Analysing Power Supply, Environmental Practices, & Future Trends for Superyacht Marinas

Author: Megan Hickling | Editor: Water Revolution Foundation | 31 August, 2021

This research has been compiled through the efforts of companies participating in the Yacht Environmental Transparency Index (YETI) joint industry project. YETI offers a systemic, data-driven approach to assess and compare the environmental performance of superyachts, and is the result of extensive collaboration between renowned shipyards, naval architecture studios, and research institutes. A shared motivation to educate on and visualize impacts and solutions has driven their efforts to develop this tool and formed the basis for the research presented below.

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1. Introduction

This report compiles findings from questionnaires distributed to marinas and yacht captains, focusing on aspects such as marina clientele, power availability, environmental initiatives, and anticipated future changes for marinas, along with the operating areas, consumption patterns, and environmental impact improvements for yachts. Targeting marinas in popular locations for the superyacht fleet over 30 meters and captains from this fleet, the surveys aimed to gather insights on current industry practices and potential future developments.

Data is analysed from surveys using graphs, tables, and other collected information. It presents results including the average, range, and standard deviation for each question to illustrate the diversity and frequency of responses. High standard deviation indicates significant variability in responses and notable deviations from the average. Gross tonnage is the primary measure for discussing yachts' power needs due to its accuracy in indicating power demands, whereas yacht length is considered for aspects like mooring sizes. For responses in categorical ranges, such as "30-40%" or "300 to 400GT," midpoints are used for graphical analysis.

2. Location

Location plays a significant role in this study, impacting various factors due to differences in national or local power supplies. These variances affect the shore power that yachts connect to, influencing their environmental impact. Additionally, shore power options vary by location, including differences in available voltages and amperages.

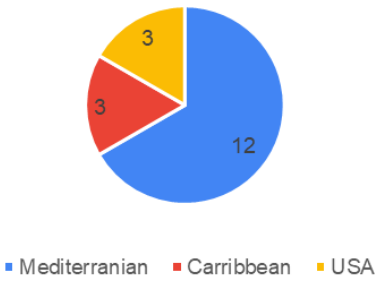


Figure 1: Marina Locations

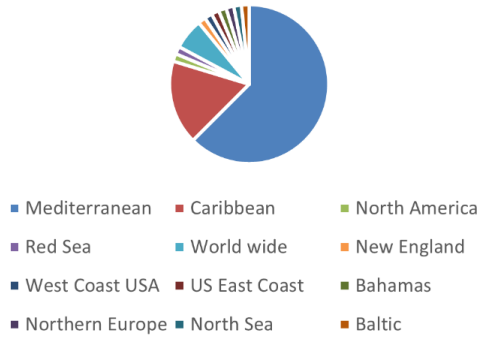


Figure 2: Captain Locations

3. Number of unique visiting yachts in a year

The number of unique visiting yachts annually is crucial for understanding the scope of the study, as it directly influences the amount of power required and reflects the diversity of marinas participating in the survey. This data not only aids in analysing subsequent results but also provides insight into the marina's popularity, although the number of berths available is also a factor.

The data on the number of unique visiting yachts annually is key to the study, impacting the power supply requirements and illustrating the diversity of marinas surveyed. This metric aids in interpreting subsequent findings and can indicate a marina's popularity, although it's influenced by the number of berths available.

With a range of 494, an average of 87.4 yachts, and a standard deviation of 119.23, the responses indicate a broad spectrum of marina sizes contributing to the survey, lending credibility to the results derived from the data.

4. Yacht size

The survey queried marinas on the maximum size of yacht they could accommodate, which influences the highest shore power option available at the marina. If the marina cannot offer sufficient power, yachts may need to rely on their generators. Interestingly, the limiting factor for accommodating yachts wasn't always length; for instance, one marina cited the vessel's breadth as a constraint due to a nearby bridge. This data also sheds light on the proportion of the fleet that might have to moor outside the marina, lacking access to shore power.

The results for the maximum yacht size that marinas can accommodate showed a range of 214 (with a minimum length of 36 and a maximum of 250 meters), an average maximum size of 92.12 meters, and a standard deviation of 46.79 meters, indicating a wide variation in marina capacities.

Figure 3: Marina Max. Size Category

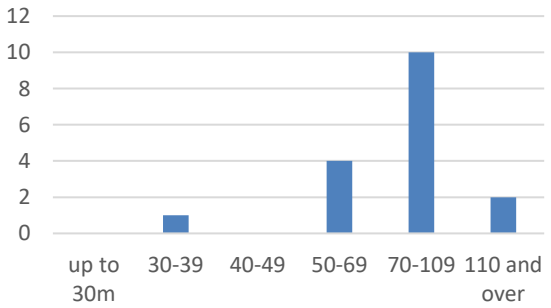


Figure 4: Captain Yacht Lengths

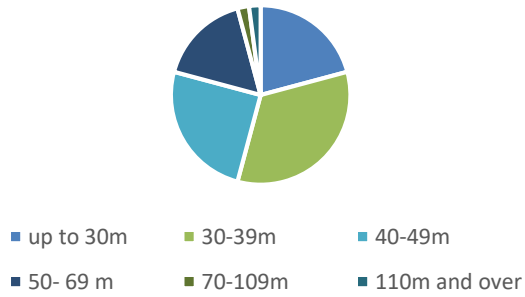


Figure 5: Captain Yacht Gross Tonnage

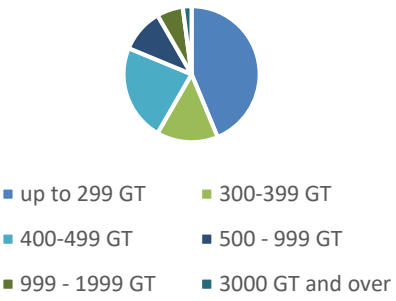
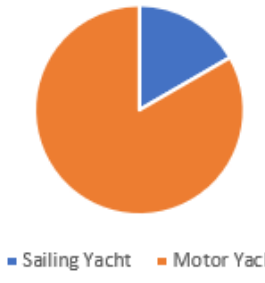


Figure 6: Yacht Type



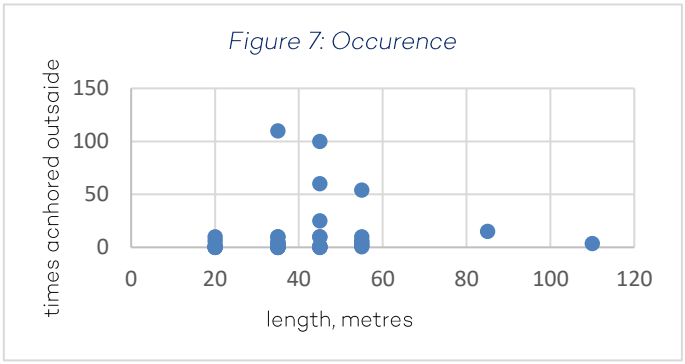
The analysis of the survey graphs indicates that the most typical yacht within the respondent fleet measures 30-39 meters in length, has a gross tonnage (GT) of up to 299, and is motor-powered. This suggests that the majority of marinas participating in the survey can accommodate the common yacht size among respondents, thereby minimizing the need for yachts to anchor outside the marina and rely on their own power sources.

5. Anchoring outside of marina

The occurrence of yachts needing to use their own power sources, as opposed to marina shore power, was reported by only 4 marinas and happened no more than 5 times a year. This infrequent necessity suggests a potential for significant environmental impact improvement, as enhancing the eco-friendliness of marina shore power could positively affect the yachts it services. Conversely, if yachts employ more sustainable methods for generating their own power, relying on marina shore power could result in a higher environmental impact.

Understanding the decision-making process regarding the use of marina shore power versus self-generated power is crucial. Insights into this decision-making were derived from the captains' responses, with estimates on the frequency of self-power usage being made based on their detailed feedback about their experiences at various marinas. This seemingly occurs more frequently than what is reported from the marinas, possibly a consequence of not receiving marina responses from all the marinas the responding captains tend to visit.

Figure 7: Occurence



6. Yacht size vs. power – engine & generator

Engine size is important for predicting future shore power needs, especially with the potential electrification of yachts, which would increase their power and charging demands while docked. Generator details clarify the yachts' electrical requirements, although it's uncertain if they're used solely for hotel loads or other purposes when moored.

Figure 8

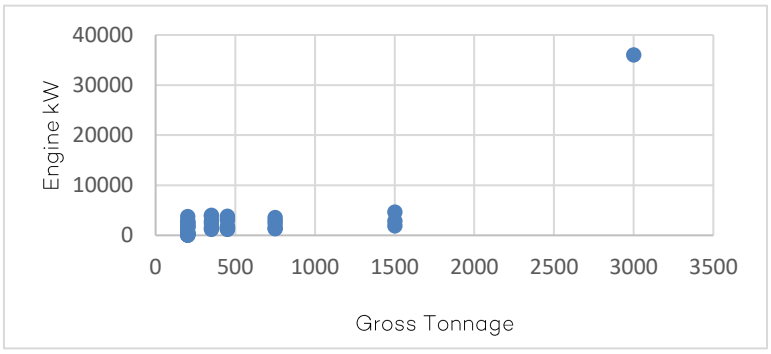


Figure 9: Possibility of Marinas to Supply Power Demand

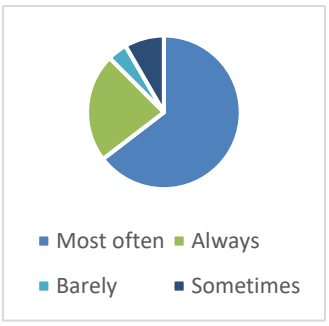
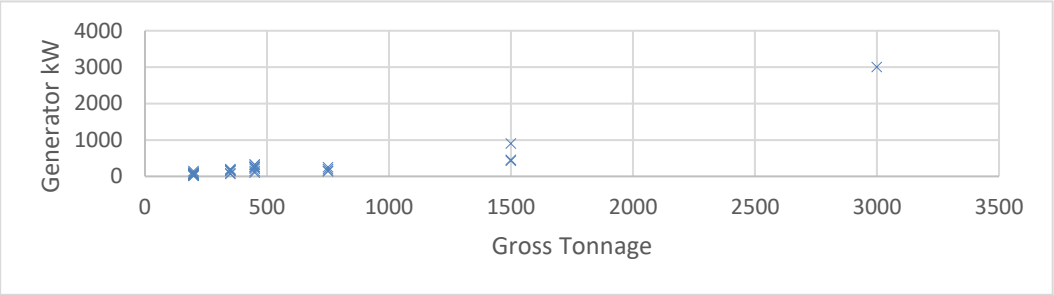


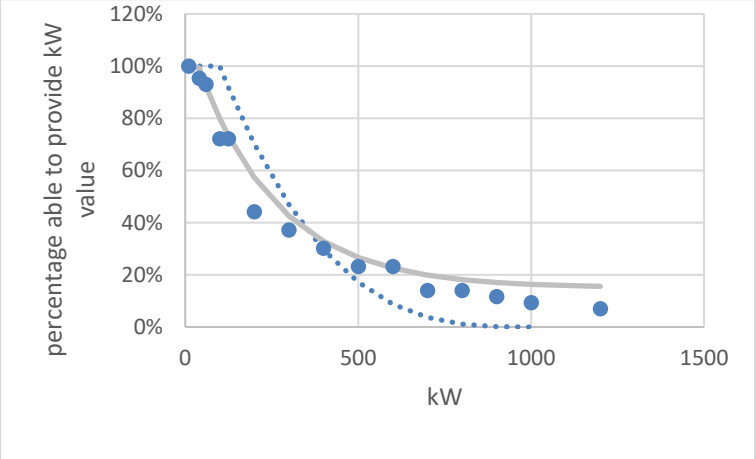
Figure 10



7. Marina power supply

7.1 Power options

Figure 11



Analysis of the survey data reveals that most marinas can provide power equivalent to what yacht generators supply, indicating that marina capacity typically isn't a hindrance to using shore power. This is supported by the fact that yachts choosing to anchor outside often do so not due to power supply issues but out of preference for anchoring. Further insights are gained from comparing reasons for using or not using shore power, as reported by both captains and marinas, though the survey lacks a method for verifying these reasons. Upcoming sections will explore attitudes towards and estimated usage of shore power, based on survey responses.

7.2 Frequency of use

Figure 12: Marina Estimate

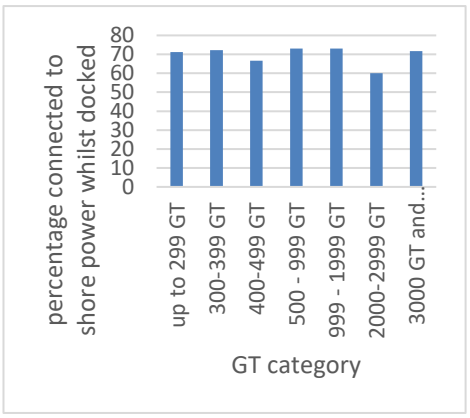
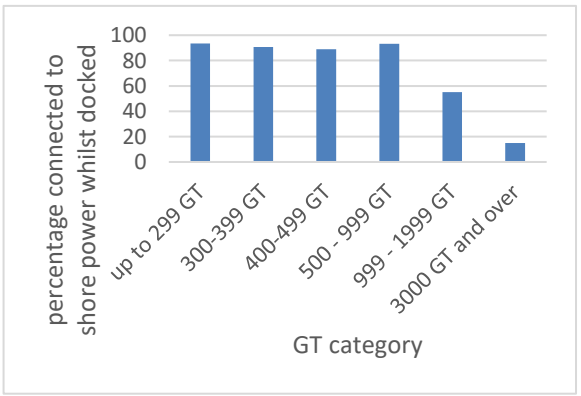


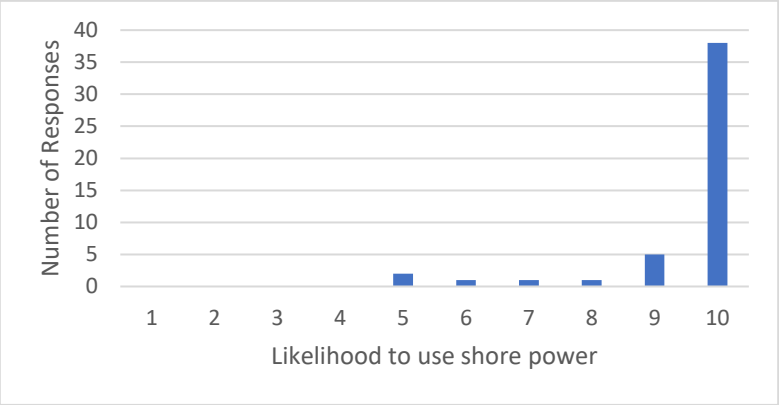
Figure 13: Captain Estimate



Survey findings reveal a strong preference across vessels of all sizes for utilizing shore power, with an overwhelmingly positive attitude towards its use evident from the responses. This indicates a widely accepted and favourable view of shore power within the surveyed population.

7.3 Captain attitude

Figure 14



The survey reveals that yachts of any size typically connect to shore power for nearly the entirety of their marina stay. Further insights on the motivations for using shore power will be discussed subsequently. This data opens avenues to explore what factors encourage vessels to dock at marinas, where they are inclined to utilize shore power.

7.4 Shore power decision factors

Figure 15: Decision Factors for Marinas

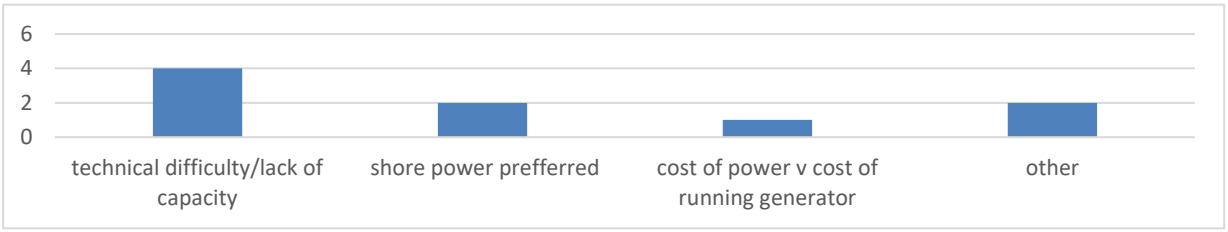
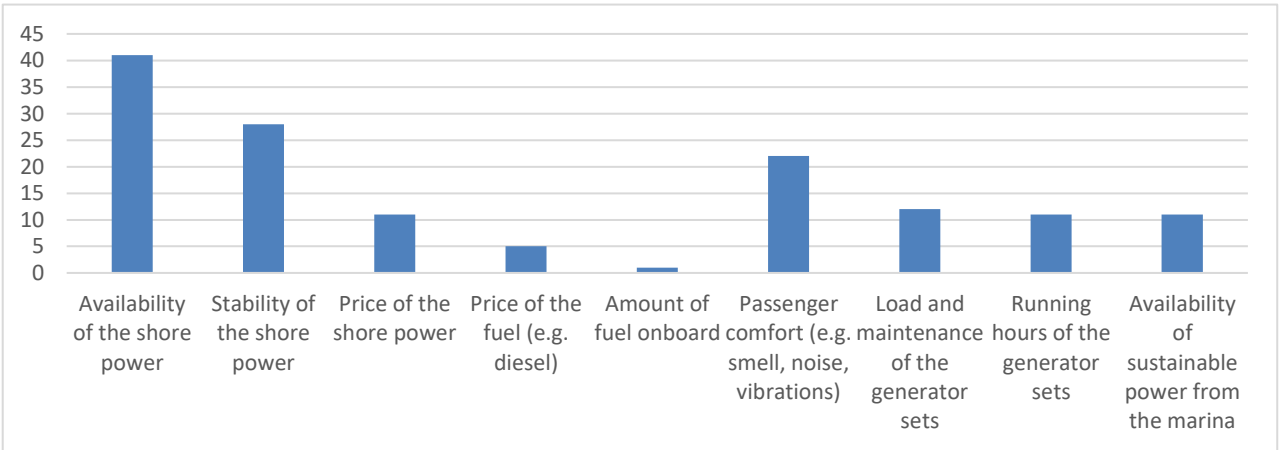


Figure 16: Decision Factors for Captains



The findings suggest that the key factor influencing a yacht's decision to connect to shore power while docked is the availability of suitable and reliable shore power. This appears to contradict earlier results indicating that marina offerings generally meet yacht requirements. However, discrepancies could arise from experiences at marinas not included in the survey or from marinas overstating their capabilities. Further analysis could explore the reliability of marina power sources and their ability to meet yacht needs consistently. Additionally, the results highlight an opportunity for environmental impact reduction by enhancing shore power facilities, encouraging yachts to utilize shore power more frequently and thus minimizing their reliance on onboard generators.

7.5 Fuel & power cost

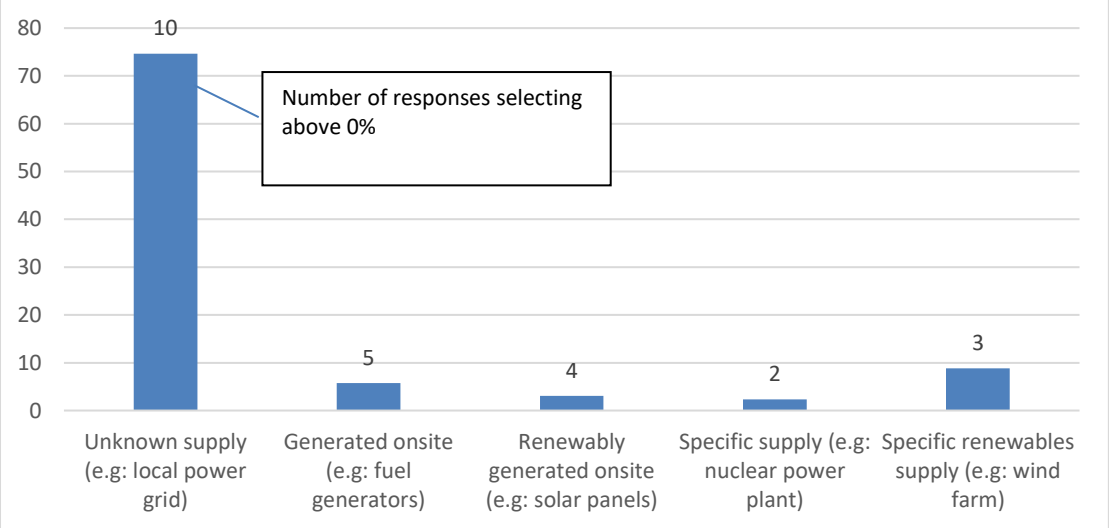
Table 1: Fuel & Power Cost

	Cost of power	*Cost of fuel*
Range	0.67	1.00
Average	0.30	0.89
Standard deviation	0.179	0.351

While earlier responses indicated that fuel cost is not a predominant factor in deciding to use shore power, analysis reveals that per kWh, shore power tends to be cheaper than fuel. However, directly comparing the costs of diesel per liter and electricity per kWh is complex due to the varying efficiency of generators, which affects the power equivalence. The minimal variation in the pricing of both fuel and electricity suggests that cost differences may not significantly influence the decision to use shore power.

7.6 Current power supply

Figure 17: Average Distribution of Power Sources Supplying Marina



The graph averages responses to show most marina power is from unspecified sources, followed by renewable energy. The highest individual use of renewables, 80-90%, was at a Barcelona marina.

Figure 18: Sufficiency of Power Supply in Marinas

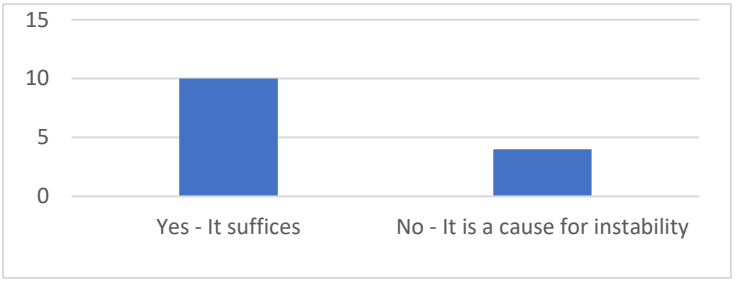


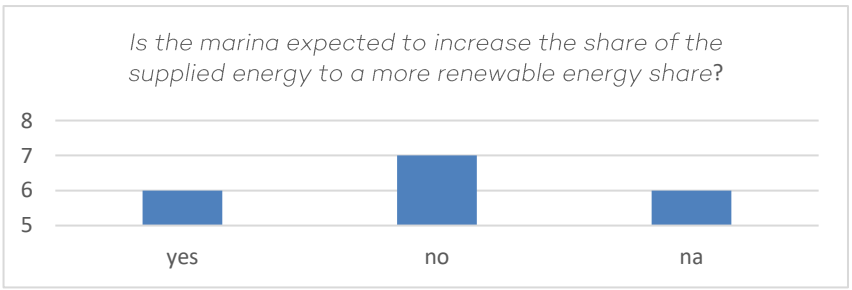
Figure 17 shows that the majority of marinas power supply is sufficient to meet with demand, and thus linking with the previous response should indicate that this is not a frequent occurrence to prevent yachts form using shore power, but those that do experience this issue are particularly likely to update their shore power to remove this.

7.7 Future changes

To support future environmental improvements for marinas and captains, it's important to grasp their expected changes. The survey included questions to capture insights on anticipated shifts, aiding in understanding potential future developments.

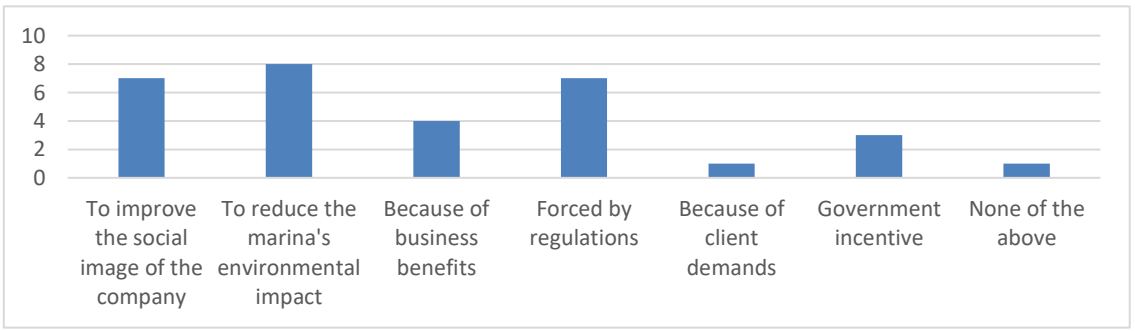
7.8 Renewable power share change

Figure 19



It's important to note that the "na" responses likely indicate the presence of existing renewable sources within their power supply.

Figure 20: Reasons Marinas are Looking to Change the Share of Renewables



Despite prior responses, the expressed reasons for a greater reliance on renewable sources suggest an inclination towards further adoption of renewable energy.

7.9 Power's capacity to change in the future

Figure 21

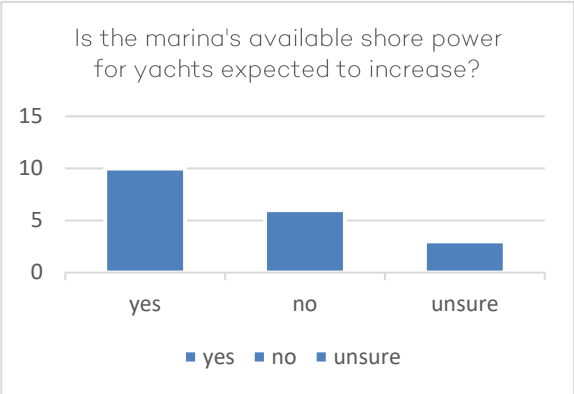
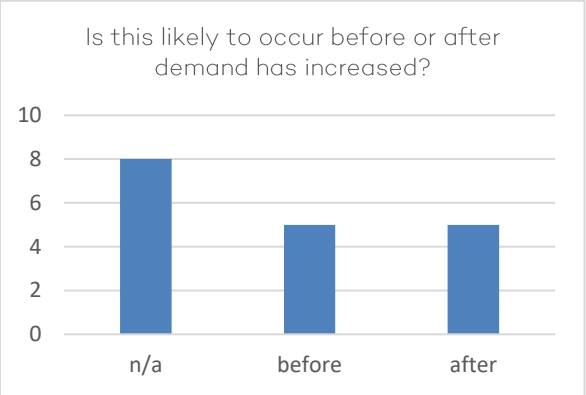


Figure 22



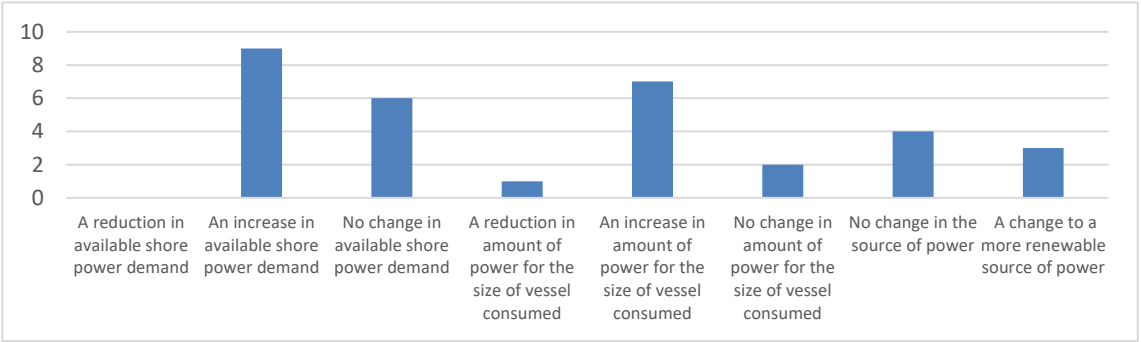
Note: "n/a" indicates respondents who do not anticipate future increases in shore power usage. Those mentioning "after" may face instability in shore power connections, especially for yachts with demands exceeding the current power supply capacity. The table that follows outlines the reasons behind potential changes in shore power services.

Table 2

Reasons	*Number of responses*
Meeting increased demand from larger yachts and new ships needing more power	3
Updating old system, or adding new power source	3
No further demand expected	3
As technology continues to improve onboard with converters, marinas are requiring less power alternatives to attract vessels.	1

7.10 Source of power & potential changes

Figure 23



The responses highlight expected trends from marinas, including an anticipated increase in available shore power to meet growing demand, a rise in the amount of power consumed relative to vessel size, and no significant change in the source of power.

7.11 Duration of stay

Table 3: Duration of a Yacht's Stay

	Marina	*Captain*
Range	362	298.5
Average	77.8	34.239
Standard deviation	105.799	68.381

The duration of a yacht's stay is directly related to its power consumption and can be utilized to calculate specific details regarding its energy use.

7.12 Daily consumption of captain

Table 4: Daily Consumption Yacht

	What is the yacht's average consumption when berthed? kWh	*What is the yacht's maximum consumption when berthed? kWh*
Range	350.591	498.5
Average	571.01	747.4
Standard deviation	2100	2760

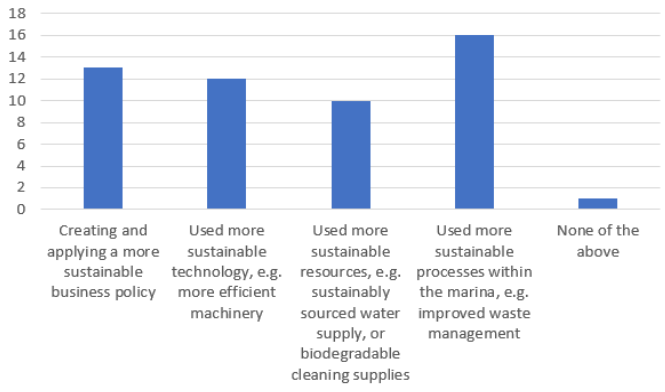
7.13 Weekly consumption of marina

Table 5: Weekly Consumption Marina

	What is the average weekly consumption of all yachts combined? kWh	*What is the weekly consumption of all yachts combined in peak season? kWh*
Range	112000	112000
Average	181,842,165.4	60347.19
Standard deviation		32973.20

7.14 Environmental behaviour of marina

Figure 24: Environmental Behaviours of Marina



7.15 Quick charging, electric tenders, & electric propulsion

Figure 25

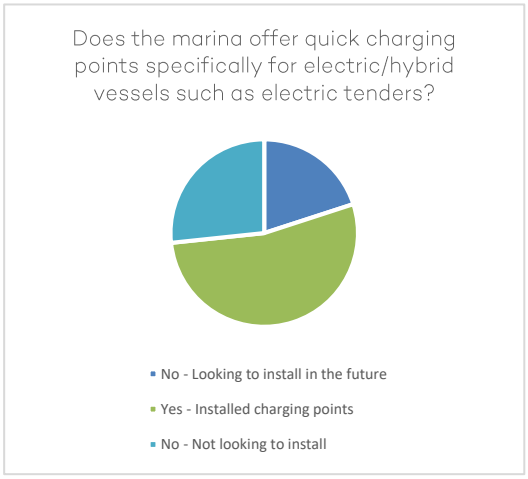


Figure 26

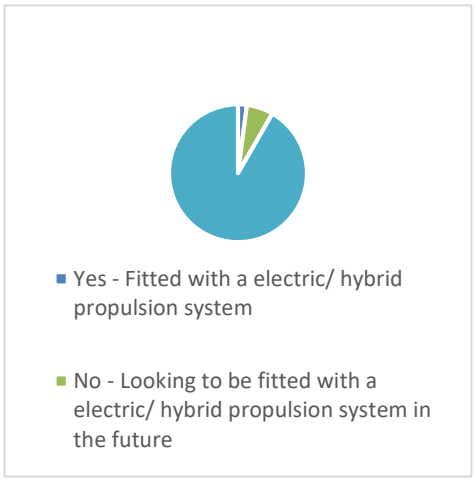


Figure 27

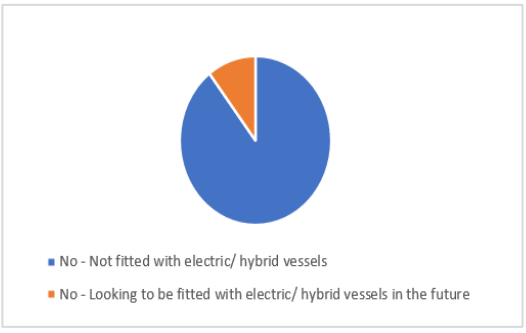
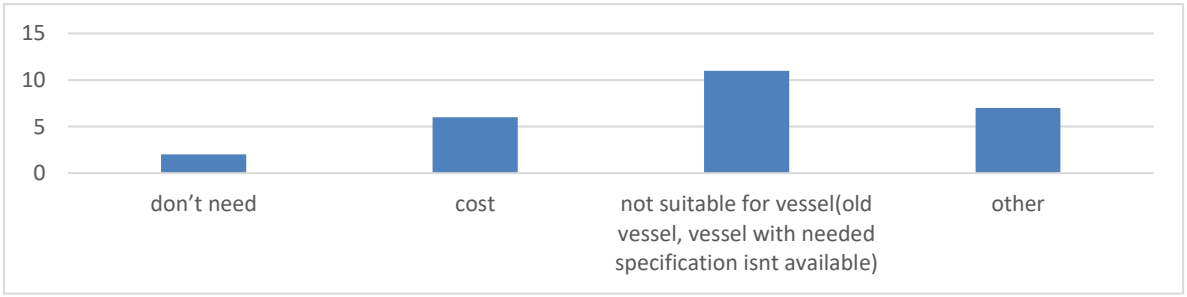


Figure 28



The data suggests marinas are preemptively providing electric tender charging options before yachts actively seek them, removing potential barriers to future adoption. This foresight matches marinas' pattern of enhancing shore power ahead of demand, with current responses indicating limited plans for further installations in the near term.

8. Discussion

Despite a limited number of responses (19) from marinas, the survey's global diversity offers valuable insights into the yachting industry's environmental practices. While variations in responses reflect the different scales of marinas, overall findings suggest a trend towards reducing environmental impact. Although hesitations exist regarding the adoption of renewable energy by marinas and electric power systems by captains, there's a clear inclination towards improving sustainability. The likelihood of marinas increasing power supply to yachts presents an opportunity to encourage renewable energy use, highlighting a path forward for enhancing the industry's environmental footprint.