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Renewable Energy: Examine Implemented Solar Energy For The Housing Sector In The UK

Araz Agha[1*], Abdussalam Shibani[1*], Mahamed Fatah[1], Dyaa Hassan[1,2]
[1]School of Energy, Construction and Environment, Coventry University, CV15FB, Coventry, UK
[2]Civil Eng. Dep., Higher Technological Institute, 10th of Ramadan city, Egypt.

***Abstract*— In the United Kingdom, the use of solar energy in the construction industry is constantly evolving. However, the obstacles and restrictions still prevent its full implementation in the housing sector. This is mostly caused by socioeconomic factors, such as concern over whether using solar panels will be dependable, efficient, and provide enough financial benefit to justify its use. Through a thorough assessment of the literature and data analysis, this study seeks to understand why these problems are impeding the development of solar panels by identifying and evaluating all relevant factors. There are numerous factors were considered and evaluated ranging from the matter of lack of awareness of solar panels in the housing sector to the economic feasibility of installing them as a mainstream source of energy. The lifecycle emission rates for solar photovoltaic systems range from 0.08 to 0.2 lbs. That is way compared to the emission rates for natural gas is about 0.6-2LBS of C02E/kWh which illustrates the potential solar energy offers in dealing with the current climate change of about 0.6-2lbs. of C02E/kWh. The research found that the government's lack of awareness of solar panels and the arising issue of maintenance and efficiency of solar panels was one of the most significant limitations in implementing solar panels for housing in the UK. results show that 65% of professionals agreed there are a shortage and lack of government initiatives to make people consider solar panels which alone is a worry for the future of this renewable energy.**

Keywords*— *Renewable energy; solar energy; housing sector; Construction industry; UK.

I. INTRODUCTION

Energy is an important contribution to economic development. There is an imperative need to focus attention on the development of renewable energy sources and the use of energy-efficient technologies in the world. (Nehrenheim, 2017). The energy industry contributes a growing proportion of the GDP (Gross Domestic Product) and employment rate hence why it is crucial for the growth of a country economically and development-wise. Statistics show, that 5% of the UK'S GDP came from energy-related industries as of 2014 (EY, 2014). This makes you wonder why the smart technology revolution in construction has become a huge talking point. Solar panels are the transformation of sunlight captured from the sun using photovoltaics into electricity, which can be implemented to run household appliances and lighting. (EDF Energy, 2017). As stated in the (DECC 2013), the Department for Energy and Climate Change, energy bills are set to continue with an estimated 40% increase over the next ten years (DECC, 2013). Because of this, there is no better time for the public sector to invest in renewable energy and gain access to the eco-friendly benefits of solar photovoltaic implementation. With statistics like these, the use of solar power through the use usage and implementation of this is vital for the near future. Furthermore, with research indicating that little global warming emissions are associated with generating electricity from solar energy (Hu et al., 2018), this has all the signs that it is something that must be considered now. With energy prices rising at a high level, the issue surrounding pollution and the shortage of resources and environmental degradation. This has put the leaders of the world on alert regarding the limited resources around the globe.

Using fossil fuels causes plenty of harm, causing greenhouse emissions. This must be addressed seriously when considering new buildings. As of September 2017, the government announced the installation and implementation 'across8 800,000 social housing properties in England and Wales over the next five years in a bid to cut the cost of utilities for tenants', this one of the first massive investments by the government to deliver sustainable projects across the UK (BBC News, 2017). This will not only create jobs but will hit one of the main objectives which are "cheaper energy bills "said International Trade Minister Greg Hands. The costs and financial plays a huge part in any smart technology being considered or implemented. Current prices for an average household in the UK (3kw or a 4kw solar system) are upwards of £5,000 (The Eco Experts, 2017). This is a nearly 70% reduction in costs if purchased in 2010. In addition, as part of the EU'S Renewable Energy Directive set goals of reaching 20% of renewables target before 2020 (European Commission, 2009), the government has put up schemes for people in the UK to install solar panels. Feed-in-Tariff, introduced in April 2010, is a scheme for owners of solar panels who generate electricity using solar panels or wind turbines to receive a calculated amount of money for each unit (kilowatt per hour) they produce and for the extra electricity they decide to sell back to the grid (Energy Saving Trust, 2017).

As this is a very new technology that has surfaced recently in the construction industry and a huge talking about point to what it can offer in the future. (Moriarty and Honnery, 2012), previous case studies must be analysed in depth to get a clear understanding of what has been looked at, the findings and overall conclusions. One of the many cases studied is that of Professor Robert Kaufmann, a professor in Earth and Earth Environment. This study looks at the effect of installing rooftop solar panels in the state of Massachusetts, observing whether installing solar panels will have environmental effects in a negative or positive direction, and see if the introduction of solar panels can be a new form of creating sustainable renewable energy for the future (Boyle,2012) To further

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highlight the significance the important in trying to find a sustainable source of renewables, another study by a group of researchers was carried out to study use and implementation of solar and without it. The study found out solar panels alone induced cooling by converting sunlight into electricity and whereas not using solar panels would be harmful to the climate (Van Vuuren, D. P. ET 2011). Solar power will hopefully be the answer to stabilize if not reduce C02 emissions in near future (Boyle, 2015). With the increase in demand to deliver Solar PV installation, supply has elevated the UK into one higher tier of global markets for installed solar PV capacity. Due to such a surge in instalments, this has engrossed £6.4 billion in private sector investments in the three years to 2013 (Solar Trade, 2017).

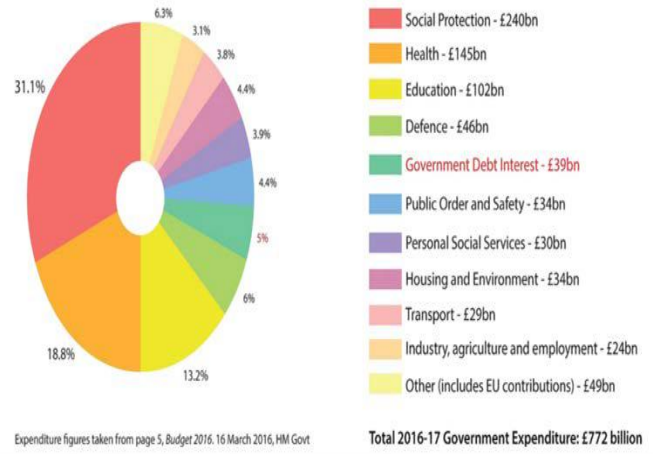

Fig. 1. Pie chart illustrating Annual Government Expenditure for the United Kingdom 2016

The construction industry in the UK is a vital governmental sector to its economy. It contributes to around 2.3% of the UK's GDP (Gross Domestic Product) which is about £110bn per annum to the economy. The industry contributes a considerable percentage to the employment rate in the UK, and thus, it is vital for economic growth and prosperity. (BEIS, 2017). The advanced technology sector in the UK construction industry is rapidly rising. Solar PV is a key renewable energy technology – which is the conversion of sunlight directly into electricity. Renewable energy has the potential to transform the solar power market completely. Solar PV installations have nearly doubled in the last year alone with nearly 710,000 deciding to implement solar PV in their household. (Green Match, 2018). A recent report published by the Centre for Economics and Business Research (CEBR), commissioned by the Solar Trade Association, has come up with the prediction that the UK can potentially benefit £25.5bn from the emerging market that is the development of solar power. (Solar Power Portal, 2014). This clearly shows the evident prosperous market the UK is trying to involve itself in and the potential benefits that it could bring to the country.

Furthermore, the yearly cumulative capacity of solar photovoltaic installations in the United Kingdom from 2010 to2021 has been shown above which further shows the rise of installations and its revolutionary promise (Statista, 2021).

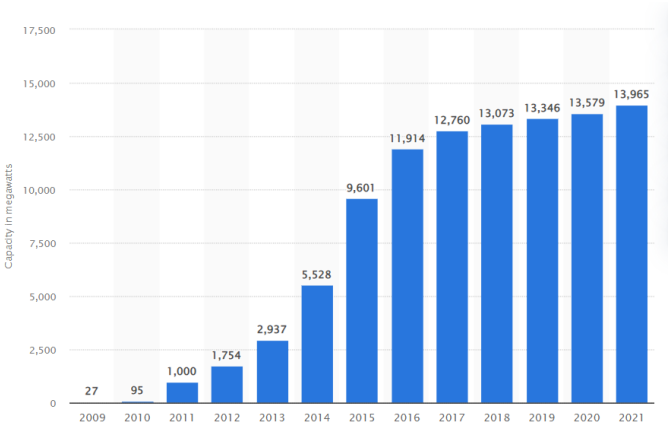

Fig. 2. shows the monthly solar PV installations in megawatts in the UK

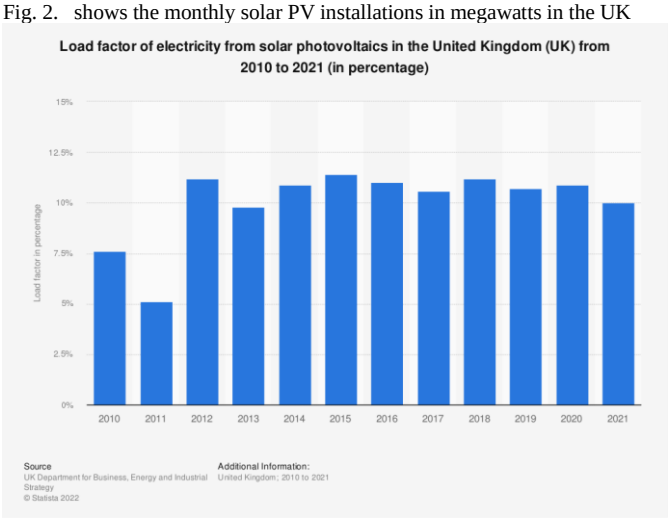

Fig. 3. Load factor of electricity from solar photovoltaics in the United Kingdom (UK) from 2010 to 2021 (Statista, 2021)

Solar PV installations have experienced the highest growth rate and 'now account for over 80% of all renewable electricity and '98' of all installations under the Feed-In-Tariff (FIT). (4-Barbour Product Research, 2017). This speedy growth in recent years has boosted the UK's image on the world stage and consequently moved into the top 10 markets globally and top 4 in Europe for solar PV installed capacity. Solar panels have the potential to be a great way to create a renewable-free source of energy. A solution to minimize greenhouse gas emissions and shift away from fossil fuels as the dominant energy source. (Moriarty and Honnery, 2012). Furthermore, the global general image of solar power has generally increased to be used as a main source of energy. (Nuortimo et al., 2018). Given the short amount of time solar panels have been used, signs are very positive and that previous barriers have such as investment cost which is slightly disinterested for the housing sector (Palm, 2017).

A. Factors Influencing Solar Implementation

Reports regarding renewable energy demonstrate that the markets are still in the early stages of fruition which is backed up by the fact that investment from government grants and initiatives is being cut. A 65% fall in the last year has caused an uproar. (Merrick, 2018). The fact that solar power is in its early premature form and the failure of the government to promote the implementation of this renewable energy is a cause for concern and lack of enterprise. The effect of this

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could be quite dangerous as ministers believe they are in danger of missing their carbon reduction targets. (European Commission, 2009). Maintenance and Efficiency of solar panels One of the main talking about is not actually what solar panels can bring to the housing industry as there is some consensus as to what it is used for but more regarding the sustainability of the maintenance and the efficiency the solar panels to make it a worthwhile investment. One of the talking about is that sometimes the maintenance of this solar power technology has a downside in terms of technology. (RGS Energy, 2015). Some of the issues are:

- Residue and waste - Washing panels with detergents
- Injury – Rooftop solar systems offer the highest risk to any homeowners seeking to maintain the solar panels in great condition. There's the chance of tripping over and consequently falling over causing a serious injury. You might also be electrocuted from the inverters used in most solar systems.
- Cracks – As its main job is to absorb sunlight, using cold water to rinse the solar panels can cause the formation of cracks which will subsequently cause cracks within the panels. The cracks will then systematically make the panels decrease in efficiency.
- The importance of fixing these issues cannot be stressed. Increasing efficiency is vital for the sustainability and development of solar-powered technologies, in this case, solar panels. (Solar Power Direct, 2016).

According to the Australian Solar Council, by just not cleaning your solar panels, efficiency can lose as much as 20%. As efficiency is huge talking about as mentioned above, with the expertise of a solar panel professional thoroughly cleaning your system can increase again increase its efficiency by as much as 21% which would be advised in terms of maximising your return on investment. So, the implementation of regular solar system servicing is imperative to maintain efficiency and maintenance.

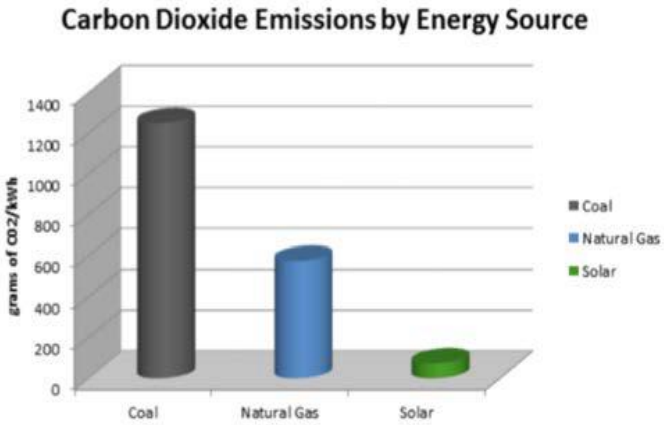

Fig. 4. Carbon Emissions by Energy Source, (Eco-Solar Home Improvement, 2021)

As shown in Fig. 4. Solar power has a huge upside when it comes to benefits that can lead to a surge in installations and consideration. One of these benefits is the environmental aspect of this renewable energy. Solar panels do not use anything else other than the Sun. Unlike other fossil fuels being utilised as a source of energy such as (coal, oil and gas), solar panels will be depending on the Sun fasts the main source of energy. (Choi, 2012). Furthermore, in terms of carbon emissions, although there is going to be some emission to the air, compared it the amount burned from other fossil fuels mentioned above, it is evident this could reduce carbon emissions and warnings of potential global warming (Choi, 2012).

B. Barriers and Implications

However, solar power is not the clean-cut all positive scenario that the world has been waiting for, it also consists of some limitations and barriers of efficiency and performance. (Shahan, 2018). Solar dependence on the Sun means that when the sun goes down or is heavily shaded, solar PV panels stop working hence the immediate stoppage of electricity stoppage. This consequently means that electricity is needed from no other source which concludes that we can't 100% be powered by solar panels. (Shahan, 2018), (Green Match, 2016).

C. Socio-Economic Ethic Benefit Arguments of Solar Energy

Arguments related to socioeconomic factors related to solar energy are an area where it is very important to consider all scenarios. Environmentally, renewable energy is an option that can be utilised but there is some doubt about the impact it can have. The solar life cycle is associated with the release of emissions even though there is an insufficient amount of emissions associated with generating electricity as analysed in the case study of Lebanon (Onsomu, 2012). The lifecycle emission rates for natural gas according to the International Panel for Climate Change is at (0.6-2LBS of C02E/kWh) and coal (1.4-3.6 lbs. of C02E/kWh) (IPCC,2011) which is far more than the emission rate of concentrated solar photovoltaic systems range of 0.08 to 0.2 lbs (IPCC,2011). This further enhances the realisation that renewable energies such as solar PV implementation can be a viable option. Renewable energy could arguably contribute to achieving UK'S biding climate change and emission targets effectively.

D. International Perspective of Solar Power

China is responsible for 60% of the total cell manufacturing capacity in the world annually. (IEA, 2018). With supported policies that make the development of solar power an important area of interest and huge emphasis, China will continue to be the leader of the renewable market and subsequently signifying that there will be global implications for solar PV for demand, supply and hence prices. The United States remains the second-largest growth market for renewables. The strong drive for new onshore and solar PV capacities shows great promise in the American market (IEA, 2017). Furthermore, with the introduction of complementary multi-year federal incentives for distributed solar PV, the potential for new buyer's implementation is one that can rely on and gain financially with such a well-protected system compared to the FIT scheme offered by the UK which can be compromised in the way it did when the government cut 60% of funding which has contributed to the shortage of installations (Macalister, 2015). In addition, the introduction of the protectionist policy by Donald Trump, which will lower solar instantiations for consumers will further enhance the prospect of buyers making solar PV the main energy source (Guardian, 2018). India is a rapidly growing country in terms of GDP however when it comes to solar PV there are signs of

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real great promise with minor potential setbacks. The latest news highlighting that tariff set out by President Modi's government, can potentially introduce a 70% tax on imported solar panels could be a huge disadvantage to companies as this will have a domino effect on potential buyers as implementation costs would skyrocket which could be disastrous for the renewable sector. The figure above shows the total installed solar rooftop capacity in India. Incredibly, residential installations have risen over the commercial sector. This shows great potential in the sector where the 2022 ambitious target of 175 GW by 2022 looks attainable but still has a long journey. In comparison, China has already accomplished their 2020 target for the number of solar PV installations two years ahead of schedule showcasing real determination and emphasis on making the country use renewable energy to suffice energy demands. (Jaitley, 2018).

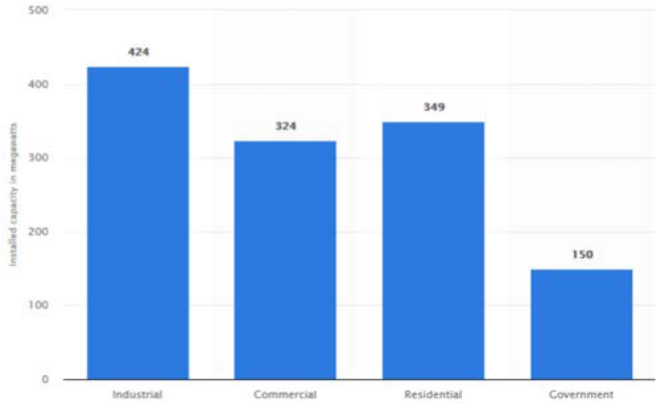

Fig. 5. Totalled Installed Solar Rooftop Capacity in India (Statista, 2016)

So, the question is why is there a low number of solar panels being implemented in the UK and with a few incentive schemes put in place by the government, what is the cause of all this? With the breaking news that government subsidies are being cut to householders installing rooftop solar panels by nearly 65%, there might a surge of people who are sceptic about implementing solar panels (Macalister, 2016). So, with little support from the people in power, installing and guidance about solar panels will only be of negative perception. So, a research study is needed to try and find out why there is a low number of installations and usage of solar panels and what exactly happened to the grant that was cut, offering the installation of solar panels to anyone who was interested. Furthermore, data according to (Statista) illustrates that the number of people who have installed solar panels in the UK has fluctuated since the introduction of the Feed-In-Tariff (FIT) scheme from 2010 to the end of 2016 (Statista, 2017).

Furthermore, as solar panel fits the criteria of being a renewable and sustainable energy source, how it is being perceived outside the UK and what are other major countries doing differently to promote and use solar power in the form of solar panels? The importance of this research is to identify the factors that are causing such a downfall in installations across the UK for the housing sector when this renewable energy offers innumerable benefits to be utilised through a mainstream energy source. The people who can benefit from the Feed-In-Tariff scheme, are prospective household owners who have been considering the option of installing solar panels. This research aims to investigate the smart technology of solar panels and critically evaluate the implementation of this solar technology within the housing sector. While the objectives of this study are to investigate the usage and Implementation of Solar Energy as a Mainstream Energy Source; evaluate the demand for Solar Power globally and domestically, identify the limitations and the greatest problems facing Solar Power and its use; and finally find barriers and implications lay behind implementing solar energy within the housing sector.

II. RESEARCH METHODOLOGY

In this research a mixed methodology in which an approach is taken combining fundamentals of qualitative and quantitative for broader understanding (Libguides, 2017) (Shibani et al., 2021). This method takes data collection and analysis alongside the conception of certain trends and opinions. The approach taken for this research project will be a mixed approach of both types of research (Agha et al., 2021). To do thorough research to find the underlying issues regarding the usage and implementation of solar panels in the housing sector it is important to back up findings with numerical data and statistics from official sources. In addition, it is also required to gain a contextual understanding of this issue in the form of interviews and surveys. The researcher first researches the current state of the implantation of solar panels and the issues being faced. Preliminary steps that would be taken are finding resources available at the university library, then online, and looking at official governing bodies related to the topic. Numerous methods are talking about specific methodological processes. Such as telephone interviews, face-to-face interviews and surveys (Shibani et al., 2020). These types of methods will be used in combination when interviewing relevant people working in the industry. These will be recent graduates to HR senior staff who deal with renewable energy. The research sample of 30 respondents is mainly solar energy experts, construction managers architectural/design engineers. The researcher ensured that all respondents were aware of the solar PV implementation issues and benefits in the UK. This would warrant that the questions are carefully completed, and the responses are valid for analyses, to supplement the main objectives of the investigation.

III. RESULTS AND DISCUSSION

The reason why the analysis of the questionnaire was personalized was to answer the main agenda, which was the objective, to validate the findings from the respondents. There are two objectives of this questionnaire. Objectives 1 - To investigate the usage and Implementation of Solar Energy as a Mainstream Energy Source. Questions 4, 7. Objectives 2 - To analyse the issues surrounding the reasoning behind not implementing the smart technology Questions 2,3,5,8. Objectives 3 and 4 - To summarize the limitations and the greatest problems facing Solar Power and its use and to identify barriers and implications lay behind implementing solar energy within the housing sector. Questions 1, 6,9,10

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Objectives 1: This section will analyse the findings of the two questions (4 and 7) that seek to determine the views of the respondents on the usage and implementation of solar energy as a mainstream energy source for the housing sector. The participants answered 10 questions in total regarding the solar PV implementation topics ranging from lack of raising awareness to potential users to the issue of efficiency and maintenance. 70% agreed that solar PV implementation installations are an issue in the UK. The majority agreement illustrates the fact there is an underlying barrier to solar implementation. Furthermore, regarding whether the benefits of solar PV implementation outweigh the costs to implement it, this is very much a mixed view where 50% agreed and 40% disagreed with the question. These results show a clear uncertainty for UK professionals in the construction industry regarding the benefits.

On the other hand, objective 2: This section will look at the 4 questions seeking to get an understanding of the respondent's views of the reasoning behind the issue of not implementing solar PV. The results show a very similar pattern to the respondents agreeing to there are limitations to the raising of awareness (75%), struggle to offer financial gain to warrant its use (65%), the issue regarding the liability of implementation (50%) and companies not doing enough promoting solar energy (65%). Objectives 3 and 4. This section of the questionnaire will cover very important questions in seeking to identify barriers and implications behind solar implementation within the housing sector. The respondents shared similar views to most of the questions in this category. The final consensus of the questions is that they agreed that solar panels do offer more benefits compared to their limitations (80%), lack of government initiatives to make people consider solar panels (60%), implementation of solar panels not promoting solar energy enough (70%) and the issue surrounding reliability + efficiency in terms of solar panels performance (80%).

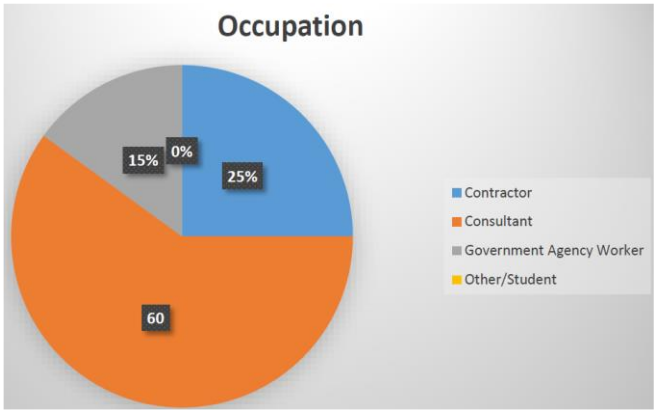

Fig. 7. Occupation of respondents

As stated in the figure above, 60% of the respondents from the questionnaire were consultants. 25 % are working as contractors and 15% as governmental agency workers. There was 0% in terms of students completing the questionnaire when asked to comment on their occupation.

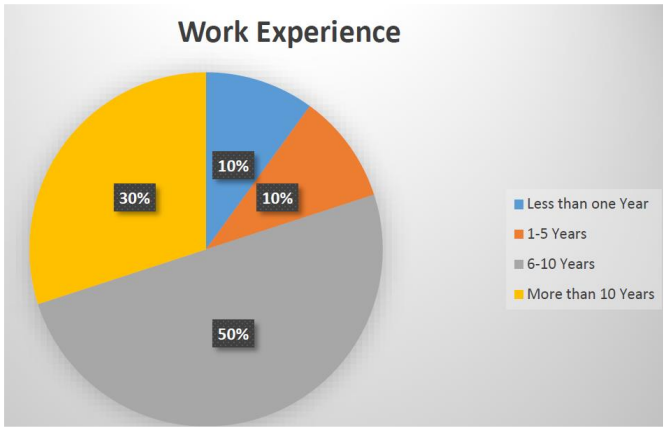

Fig. 8. Work Experience of the candidate in the construction industry

This question was asked to establish the number of years of work experience the candidate had in the construction industry. As shown in the bar chart above, most respondents had 6-10 years' experience, whereas 1-5 years' experience was around 10% and more than 10 years is around 30% as shown in Fig. 8. This justifies and conveys the level of expertise in the field and experience in the industry, which will now guarantee the outcome of results and findings of the research to be of very respectable quality and knowledge within the questionnaire analysis.

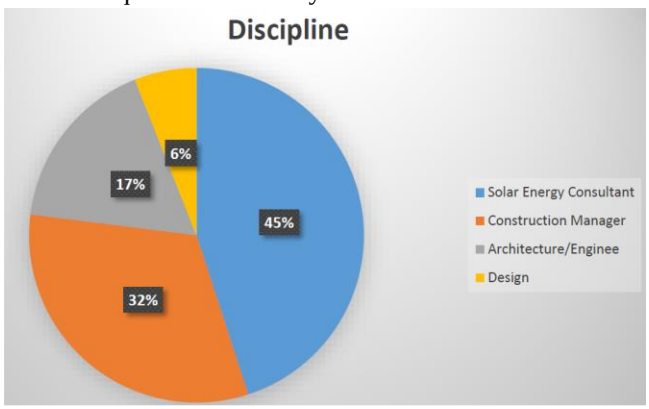

Fig. 9. Discipline in the field

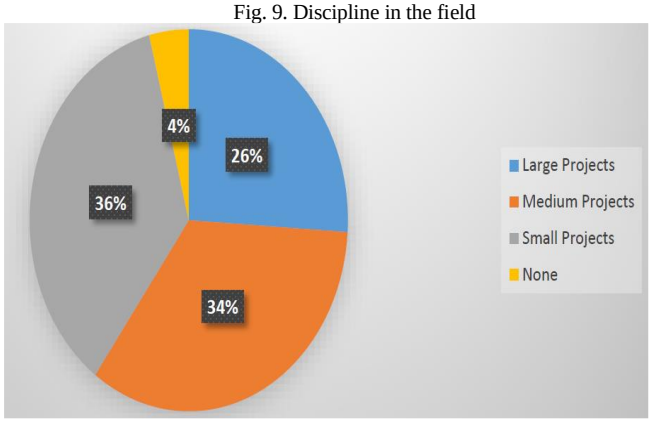

Fig. 10. Usage of solar panels in projects

Fig. 9. above illustrates the difference in the discipline within the construction industry. Most of the respondents are of solar energy consultancy background with around 45%. In second place followed by construction managers scooping up 32% closely followed in third place by Architecture/Engineering consultants with a percentage of 17%. Design consultant respondents only covered 6%. The bar chart in Fig. 10. is demonstrating that; out of the 30

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respondents, 26% established that their organisation has used solar panels in large projects whereas 34% had used solar technology in medium projects and 36% in small projects. 4% of the respondents to the questionnaire had never used solar panels in any projects.

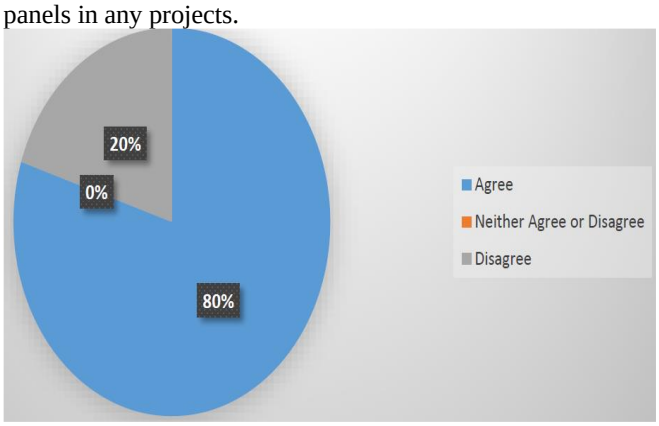

Fig. 11. If solar panels have more benefits than its limitations

The bar chart above represents the views given by the respondents to this question of whether they believed solar panels offer more benefits compared to its limitation in the housing sector. Results-wise, 80% of the participants viewed that solar PV outweighs any negative/disadvantageous stigma attached to the implementation of this solar technology in the housing sector. The interpretation of this result, greatly suggests the acknowledgement of having this renewable energy in the housing sector.

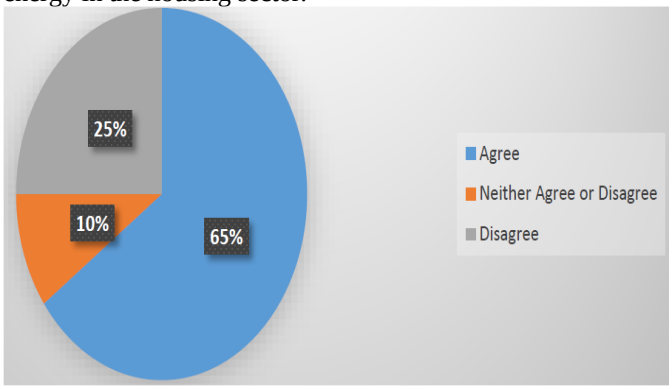

Fig. 12. Solar Awareness problem

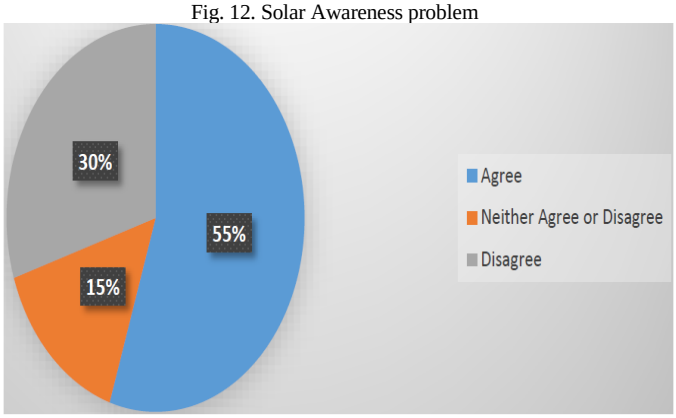

Fig. 13. The issue around the struggle of solar panels offering enough of a financial gain to warrant their use

This bar chart is in Fig 12. conveys the views given by the respondents to my questionnaire aiming to find whether there is an awareness/educational barrier to the implementation of solar panels. Astonishingly, 65% of the respondents believe that there is a lack of awareness of the implementation of solar panels to be used in the housing sector, with only 15% disagreeing. This clearly shows that UK construction professionals believe that due to a lack of awareness of Solar PV that is directly proportional to the fact there is a low number of installations capacity rate.

The bar chart above in Fig. 13 represents the views of the 30 correspondents of the questionnaire aiming to find out whether solar PV implementation struggles to offer enough financial gain to warrant its use. 55% of the respondents believed that solar panels don't offer a financial gain to warrant their use, whereas 30 % disagreed. This large percentage of the respondents could be since there is no awareness and issue of promoting solar PV implementation in the UK construction industry by companies and professionals. Furthermore, the fact that solar PV implementation benefits in terms of saving and financial gain, the financial gain aspect will take time before any profits can be generated.

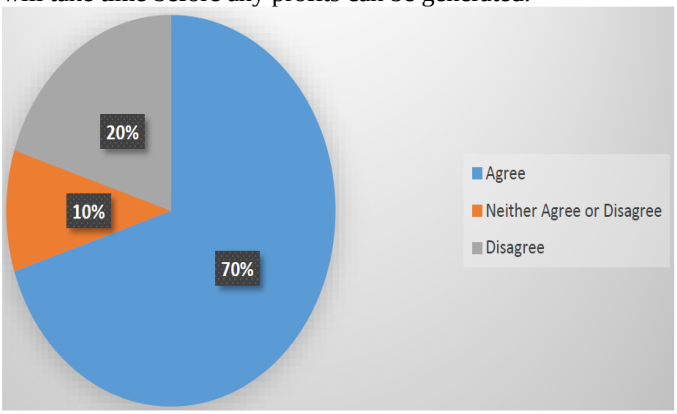

Fig. 14. Solar implementation issue in the UK

Fig. 14. represents the views of the 30 correspondents of the questionnaire aiming to find out whether solar PV installation is in a crisis in terms of the rate of solar PV being installed across the UK sector. Incredibly, the results show that the majority (70%) of the respondents believe that there is an issue with a solar PV installation. 20% interestingly chose the option of 'neither agreed nor disagreed and 10% completely disagreed. With most of the respondents believing there is an issue, this clearly emphasises the lack of awareness which is contributing to the low number of installations. On the Other hand, The chart in Fig. 15. represented the views of the 30 correspondents of the questionnaire aiming to find out whether solar PV implementation is too risky to invest in from a liability standpoint to warrant its use. Out of the 30 respondents, 50% agreed that there is a risk involved from a liability standpoint to make it a reality. 35% were unsure and chose to reply with the neither agree nor disagree option and 15% disagreed with it. The high percentage of most of the respondents agreeing with the statement is not a complete shock due to the nature of this renewable energy. There are unanswered questions regarding its liability in terms of efficiency and maintenance which could have contributed to the professionals of the UK construction industry agreeing with the question.

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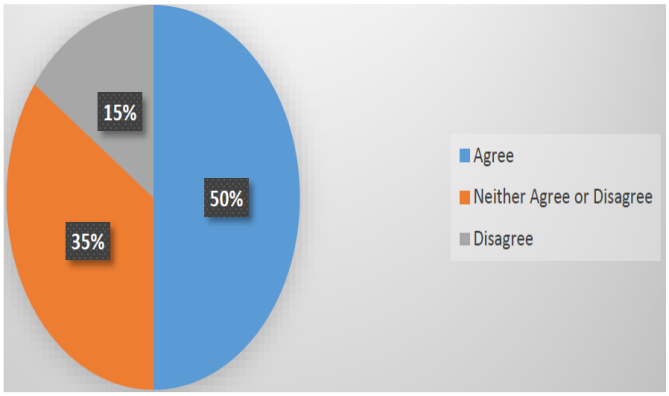

Fig. 15. The issue around the struggle of solar panels offering enough of a financial gain to warrant their use

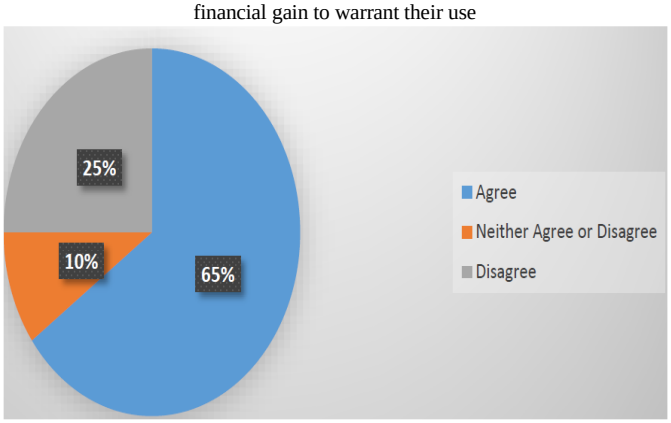

Fig. 16. Lack of government initiatives

The bar chart above represents the views of the 30 correspondents of the questionnaire aiming to find out whether there is a lack of government initiatives to raise awareness but most importantly make people consider solar PV implementation. Out of the 30 respondents, 65% agreed that there is an issue regarding government initiatives to make people contemplate the realisation of implementing solar PV. 25% disagreed with this and only 10% neither disagreed nor agreed. According to the FIT (feed-in tariff) records, solar PV implementation has been growing steadily until the last couple of years when there has been a standstill in installations. With further funding cuts and subsidised, the future of this renewable energy being utilised more frequently is in doubt.

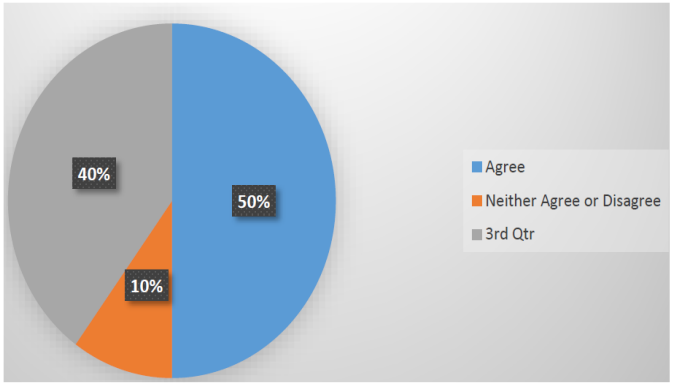

Fig. 17. If solar implementation outweighs the costs to implement it.

The bar chart above represents the views of the 30 correspondents of the questionnaire aiming to find out whether the benefits of solar PV outweigh the costs to implement solar technology. 50% of the respondents firmly agreed that even though there are benefits to implementing solar PV in the housing sector, there was a large number who also disagreed totalling 40% and 10% unsure about it. With over half of the respondents believing that the benefits outweigh the installation's costs, this represents a general admission of concern and doubt that is within the UK construction industry by professionals. However, such a big difference in views – shows there is still a shortage of understanding of solar PV hence there is still optimism regarding utilisation and implementation soon.

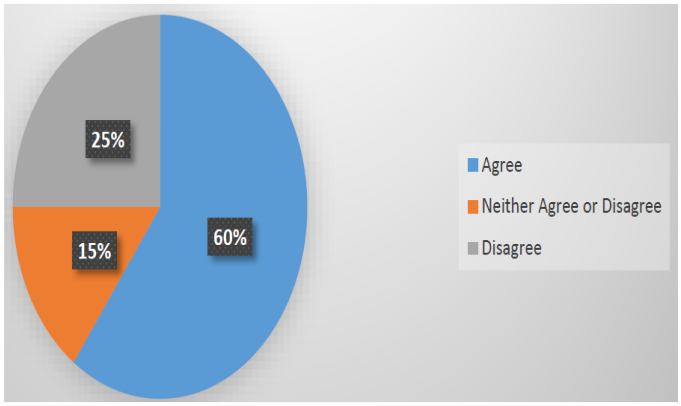

Fig. 18. Issue surrounding companies' lack of promotion of solar energy

The bar chart above represents the views of the 30 correspondents of the questionnaire aiming to find out whether the issue of companies involved in the solar sector's lack of promotion contributes to the low number of solar PV installations. Interestingly, most respondents (60%) agreed that there is a lack of promotional awareness of solar PV implementation. It suggests that the construction professionals within the UK believe if there was more awareness, consequently there would be solar implementation. 15% disagreed with 25% being unsure whether companies are doing enough. Amusingly, the 25% of professionals who disagreed suggest that they believe there is no barrier and companies are doing all they can – with the lack of installations coming from the uncertainty of the premature renewable energy factors that are arguably scaring any new potential customers.

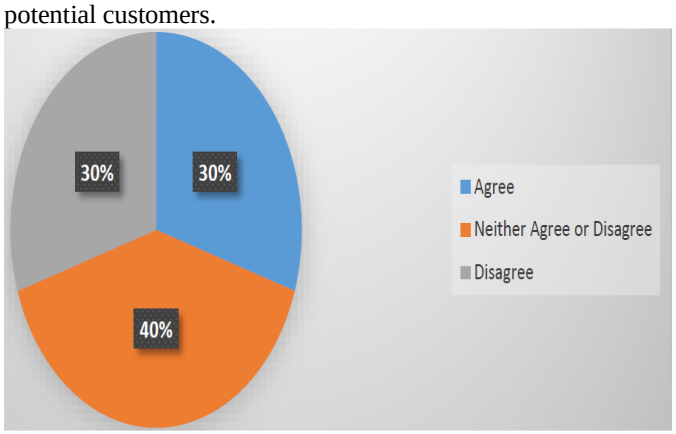

Fig. 19. If solar implementation relies on international experts.

The bar chart in Fig. 19 above represents the views of the 30 correspondents of the questionnaire aiming to find out whether solar panels implementation for the housing sector relies on international experts. A very mixed view was collected regarding this question. As 30% of the participants agreed which was the same for the number of people who disagreed. Interestingly, 40% were unsure if international expertise is needed and relied on for solar implementation in

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the UK. For professionals to have a such high level of uncertainty when it comes to solar technology – clearly emphasises the shortage of understanding and confidence in this renewable energy that could be very beneficial if utilised.

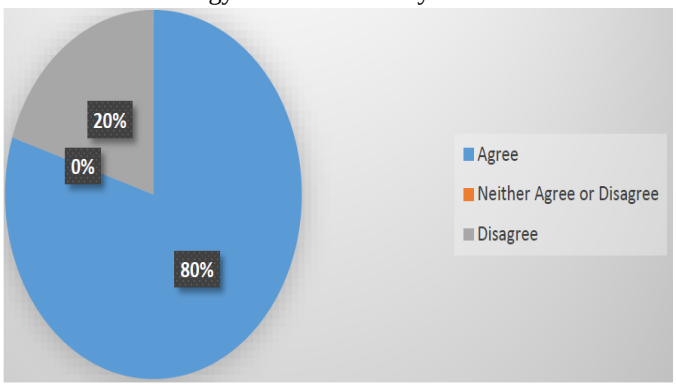

Fig. 20. Issue regarding the efficiency and reliability of solar panel's performance

Fig 20 represents the views of the 30 correspondents of the questionnaire aiming to find out whether the dangers of reliability and efficiency of solar panels performance is a barrier for users to implement solar PV. Out of the 30 professionals who answered the questionnaire, 80% agreed there is an issue of reliability and efficiency which is creating doubt for potential users of solar PV. However, 20% disagreed suggesting that there is no real issue. With most people agree that these two factors contribute to the shortage of installations and the slow solar PV implementation capacity rate. As mentioned earlier, maintenance of solar panels is essential for it to work to a very high standard hence why there are still unanswered questions surrounding solar PV's potential benefits to the UK construction industry.

IV. CONCLUSION AND FINDINGS

This study was to investigate the emerging market for renewable energy in the form of solar energy but most important the issues surrounding the implementation of solar PV panels in the housing sector. The research considered factors such as limitations and barriers to solar and the socio-economic ethical arguments relating to the issue that contributes to the lack of installations in the UK for the housing sector. The data were collected to further develop an understanding and come to a consensus on why there are a shortage and blockades about solar energy being utilised as the main energy source. The methodology chosen for this investigation had to be a mixture of the main research methods, quantitative and qualitative. The basis of using a mixed approach was to create an investigation that contained an in-depth analysis of the topic of solar panels implementation.

Objective 1 was looking at the usage and implementation of solar energy as a mainstream energy source in the UK. The study conducted by (Moriarty and Honnery, 2012) concluded that renewable solar energy can provide a sustainable life cycle to make it an option to be used as the main energy source. In addition, the study done by (Van Vuuren, D.P., ET a 2011), further explained and agree that solar panels can only be to beneficial use in terms of potential dangers are limited such as the introduction of emitting harmful gases to the climate. Objective 2 was the evaluation of the demand for solar power globally and domestically. As mentioned before, renewable energy is the latest development in technology to hit the UK construction industry. According to one of the biggest solar associations, Solar Trade, the demand in the UK has been on the rise directly making the UK one of the top brackets for global markets for installed solar PV capacity. The demand is solar energy installations has engrossed close to around £6.4b in private sector investment in the last three years. (Solar Trade, 2017). Although private investments have been of recent surge, this has complications as this will influence the public sector meaning that potentially higher tariffs costs for implementations. However, the results from the questionnaire, indicate that professionals still believe that the potential financial gain outweighs that of the costs to implement solar PV.

One of the main key points of the research investigation was to identify what is stopping solar energy from being implemented and what are the greatest problems that it is facing. After analysing web journals and case studies such as Macalister (2016) and RGS Energy (2017), there is a consensus that solar energy provides a sustainable option in making the main source of energy but there are limiting factors such as the lack of operational efficiency and stable governmental initiatives schemes. With the uncertainty of governmental agendas, cuts can happen at any moment putting a cloud over the development of solar implementation in the housing sector. As recently as 2016, the government cut 65% of funding further highlighting the incompetence and unreliability of such schemes. Furthermore, the data analysed from the questionnaire, questions 5 and 6, indicate there is a fundamental issue in the promotional sides of making people consider solar panels and that nearly 50% of the respondents believe there is a liability standpoint which contributes to the fact there is a shortage of interest or that they also agree with the studies mention of insufficient efficiency levels of the solar PV.

The final objective is like the first objective but his time there was an emphasis looking at identifying the implications behind the implementation of solar energy within the housing sector. After analysing the data thoroughly regarding this objective, I have concluded that the absence of sustained awareness by companies and the government has led to the shortage of installations across the UK. As can be seen in the Appendices from the questionnaire, 65% of professionals in the UK construction industry agree with the fact that due to this barrier, the implication of this being there has been no real significant growth in comparison to other major countries such as China and the USA. In comparison to other climates such as Africa or Asia, the climate in the UK is known as temperature maritime consisting of cool summers and milder winters, meaning that solar dependency is an issue due to the fact energy can't be produced when the sun sets or when heavily shaded as the solar PV panels will stop working. (CleanTech, 2016). Regarding the interview, this gave me a fresh insight into what the perception of a construction industry professional had to say regarding solar implementation. One question asked was what the socio-economic arguments related to implementing solar PV, and he clarified clearly that there are still doubts as to whether solar panels are efficient enough but highlighted that there is huge

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potential in the use of solar power. This is backed up in my literature review where I found that solar panels do not generate when the sun is heavily shaded or when the sun goes down (Shahan, 2018).

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