before a formal decision is necessary. In offshore projects, where delay costs are enormous (each day of renting a specialized vessel costs tens of thousands of euros), such a swift adjudication mechanism can be invaluable (Hangebrauck, 2017). FIDIC also standardizes the agreement establishing the DAAB (signed by the employer, contractor, and board members), ensuring their independence and defining payment terms. Nothing in the BGB or ZOO prevents parties from establishing such a body—the principle of contractual freedom allows it. Beyond DAAB, traditional arbitration or litigation remains an option for the resolution of disputes. In international offshore contracts, arbitration is the preferred choice—whether under ICC in Paris, LCIA in London, or ad hoc arbitration under UNCITRAL rules. Arbitration provides reasonably fast adjudment, It is therefore unsurprising that any serious investor would prefer arbitration for disputes with international contractors. Another mechanism mentioned in the literature (Beadnall & Moore, 2021) is mediation or negotiated dispute resolution. When a dispute arises, the parties may try to resolve it through high-level negotiations (e.g., meetings between executive directors) before activating the DAAB or arbitration.

7. CONCLUSION

The article showed how complicated and interconnected the technical, market, and legal aspects of offshore wind farms are. The key findings can be summarized in several points.

First, technological advancements have enabled offshore wind farms to become large-scale realities, but these advancements bring increased project complexity and the need for specialized expertise. The size of turbines and the demanding marine environment dictate specific legal arrangements, from procurement and construction contracts to regulatory permits.

Second, Germany has shown how a state can handle the growth of a new industry through the development of its legal framework (WindSeeG). Central area planning, preliminary studies, an auction system, and recent speeding up measures (like waiving EIA for a short time) are all examples of proactive policies that help reach big goals. Croatia, though still at the beginning of its path, can learn much from Germany's experiences—it needs to strategically plan offshore locations, adopt spatial and environmental regulations, and ensure that the domestic legal system is ready to support investments (e.g., by accelerating procedures and strengthening legal certainty).

Third, contractual frameworks grounded in FIDIC standards and prudent risk allocation underpin successful offshore wind projects. Given that no single model suits every scenario, multi-contracting remains prevalent but demands rigorous coordination and robust interface management. While the FIDIC Yellow Book provides a reliable basis, it must be supplemented by offshore-specific clauses covering insurance, knock-for-knock regimes, and contingency planning to satisfy bankability criteria. Recognizing these unique challenges, FIDIC has established a task force to develop a dedicated offshore renewable energy standard contract (expected by late 2025), designed to more equitably allocate risks and address issues such as weather delays, interfaces, and liability limits.

Fourth, the financing of offshore projects illustrates how engineering and law are intertwined: without well-structured contracts, there is no financing, and without financing, there are no turbines at sea. Banks, as silent partners, impose discipline and standards that ultimately contribute to project success—contract clarity, revenue security, and risk mitigation.

Fifth, dispute resolution has evolved from prolonged court battles to a preventative and faster model through DAAB boards and arbitration. A dispute resolution clause is almost a necessity in such projects—timely justice here prevents the loss of millions of euros due to delays. German and Croatian law, despite their different traditions, provides enough flexibility for these mechanisms to be effectively applied, which is encouraging for future projects.

Looking ahead of offshore energy in the EU and Croatia, we can expect further growth in projects and capacity. With the right planning, Croatia could use some areas in the northern Adriatic (which are shallower and closer to the coast, so they are less affected by landscape and tourism) for its first offshore wind farms. To bring about change, however, the rules need to be spelled out clearly. There must be clear procedures for site allocation (concessions on a maritime domain), maritime spatial planning needs to be in line with energy goals, and EIA procedures need to be made sure to be efficient while still protecting the environment and not getting in the way of development too much.

Correspondingly, Croatian legal practice in contracting projects should benefit from international standard slike FIDIC model contracts, to avoid reinventing the wheel and reducing the risk of disputes due to unclear contractual clauses.

CONFLICT OF INTEREST

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