Advancing Deep Retrofits in the UAE

Appendix

EmiratesGBC Advancing Deep Retrofits in the UAE

EmiratesGBC Energy Efficiency Program

Appendix

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Disclaimer
The EmiratesGBC's Advancing Deep Retrofits in the UAE results, findings and conclusions are based on literature reviews, research, analysis of survey responses, clarifications, and interviews with selected respondents. EmiratesGBC and the parties involved in the creation of this publication do not assume any liability or responsibility to the user for accuracy, completeness, or reliance of information contained in these reports.

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EmiratesGBC would like to acknowledge the contribution of all survey respondents, retrofit professionals, and retrofit publication authors for sharing their knowledge, expertise, and time to support the results of this publication. Due to confidentiality guaranteed to those who participated in this study, the names of the participating individuals and organisations cannot be disclosed.

Emirates Green Building Council (EmiratesGBC) is a business forum based in the United Arab Emirates formed in 2006 with the goal of advancing green building principles. The Council gathers member companies and partners representing a diverse range of stakeholders from within the building industry, government, and academia. EmiratesGBC functions as a common platform for all stakeholders to meet, discuss, interact, and exchange ground-breaking ideas which helps to promote a sustainable built environment in the UAE and the surrounding region.

Since its formation, EmiratesGBC has initiated several programs and events related to improving the operational efficiency of existing buildings. Membership is open to all stakeholders willing to influence a positive change in the country's-built environment.

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Section A: Background

A.1 Objectives

The purpose of this **Appendix** is to give further insight on the results and findings as reported in the **Advancing Deep Retrofits in the UAE** report published in October 2020. While all the key results were published in the report, it was deemed necessary to provide the full results from the EmiratesGBC's internal research, the Market Survey, and the Developers Survey to the market. This is not only good practice for data transparency and data sharing, but also allows readers, researchers, and the wider industry to examine and utilize the results within their respective fields to accelerate the path towards decarbonization of the built environment.

Consequently, this appendix provides in-depth information of the current retrofit market in the UAE, along with the various emirate-level strategies and targets which drive the energy efficiency market. This Appendix also provides more detailed explanation on the Study methodology, background research analysis and the results as conducted by EmiratesGBC. Lastly, the results and the findings from the Market Survey and the Developers Survey are also shown, with additional analysis being performed on key questions or questions that needed further investigation. It should be noted that the findings are reported directly from the results, with the recommendations being reported in the **Advancing Deep Retrofits in the UAE** report.

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A.2 Introduction

Globally, building construction and operations account for the largest share of both global final energy use (36%) and energy-related CO2 emissions (39%). In the UAE, however, buildings account for up to 70% of the country's electricity consumption. As green building regulations were mandated, first in Abu Dhabi and then Dubai and Ras Al Khaimah, after 2010 onwards, majority of the building stock in the country were built prior to any green building codes and can be considered inefficient. For instance, in Dubai, the Dubai Side Management (DSM) Retrofit Program aims to retrofit 30,000 buildings by 2030. The other emirates also have targets for retrofitting with Abu Dhabi targeting 3,000 government buildings by 2030 (through Abu Dhabi Demand Side Management and Energy Rationalization Strategy 2030, RAK targeting 3,000 buildings by 2040 (through the Ras Al Khaimah Energy Efficiency and Renewable Energy Strategy 2040) and Sharjah focusing on, but not limited to, the top 100 consumers (through the Sharjah Electricity and Water Authority's Retrofit Program).
To support Dubai's targets, the Dubai Supreme Council of Energy (DSCE) Directive No.1 2015, mandates a walkthrough Energy Audits for Government Buildings with over 1,000 m^2 GFA. It should be noted, however, that the directive mandates the development of retrofit plans for estimated potential savings exceeding 20% of electricity and/or water consumption and payback time of less than 10 years, and therefore can be considered as only shallow retrofits. Currently, the other emirates do not have any mandates or regulations for retrofits.
In 2013, the Emirates Green Building Council (EmiratesGBC) created the Energy Efficiency Program (EEP) as a market-influencing and capacity-building platform to facilitate the reduction of the UAE's carbon footprint through energy efficiency retrofits of existing inefficient buildings. In 2014, the EEP Database was created to help facilitate building retrofit projects by streamlining the energy efficiency market in the UAE. This was followed by the publication of the Technical Guidelines for Retrofitting Existing Buildings in 2015, which provide an organized collection of economically viable methods for building owners in the UAE to achieve sustainable buildings. With the success of the Technical Guidelines, the Building Retrofit Training (BRT) was launched in partnership with Dubai Supreme Council of Energy and Masdar, with the Introductory course launched in 2017 and the two-day Advanced course launched in 2018, to teach the fundamentals and in-depth technical knowledge of retrofits specific to the MENA region.
Two benchmarking studies, the 2016 Hotel Benchmarking Report and the 2019 Building Efficiency Accelerator Benchmarking (BEA) Project Report, were also published by EmiratesGBC to support the buildings retrofit market in the UAE. The 2016 report established the first ever industry energy and water performance benchmarks for the hotels in the UAE. The 2019 BEA report helped further refine the results for the Dubai hotels and presented energy and water benchmarks for Dubai schools and malls.

To support the industry and in line with the EEP objectives, EmiratesGBC conducted a **Deep Retrofit Study** to understand the current UAE retrofit market awareness and capabilities as well as the challenges and opportunities related to deep retrofit projects. The Study results were highlighted in the **Advancing Deep Retrofits in the UAE** report published in October 2020.

As part of the vision for the UAE to be a global leader for sustainability in the built environment, the Study was conducted to help explore solutions and approaches to retrofitting buildings that go beyond current renovation programs to achieve greater energy and financial savings. The Study also aligns and supports EmiratesGBC's Net Zero Centre of Excellence, which was formed as a think tank and accelerator to advance net zero carbon buildings in the UAE. It is hoped that these deep

retrofits will pave the way for existing building stock to ultimately decarbonise and support the industry to move towards a net zero carbon future.

A.3 Definition of Deep Retrofits

According to the IEA[1] and the Rocky Mountain Institute[2], a deep retrofit is defined as a whole project analysis and construction process in which the site energy use intensity (including plug loads) has been reduced by at least 50% using energy efficiency measures as compared to the baseline site energy use intensity. Instead of focusing on single stand-alone systems such as lighting, HVAC, building operations, a deep building retrofit focuses on the project as a single, integrated system in order to maximise energy savings. While the intent of a deep retrofit is ultimately energy savings, improvements in various operational systems also lead to improvement in indoor environmental quality and occupant comfort. Additionally, it was clarified with the authors of the IEA report[1] that the definition prioritises energy efficiency measures before onsite renewable generation, unless cost-effective, for meeting the 50% target.

A.4 Shallow vs Deep Retrofits

Shallow retrofits target low-hanging, easy-to-implement, short payback and/or low risk single measures and/or partial changes and upgrades such as lighting, HVAC systems, retro-commissioning, etc. In such cases, measures such as façade or roof insulation, replacement of windows, remediation of thermal bridges, or significant improvements in building air tightness are not considered, while they represent bigger savings, as such measures require higher initial capital investment and are perceived as high investment risk. Additionally, the payback period might be longer and thus is not considered an attractive option to investors and building owners and operators.
Conversely, deep retrofits consider all major capital needed in the project over the next several years and plan interventions to this business-as-usual scenario to create higher efficiencies and other benefits. Deep retrofits target higher savings by considering whole-building analysis to implement a bundle of individual measures (such as building envelope insulation, window replacement, improved airtightness, etc.) to maximise efficiency gains across a series of systems. The implementation can occur together or be phased over several years, depending on the project requirements and cost-effectiveness of the planned improvements.

A.5 Deep Retrofit Survey Methodology

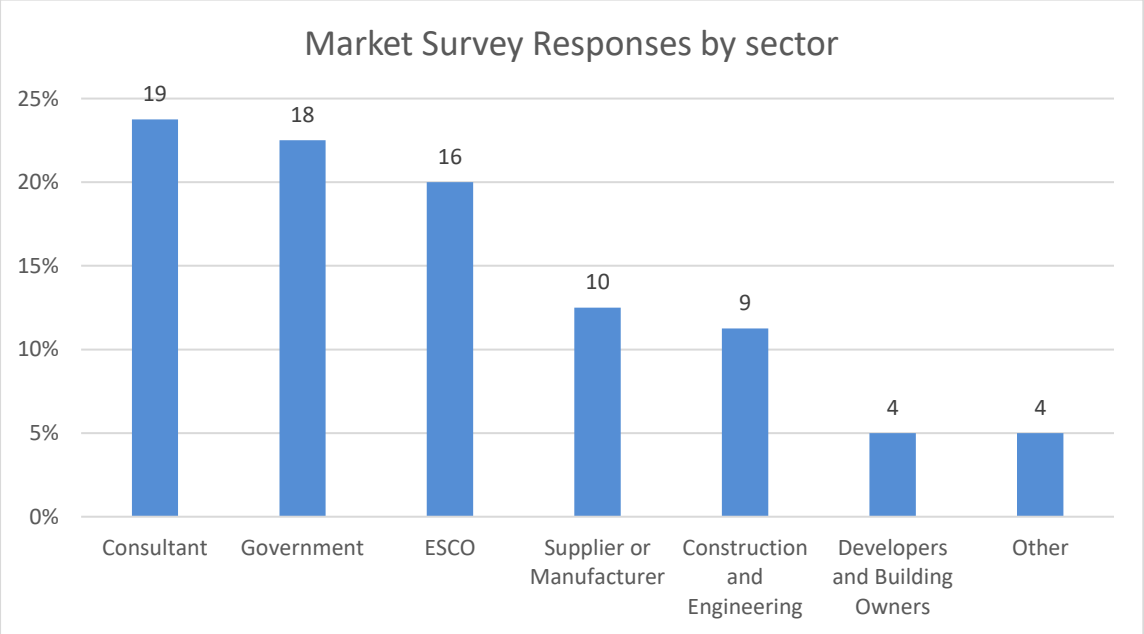
The Deep Retrofit Study was done in several stages, with Market Survey being conducted during the EmiratesGBC Deep Retrofit Focus Day on November 12th, 2019. A link to the Market Survey was distributed to the participants of the event and was completed by 27 out of the 55 in attendance, representing a competition rate of 49%. Upon evaluation of the initial Market Survey responses, it was seen that majority of the responses represented the opinions of the supplier/manufacturers and only limited responses were received from the energy saving companies (ESCOs) and the government.
The Market Survey was then sent out to selected individuals from the other sectors such as consultants, ESCOs and the government to holistically represent both public and private responses for the study results. The individuals were selected based on the market experience and position within the organization, with the ESCOs being selected from the EmiratesGBC membership and the RSB Dubai accredited ESCO list. The second Market Survey was conducted during February 05th,

[1] IEA: https://iea-annex61.org/files/results/Subtask_D_Guide_Final_Version_2017-11-06.pdf
[2] Rocky Mountain Institute: https://rmi.org/wp-content/uploads/2017/04/RetroFit_Depot_Managing_Guide_1.1.pdf

2020 and February 20th, 2020, with some of the responses being investigated and validated with phone calls and/or e-mails from February 23rd to February 27th.
During the verification phase, the respondents were asked to confirm their answers on specific Market Survey questions to clarify whether they answered the question whilst understanding the meaning and intent of the question. Out of all the respondents contacted, only one person had changed their initial response. Additionally, during this phase, information regarding specific retrofit projects was also requested which were not requested within the Market Survey questions. Additional retrofit projects were identified either through the answers that respondents had submitted or through the response investigation/validation phase.
After the analysis of the Market Survey responses, it was evident that developers were not well represented. The last stage of the study explored the viewpoint of developers through the Developers Survey, which was conducted exclusively for them. This was important as the developers' opinions were needed to fully capture and understand the position and requirements of the buildings and construction market. The Developers Survey was conducted from April 9th to April 14th and was sent to 32 developers across the UAE.
The results and analysis of the Market Survey and Developers Survey are shown separately below to avoid confusion when interpreting the results. Each question is reported separately as well, with the open-ended responses being provided as summaries.

Section B: Market Survey Results & Findings

Market Survey Respondents

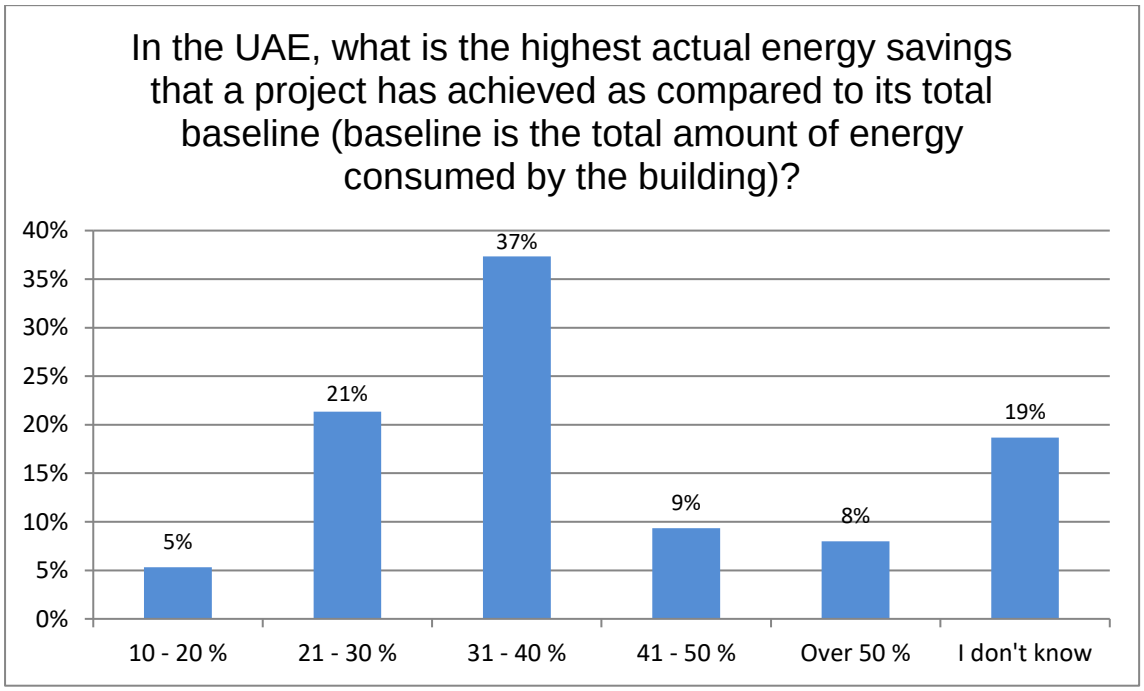


A total of 80 out of the 106 contacted individuals completed the Market Survey, representing a completion response rate of 75%. The Market Survey responses consist of the following sectors:

- 23.75% Consultants
- 22.5% Government
- 20% ESCO
- 12.5% Suppliers and Manufacturers

- 11.25% Construction and Engineering (Facility Management Companies, Advisory, Planning, Project Management, Contractor and Commissioning)
- 5% Developers and Building Owners
- 5% Others (Academia, Hospitality, and Group of companies)

Question 1



Findings

- Over half of the participants (59%) have responded that the highest actual energy savings a project has achieved is between 21 and 40% in the UAE.
- 37% of respondents believe that the highest level of actual energy savings is between 31% and 40%.
- Around 17% of the respondents responded that savings greater than 40% have been achieved in projects.
- Around 19% also answered that they do not know what the highest actual energy savings project have achieved in the UAE, which indicates that there is a need in the market for more awareness about deep retrofit projects.

Additional Analysis

During the verification phase, several of the respondents were contacted to investigate the actual energy savings achieved by the projects. Among the group (around 9% of respondents) that responded with 41-50%, it was verified that these projects considered the energy savings as compared to the total consumption and not per single energy efficiency measure (e.g. lighting). The names of these projects were also verified, and the energy savings figures are based on actual projects in the UAE and are given below.

However, while several of the contacted respondents named the specific projects, they were not aware of the specific energy efficiency measures that were implemented on those projects. To

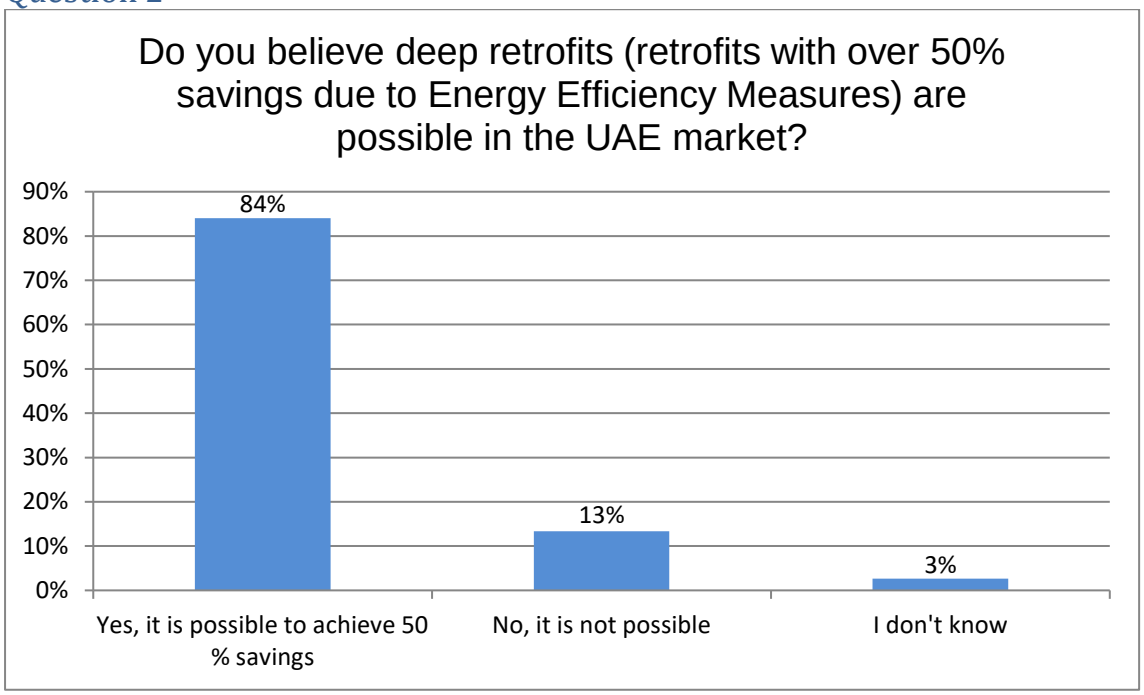
investigate this, the specific ESCOs were contacted, where it was noted that some of the publicly reported figures include savings from both implementation of energy efficiency measures as well installation of solar PV systems. Among the verified projects, two of the ESCOs stated that they do not consider renewable energy as part of their energy savings calculations. More details about the highest energy savings projects are given below.

Project Name	**Energy savings (kWh)**	**Onsite renewables included**
Office Building (Name confidential)	46.5%	No
Office Building (Name confidential)	45.6%	No
Residential Building (Name confidential)	44.5%	No
Hotel Building (Name confidential)	42.7%	No
Residential Building (Name confidential)	33.5%	Yes
Commercial Building (Name confidential)	39.3%	Yes
Public Building (Name confidential)	28.1%	Yes

According to the International Performance Measurement and Verification Protocol (IPMVP)[3], savings are determined by comparing measured use or demand before and after implementation of a program, making suitable adjustments for changes in conditions. The comparison of before and after energy consumption or demand should be made on a consistent basis, using the following general M&V equation: Savings = (Baseline Period Energy – Reporting Period Energy) ± Adjustments; where Adjustments are made in order to realistically compare post retrofit conditions to the base year conditions (i.e. due to significant changes in square feet, weather differences and operational hours). It should also be noted that the above equation considers Energy Conservation Measures (ECM) rather than only Energy Efficiency Measures (EEM), where the ECM term is defined to include both conservation and efficiency actions. Renewable energy generation can be considered for calculating energy savings as per IPMVP Volume 3.

[3] IPMVP: http://www.eeperformance.org/uploads/8/6/5/0/8650231/ipmvp_volume_i__2012.pdf

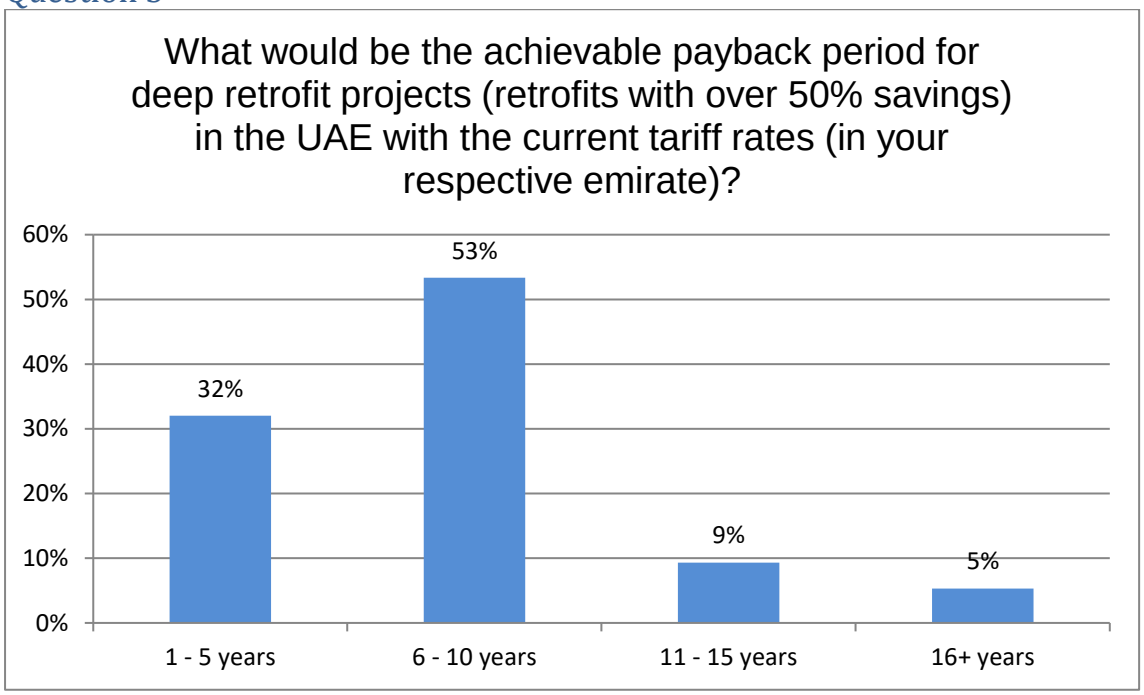
Question 2



Findings

- Majority of the respondents (84%) of the Market Survey agreed that deep retrofits (retrofits with over 50% savings using only Energy Efficiency Measures) are possible in the UAE.
- Among the government, three-quarters also agreed that deep retrofits are possible.
- Among the ESCO respondents, 86% agreed that deep retrofits are possible.

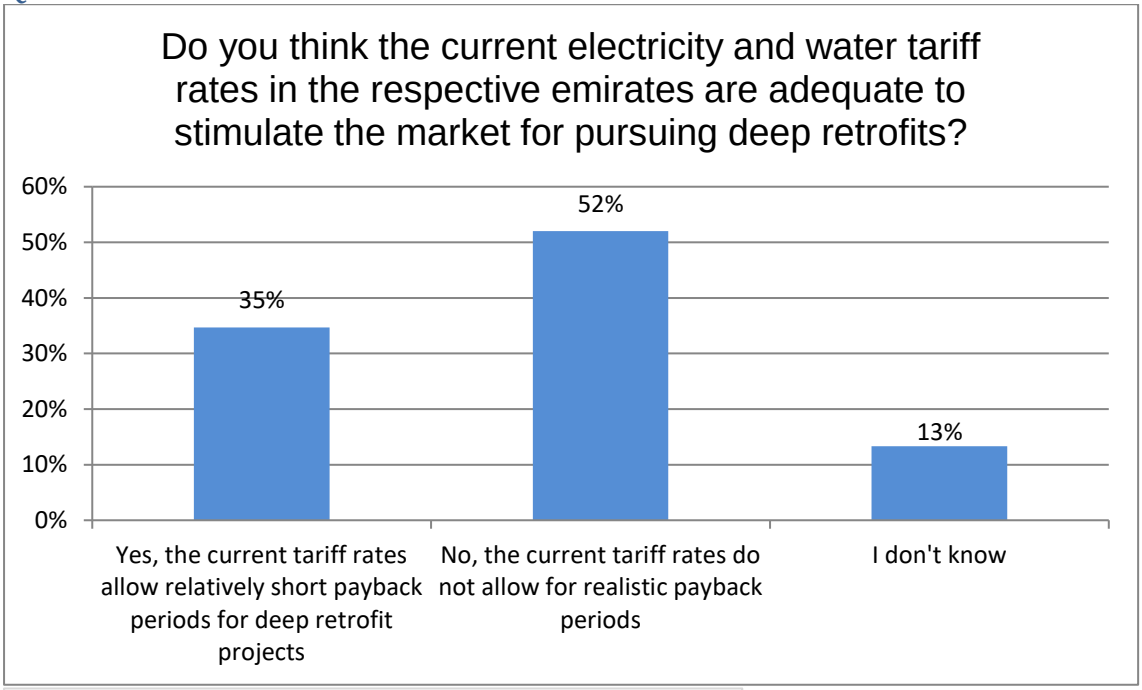
Question 3

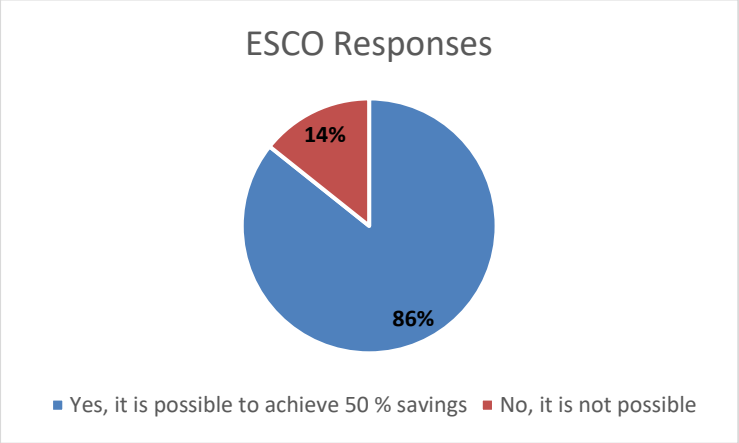


Findings

- Majority of the respondents (85%) of the Market Survey agreed that deep retrofits would have an achievable payback of 1-10 years with the current tariff rates (in their respective emirates).
- 53% answered that the achievable payback would be between 6-10 years.

Question 4



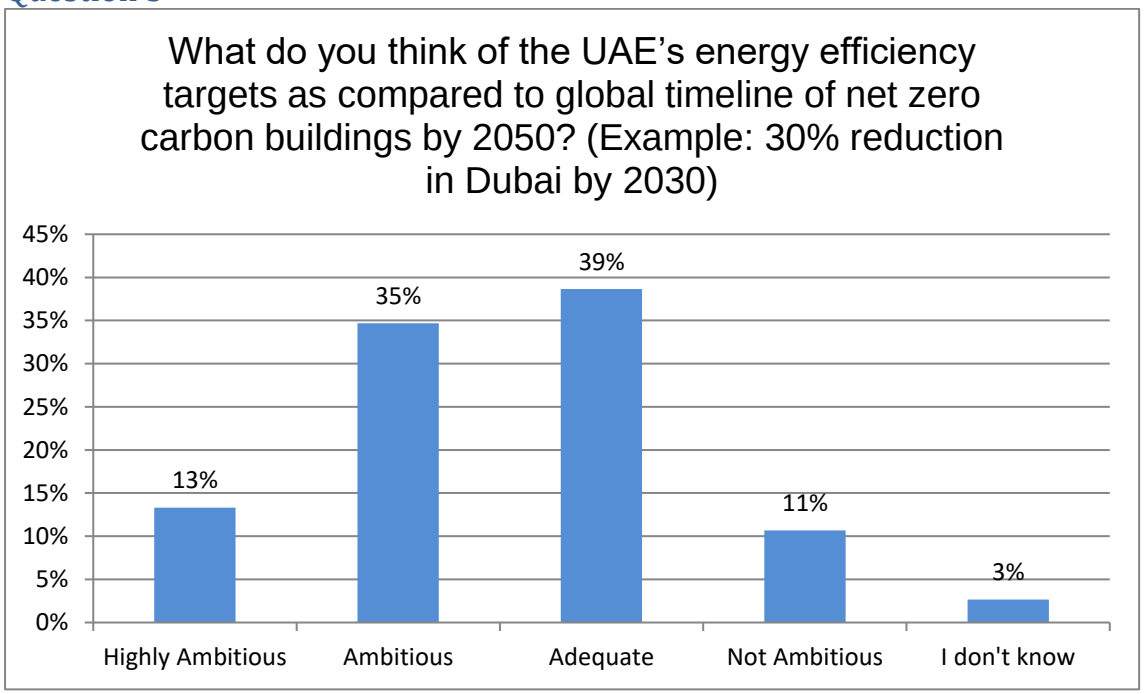


Findings

- Over half (52%) of the respondents of the Market Survey agreed that the current tariff rates are not adequate to stimulate deep retrofits.
- Among the government, over half (56%) answered that the current tariff rates are adequate. This represents 12% of the total responses.
- Interestingly, majority of the ESCO (86%) responses also agreed that the current tariff rates are adequate. This represents 16% of the total.
- However, among the private sector, excluding ESCOs, over half (51%) answered that the current tariff rates are not adequate with 20% answering that they do not know.
- However, this should be noted that most of the respondents are Dubai-based and the results might differ if there were more responses from the other emirates with growing retrofit market.
- For instance, the government respondents from Abu Dhabi and Ras Al Khaimah all responded that current tariff rates are not adequate. However, given that this only

represents a very small segment of the of the total responses, it is not possible to make any conclusions.

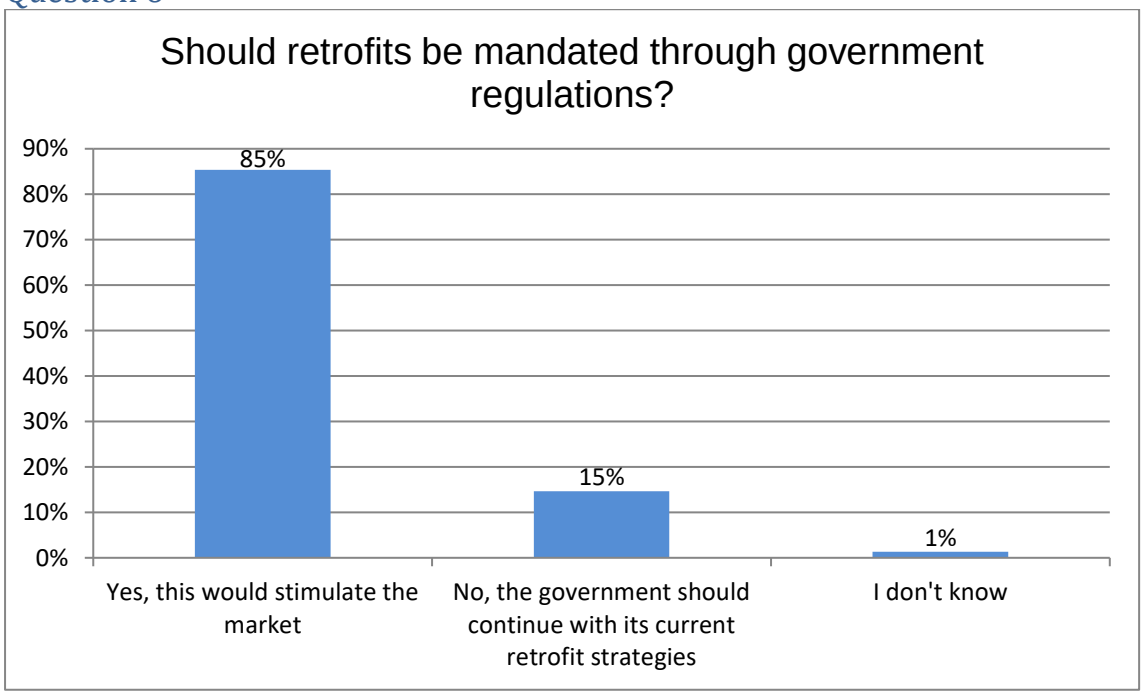
Question 5



Findings

- 48% of the respondents of the Market Survey agreed that UAE's energy efficiency targets are ambitious or highly ambitious, with 50% and 64% of the government and ESCOs, respectively, in agreement.
- However, 39% responded that the EE targets are only adequate with 11% stating that it is not ambitious.
- 73% of the responses among the private sector responses, including ESCOs, agreed that the targets are only adequate.
- It was also seen that among the governmental responses, 19% answered that the targets are not ambitious.

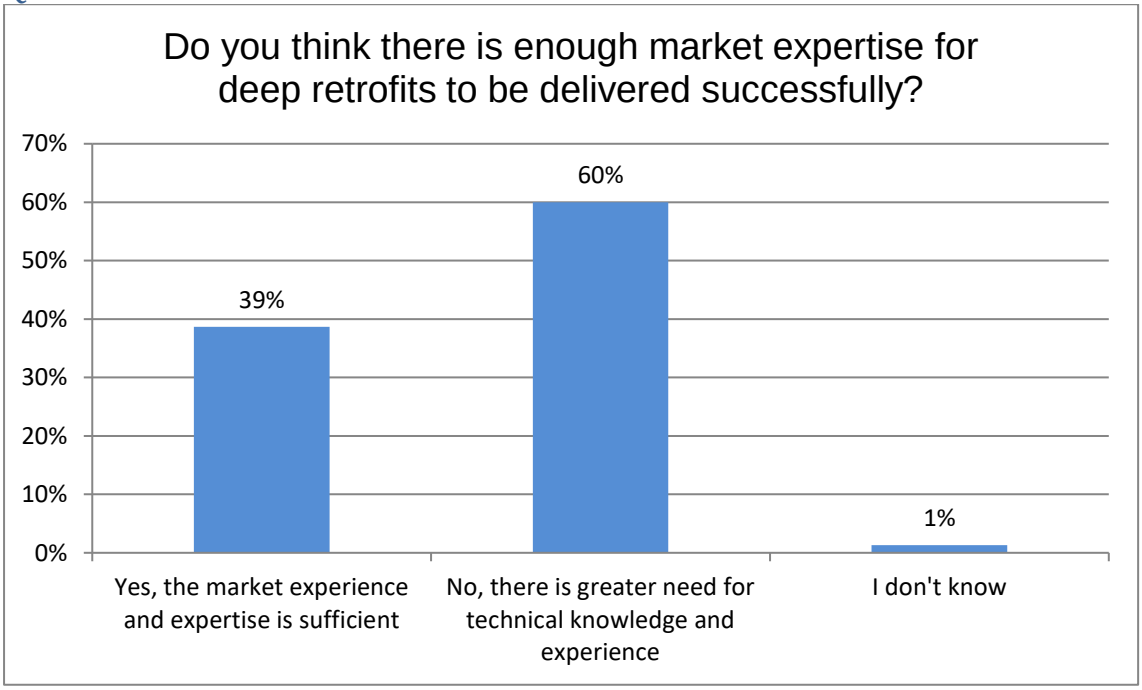
Question 6



Findings

- Majority of the respondents (85%) of the Market Survey agreed that retrofits should be mandated by the government.
- 90% of ESCOs, consultants and suppliers and manufacturers agree that mandating retrofits would stimulate the retrofit market.
- 69% of the government sector respondents also agreed.

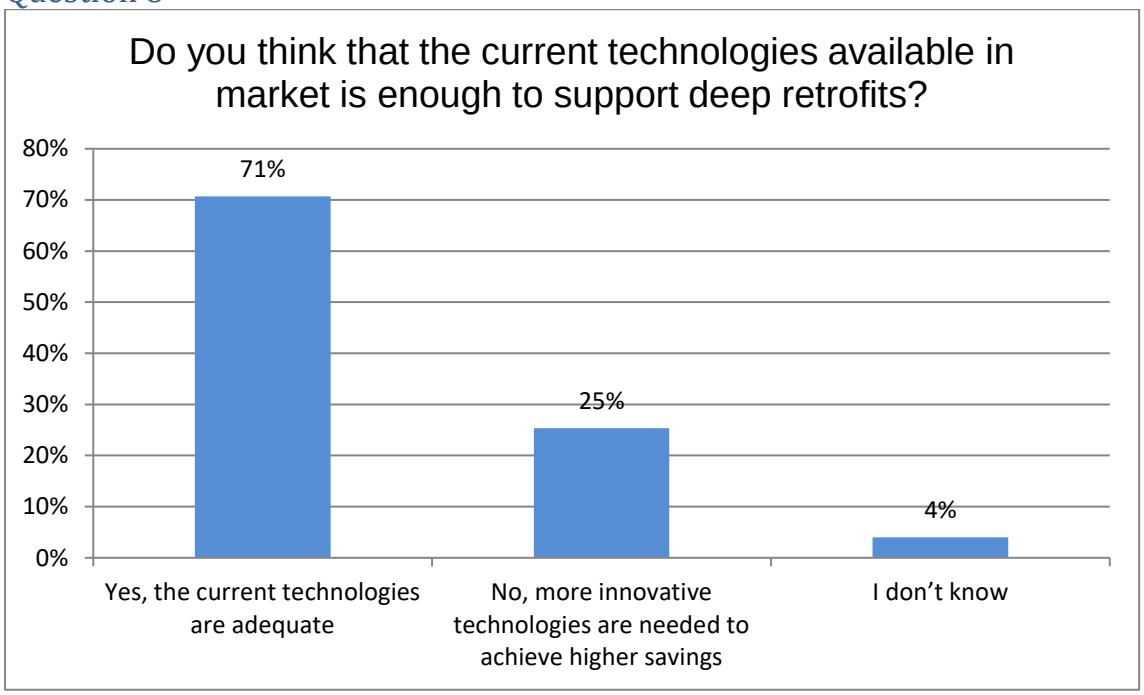
Question 7



Findings

- 60% of respondents of Market Survey agree that there is greater need for technical knowledge and experience for deep retrofits to be delivered in the market.
- However, 39% also agreed that there is sufficient market knowledge and expertise .
- This response was split for both the government and ESCO responses where only half (50%) answered there is need for more technical knowledge, whereas the other half responded that there is sufficient market experience and expertise .
- 67% of the private sector (excluding ESCOs) respondents, however, answered that there is more need of knowledge and experience .

Question 8



Findings

- 71% of Market Survey respondents agree that current technologies are adequate to support deep retrofits.
- In contrast to the previous question, 88% and 71% of the government and ESCO responses, respectively, were in clear agreement that the existing technologies are sufficient to support deep retrofits.
- While 66% of the private sector (excluding ESCOs) respondents, agreed that the current technologies are adequate, 29% responded that the current technologies are not adequate.

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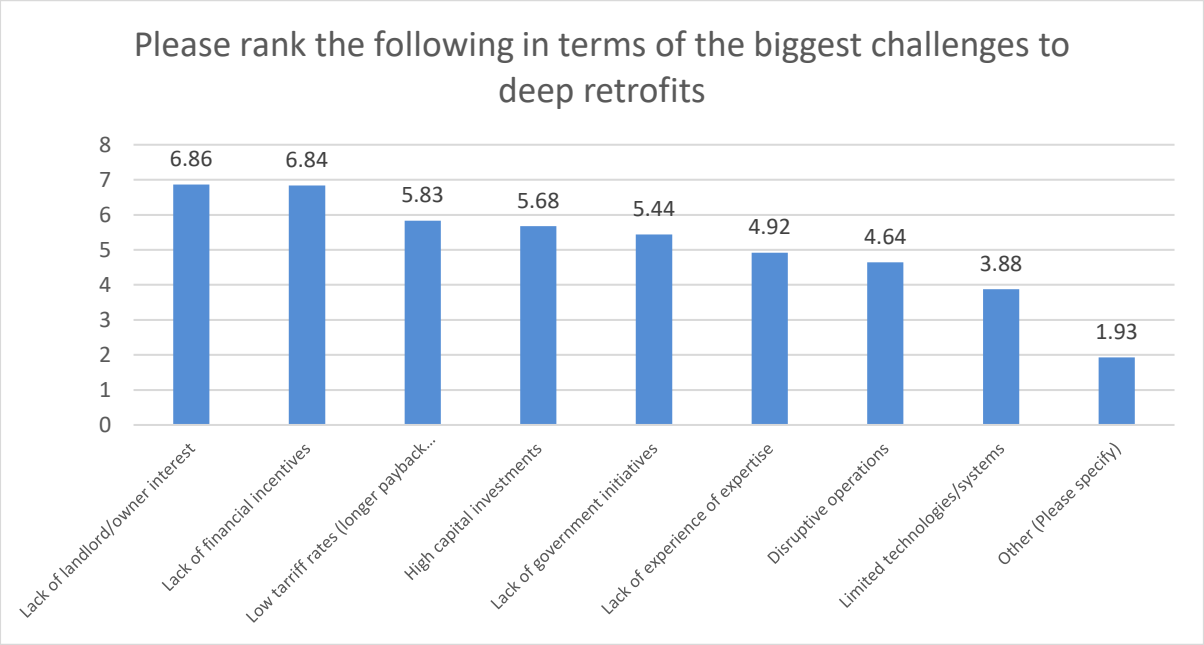
Question 9



Findings

- Lack of landlord interest was ranked as the biggest challenge for deep retrofits followed by lack of financial incentives as second biggest challenge.
- Low tariff rates were given as the third biggest challenge, but as seen in the previous responses, the government and ESCOs are content with the tariff rates (at least in Dubai).
- High capital investments and lack of government initiatives were ranked as the 4th and 5th biggest challenges, respectively.
- The ESCO responses are all consistent with the challenges identified for deep retrofit except that the ESCOs rank lack of governmental initiatives as the 3rd biggest challenge followed by high capital investments and low tariff rates as the 4th and 5th biggest challenge, respectively.
- This shows that the ESCOs perception of the biggest challenges are aligned with the rest of the market, but they believe that the government should be more supportive of the retrofit market.
- The government responses are consistent with the overall responses with the difference that low tariff rates were not identified in the top five challenges but rather the lack of experience and technical knowledge of retrofit professionals was.
- This again shows a marked distinction in the perception of the capabilities and the actual experience of the retrofit professionals.
- Other challenges included lack of rating systems for retrofit projects and lack of awareness

Question 10

Open-ended Question - Can you suggest examples, financial or non-financial, incentives that you would like to see here in the UAE to accelerate the breadth and depth of retrofits?

In summary, suggested incentives include:

- An existing building rating/labelling system to understand building performance
- Linked building performance to leasing/rental costs
- Green loans (lower interest rates), tax-rebates, grants/funds on energy efficiency-related projects and purchase
- On-bill financing to streamline financing methods
- Offer incentives to public and private sectors for investing into EE-related projects (such as hedge/investment/mutual funds) to drive funding for retrofits.

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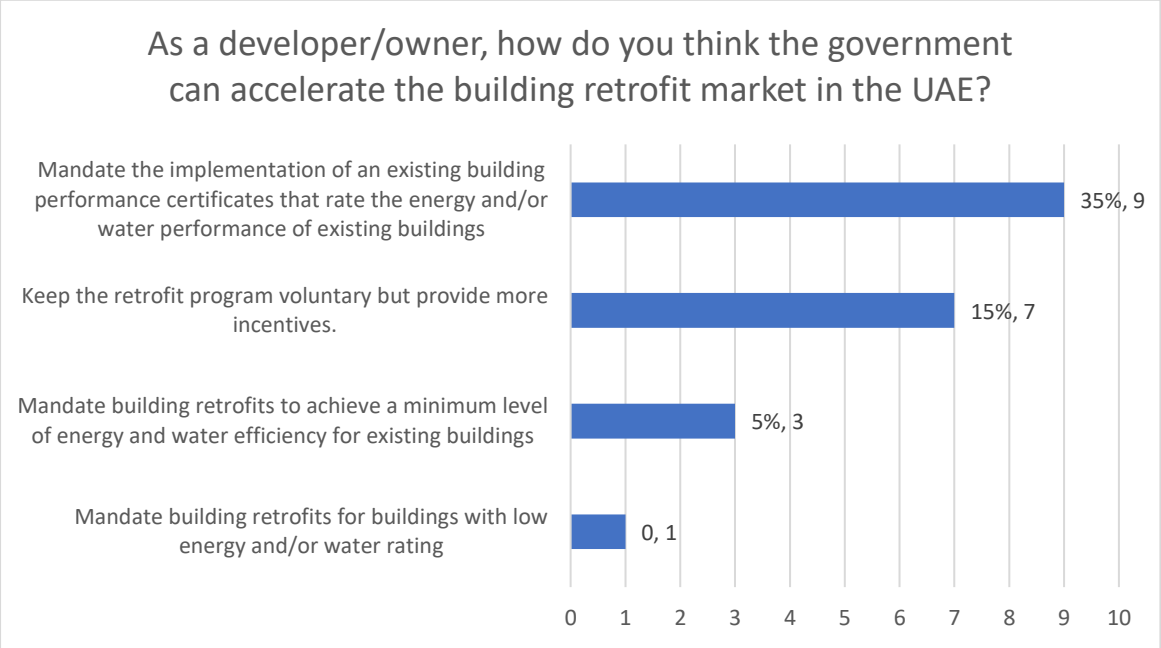
Section C: Developers Survey Results & Analysis

Overview of Developers Survey Respondents

A total of 14 out of the 32 contacted developers completed the Developers Survey, representing a completion response rate of 44%. Only developers were contacted for the Developers Survey.

Question 1



Findings

- Note that for this question, respondents could choose up to two options. Thus, even though only 14 respondents answered, the total number of responses is counted as 20.
- Overall, the 45% of the developers (9 responses) believe that the retrofit market can be accelerated by mandating energy and/or water performance certificates for existing buildings.
- 35% (7 responses) of the developers would prefer that retrofits be kept voluntary, but the government should provide more incentives.
- This contrasts with the other responses, where 90% of ESCOs, consultants and suppliers and manufactures agreed that buildings retrofits should be mandated.
- A potential reason for this disparity can be seen when examining the developers' views, where high capital investments and lack of financial incentives were ranked as the top two challenges for retrofits.
- 15% (3 responses), however, agree that buildings should be mandated to achieve a minimum level of energy and water efficiency.
- 5% (1 response) responded that mandates should be for buildings with low energy and/or water rating.

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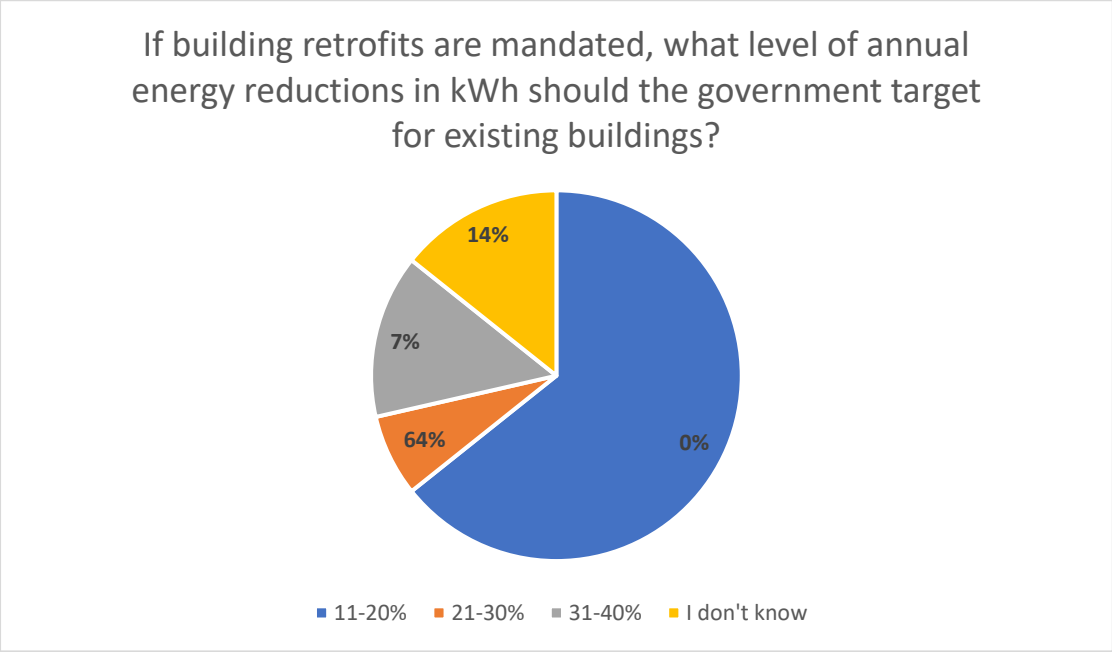
Question 2



Findings

- If retrofits are mandated, majority of the developers (64%) would prefer an annual energy reduction (in kilowatt-hour) target of 11-20%.
- 14%, however, would prefer more ambitious targets of 31-40% kilowatt-hour energy reductions.
- 14% of the developers could not specify what energy reduction target should be mandated.
- Only 7% preferred an energy reduction target of 21-30%.

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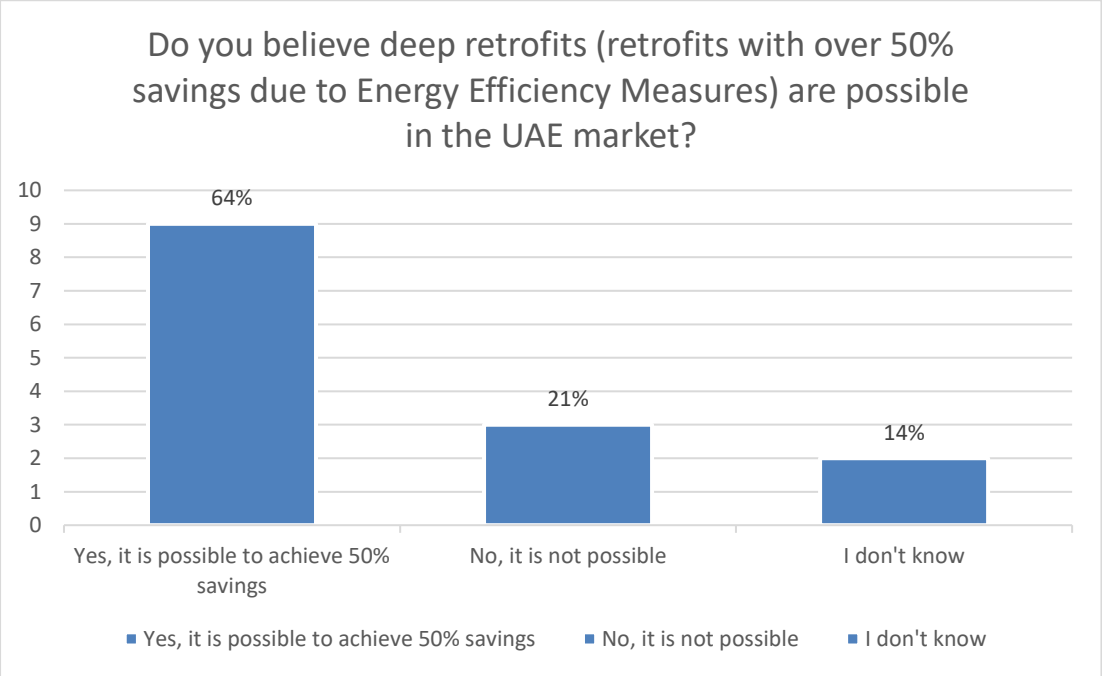
Question 3



Findings

- 64% of the developers agree that deep retrofits are possible in the UAE market. This aligns with the answers given by the rest of the private sector, where 84% agreed.
- 21%, however did not agree that deep retrofits are possible. While the question did not specifically differentiate between technical feasibility or financial feasibility, it could be likely that the potential reason for the disagreement could be related to the financial feasibility.
- This is further supported when examining these developers' responses, where they also ranked high capital investments and lack of financial incentives as the top challenges.
- 14% of developers did not know whether deep retrofits are possible.

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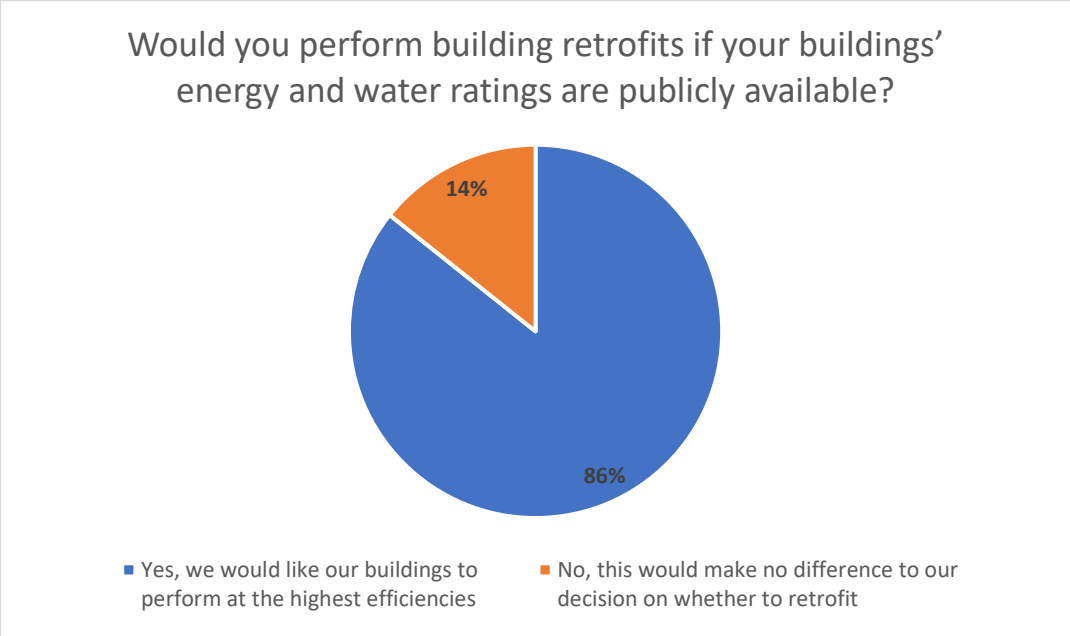
Question 4



Findings

- More than four-fifths of the developers (86%) agreed that they are more likely to perform retrofits if energy and/or water ratings for buildings are publicly available. This is supported by the answer that they would like their buildings to perform at the highest efficiencies.
- This response is also supported by the previous response, where 45% of the responses were supportive for mandating of building performance certificates.
- 14% also answered that publicly available buildings' energy and water ratings would not influence their decision for retrofitting their buildings.

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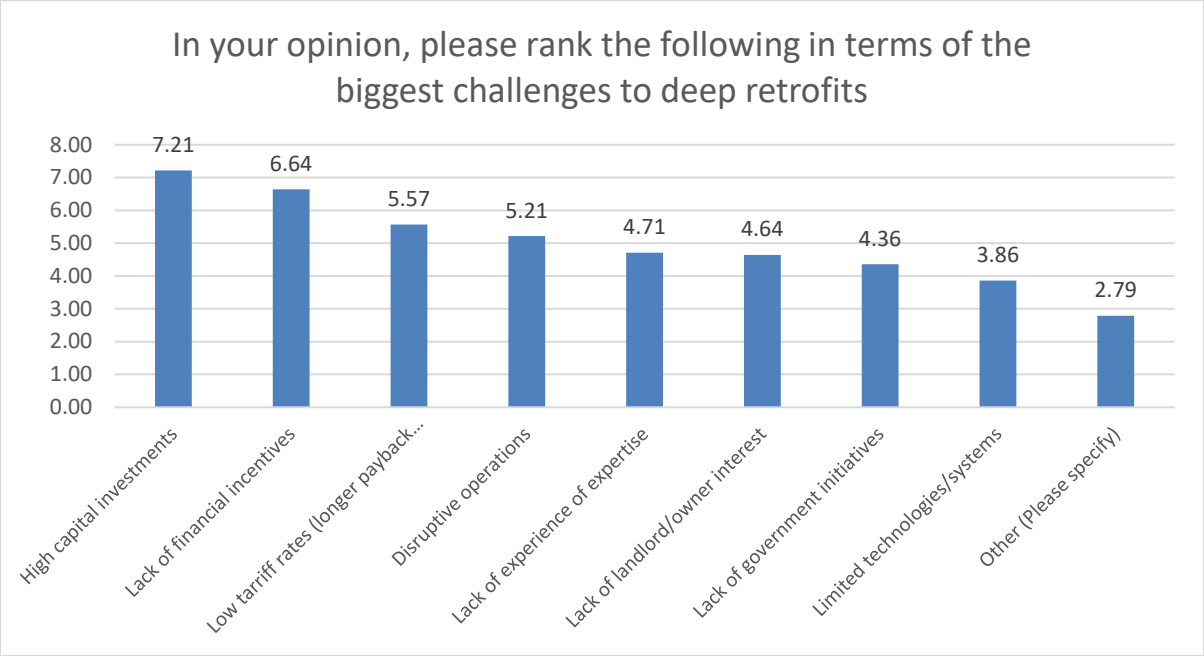
Question 5



Findings

- The top five challenges for developers, in order were: high capital investments, lack of financial incentives, low tariff rates, disruptive operations and lack of professional experience and expertise.
- The identified challenges align with the challenges that were identified by the rest of the private sector, except for disruptive operations.
- Developers had identified disruptive operations as one of the top five challenges to building retrofits. This is understandable given that some developers are also building owners in the UAE, and therefore would not want any retrofits to interrupt their building operations such as malls or residences.
- Other challenges highlighted by developers include the lack of publicly available and transparent benchmarks and/or performance ratings.

Question 6

Can you suggest examples, financial or non-financial, incentives that you would like to see here in the UAE to accelerate the breadth and depth of retrofits?

In summary, suggested incentives include:

- An existing building rating/labelling system to understand building performance
- Grants/funds on energy efficiency-related projects and purchase
- Time of use or dynamic tariffs rates