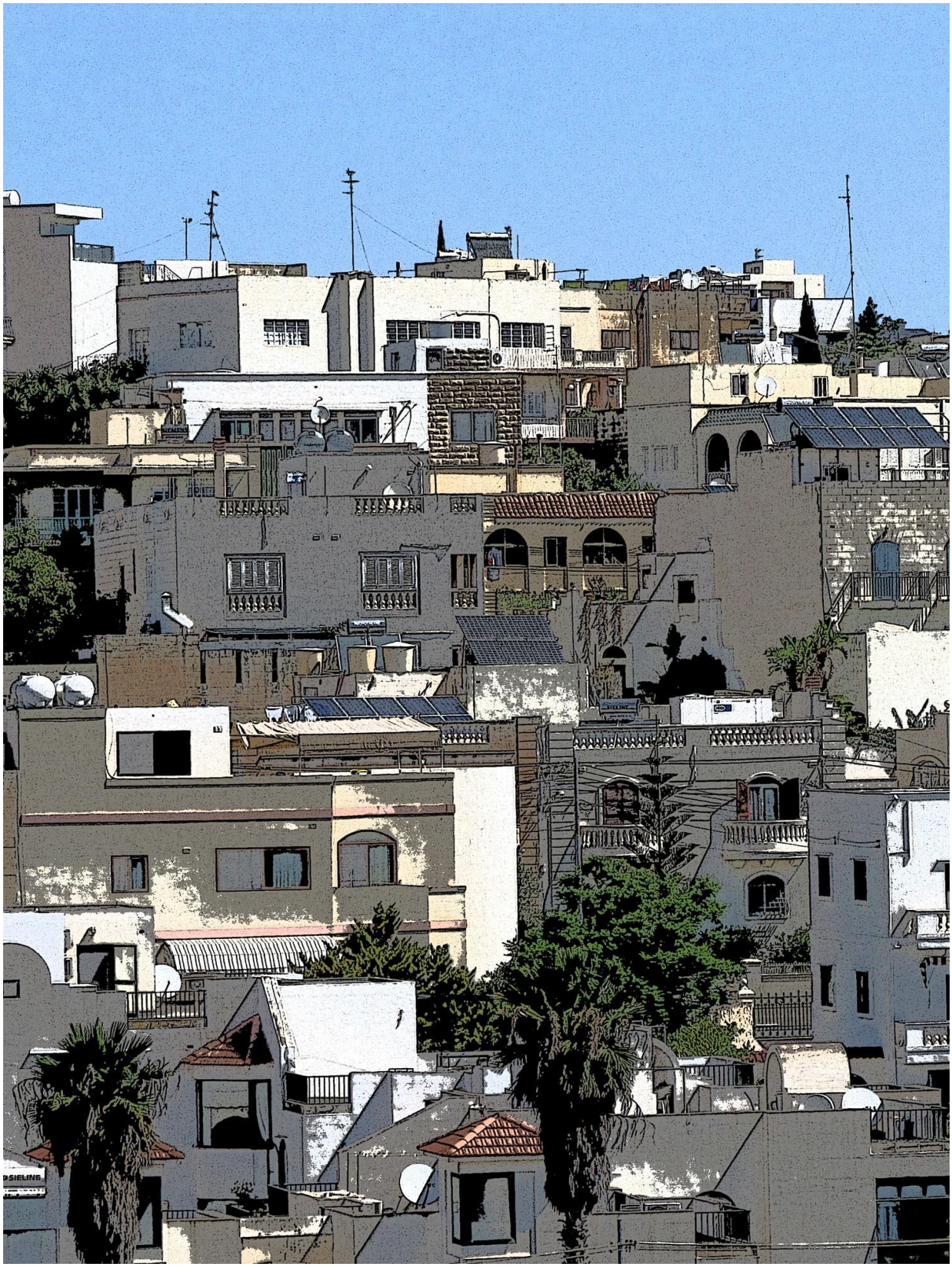


LifeMedGreenRoof Project

Monitoring the Perception of the Target Audience

LIFE12ENV/MT/000732

LifeMedGreenRoof Project

Contents

Executive summery

During the course of the LifeMedGreenRoof Project and as part of Action C3, five questionnaires were circulated to establish how the stake holders' perception of green roofs have changed. Through media channels, the project conducted various activities to inform stake holders about green roofs and their benefits. Stake holders mainly included the general public, education sector, the design industry and the policy makers. A general questionnaire was circulated towards the first half of the project whereas a second general questionnaires was circulated towards the latter half. Two other studies not envisaged in the project proposal were carried out to assess the perception of the staff members of the Faculty for the Built Environment following the construction of the demonstration green roof. The aim of this study was to understand whether green roofs did actually effect people's lives.

The design of the first questionnaire spanned further from the issue of green roofs by including aspects of green infrastructure and energy efficiency in buildings. This was done to better appreciate people's understanding of the benefits of green infrastructure, (of which green roofs is one) and the why and what is understood by alternative energy. The questionnaire also attempted to gather information about the prevalent media sources to concentrate efforts in information dissemination.

The questionnaires were published on line following the consideration of other possible methods. This has resulted in the targeting of a selection of the population, mainly the middle class. Targeting the middle class was important as it constitutes the largest sector of the population.

Through the media activities conducted by the project, and as confirmed by the questionnaires, the perception of stake holders towards green roofs increased. More people are now aware of what green roofs are and what their purpose is when compared to the situation prior to the commencement of the project.

The way that information was disseminated proved important. Internet proved very effective. The use of a website and better still social media widened the catchment area. Publication of articles and press releases exposed stake holders to the concept of green roofs. However, the demonstration green roof proved to be the most effective way of altering the perception of stake holders. Many were those who perceive green roofs as being difficult to establish locally. Through the demonstration green roof, stake holders could see that green roofs can be a reality in Malta and that issues such as water leaks are curbed with the proper workmanship and the right construction methods.

From the questionnaire conducted at the Faculty, it did transpire that the green roof has in fact increased the quality of life of those with views onto the green roof. This was mainly associated with better views and the increase in biovidersity.

Monitoring of the impact of the project actions – Action C3

Actions C, 'Monitoring of the impact of the project actions' is an obligatory action.
The scope of this action, C3, is to analyse the change in green roof perception during the course of the project. Through this action, the opportunity was taken to create a base line study on issues related to green roofs. The questionnaire would also serve to guide the project team on ways and means of being more effective in delivering information about green roofs on a national scale and understand better the public's perception of green roofs. Green roofs in Malta are not prevalent. There has been no prior study by other entities nationally on why this is so and one can only speculate the reasons for this. The lack of interest in green roofs amongst the public, policy makers and design/construction sector is in contrast with the European counterparts considering the popularity of green roofing and green infrastructure in Europe and beyond. One has also to consider that in major European countries the authorities have enforced regulations and put in place incentives for the increase in roof greening in major cities. The latest of such initiatives has been instigated in France where all new buildings in commercial areas are to be covered by green roofs or photovoltaic panels.
So as to monitor the current state of affairs, three target audiences (stakeholders) were identified during the drafting of the proposal. These included:

- The general public
- The design and horticultural industry
- The policy makers.

Data Gathering

The action was divided into four parts as follows:

- An *initial questionnaire* was produced to create a baseline on the target audience's insight and understanding of green roofs and green infrastructure, three different questionnaires were created. Firstly, a web based questionnaire for the general public and secondly a face-to-face interview for policy makers and the design/horticultural industry.
  The on-line questionnaire was circulated through the project website and project Facebook page.
  Face-to-face interviews were conducted with the design professionals, horticultural industry and policy makers. This was done so as to guarantee feedback due to their hectic schedules.

- A *follow-up questionnaire* designed to evaluate the change in perception and understanding of green roofs. This follow-up questionnaire was circulated through Facebook and the project website. The layout was much simpler and the questions, unlike the former questionnaire, mainly referred to green roofs.

- Following the construction of the demonstration green roof, a questionnaire was designed to target the employees of the Faculty for the Built Environment. This questionnaire was not required by the project actions however this was an opportunity to evaluate in more detail and clarity whether green roofs have a psychological impact on people and whether this affected their well-being. Two questionnaires were published one on completing the construction of the green roof (*Initial perception* of the green roof) and a second a year later (*Change-in-perception* of the green roof). Both questionnaires were similar and were conducted via e-mail.

The Design of the questionnaires

Open ended questions were kept to a minimum. The main part of the questionnaire did not refer to green roofs only but included questions related to green infrastructure, alternative energy use and urban related problems. This was done to avoid informing and influencing the way the audience

answered the questionnaire, and to understand people's perception of green infrastructure, the urban environment and sustainable energy use, all of which are relevant to roof greening.
The questionnaire started with a question related to place of residence and profession/skills. This was followed by ten questions related to green roofs. Images of different roof settings were shown to establish whether people's perception of what a green roof constituted was correct. Questions addressed the importance of green roofs, the possibility of constructing green roofs, their benefits and their appropriateness in the local context.
The questionnaire proceeded with questions related to the lowering of the carbon footprint of buildings, energy efficiency in buildings and visual qualities of green infrastructure in an urban setting. This also included questions to assess how people perceive nature within an urban setting. Questions related to urban flooding and water management in urban areas were also included.
The final questions were related to media frequently used by the individuals filling the questionnaire, and other general personal data.
The questionnaire directed towards the policy makers was a condensed version.
A copy of the questionnaires can be found in the annex.

The second stake holder questionnaire was much simpler; it was aimed more at green roof issues and excluded questions related to green infrastructure. The questionnaire started with a query related to place of residence and profession/skills followed by a number of questions associated with green roofs, their benefits, importance and success in their installation. The final section of the questionnaire related to personal data.
Both the Initial perception of the green roof questionnaire and Changing perception of the green roof questionnaire have a similar layout. They do not request personal data, but request information about one's impression of the demonstration green roof and how the roof has effected the respondents' daily life at the office. As with the other questionnaires, open ended questions have been kept to a minimum.

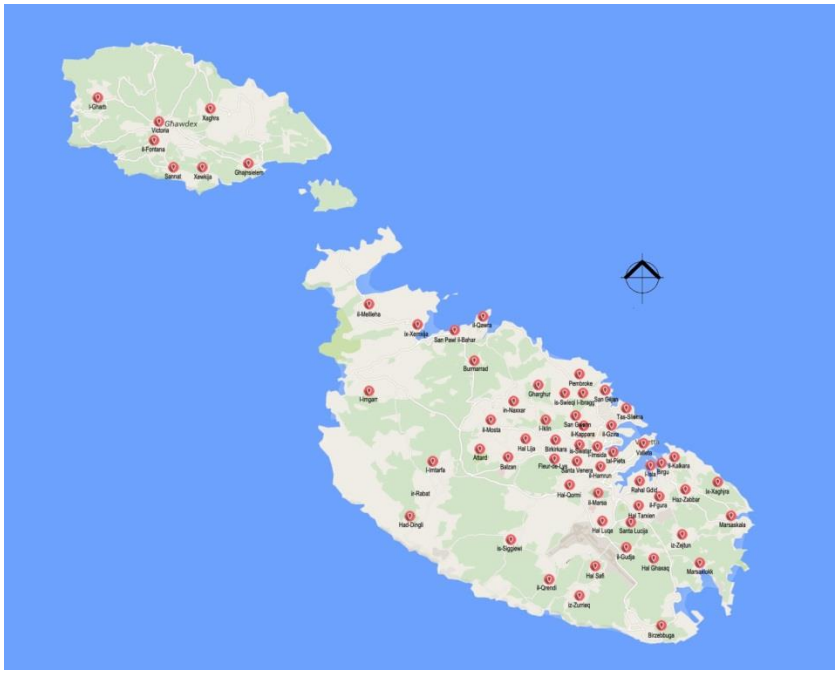
Number of questionnaires completed

Ref	Questionnaire type	Stakeholders	Questionnaires completed
1	Initial Questionnaire	General public, policy makers, design and horticultural sectors	300
2	Follow-up questionnaire		319
3	Initial perception	Faculty employees	13
4	Change-in-perception	Faculty employees	55

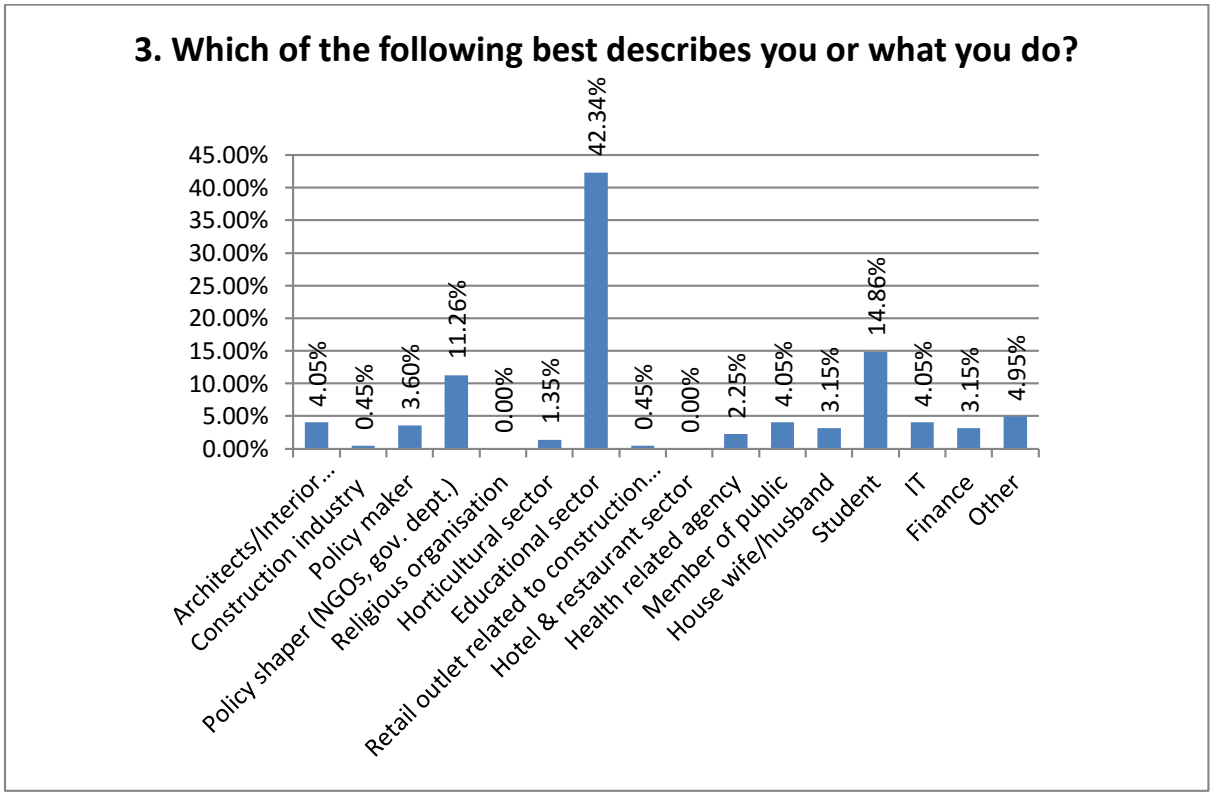
Result analysis

Initial questionnaire (Q1)

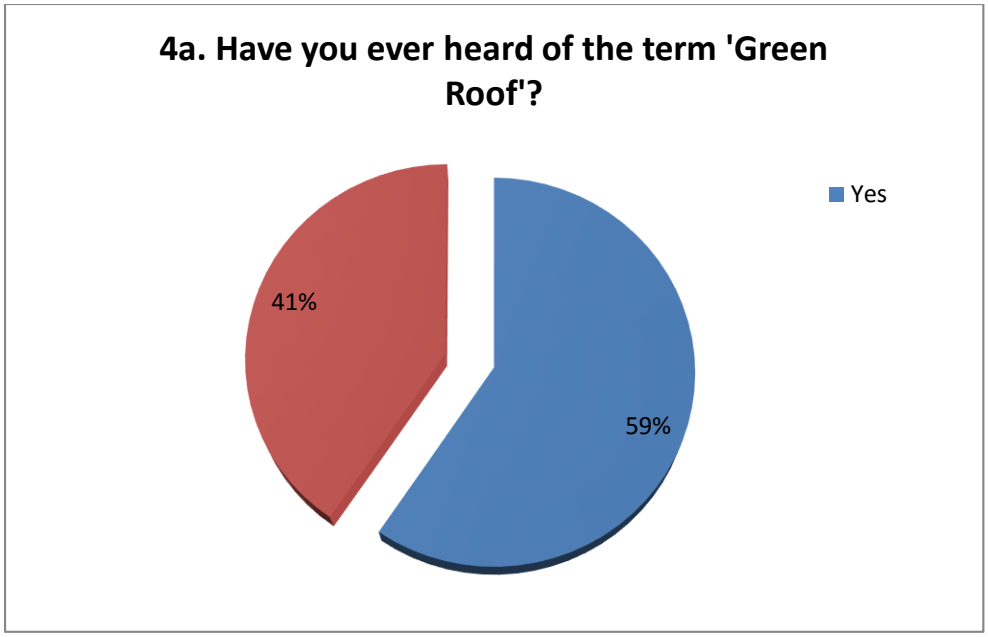
1. Where in Malta do you live?



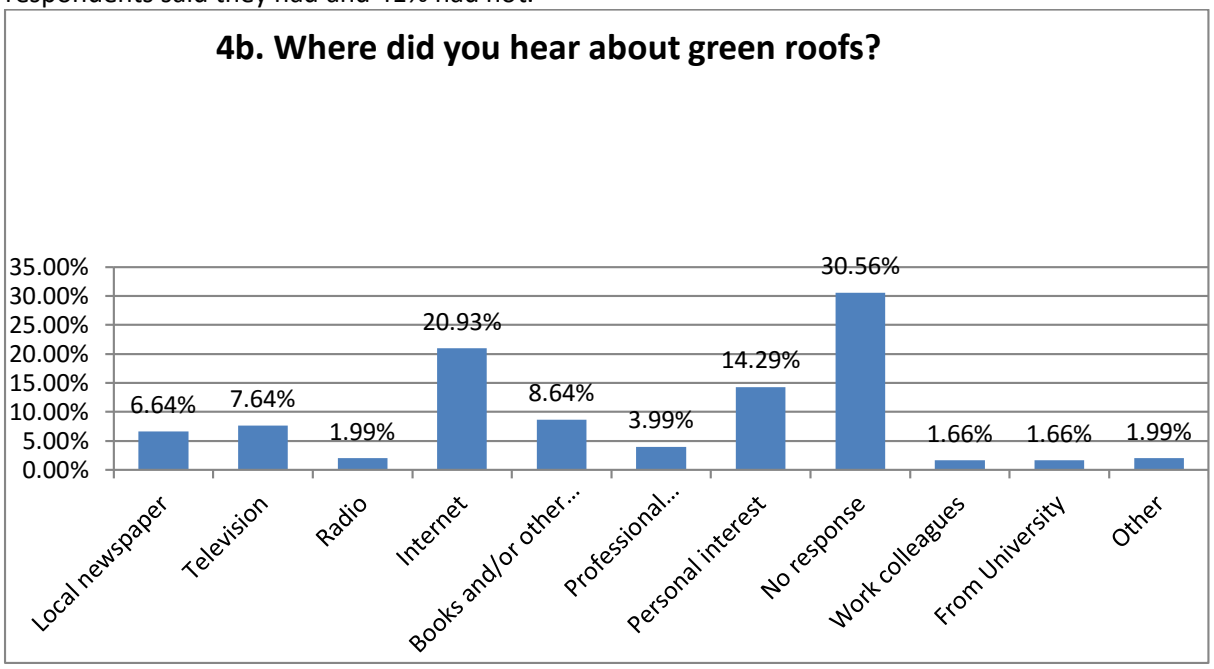
The above image shows the distribution of the respondents' over the Maltese islands. The distribution is fairly consistent with the distribution of the urban areas in both Malta and Gozo.



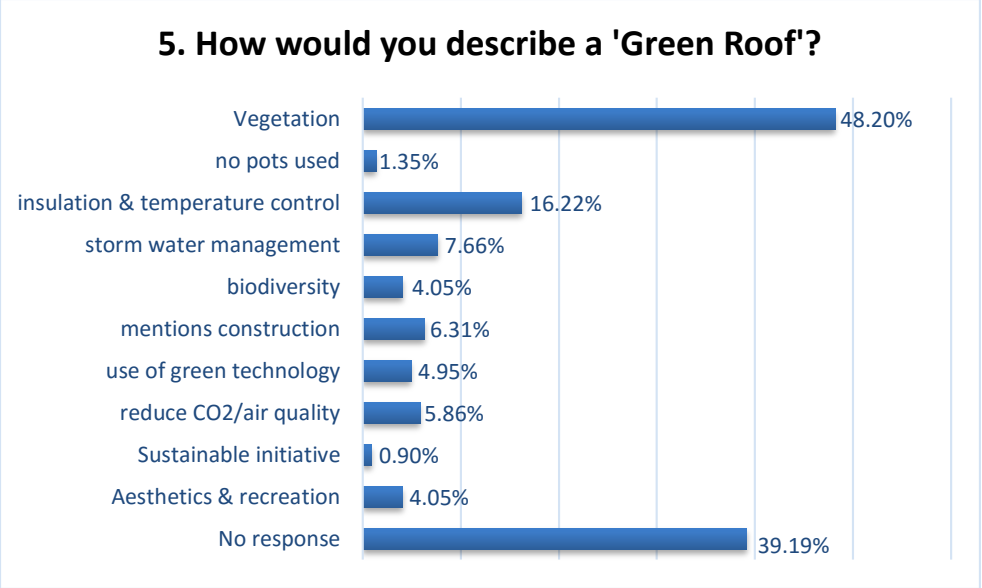
The above describes the profession or background of each respondent. Most of the respondents come from the Education sector with 94 questionnaires (42%), 33 students (14.9%), 25 Policy shapers (NGOs, government depts. etc) (11.3%) and 8 policy makers (.04%). The occupations of the core sample varied substantially from members of the design sector (Architects and other designers) to Health related agencies and general members of the public.



When the respondents were asked whether they had heard of the term 'Green Roof', 59% of the respondents said they had and 41% had not.



As can be observed from the above chart, 41% of the respondents did not answer this question. These include those individuals who have not heard of green roofs prior to the interview. 28% respondents claim that they have heard about green roofs from the internet, whereas 19% said they have learnt about green roofs through personal interest. 8.6% of the respondents heard about green roofs from books and other publications whereas 10% and 9% of the individuals heard about green roofs from television and the local newspapers respectively. 5% heard about green roofs from professional publications, 2% from the radio and other sources while another 2% individuals heard about green roofs from their work colleagues or from university.



When asked to describe what they understood by 'green roof', 39% of the respondents did not answer the question. This corresponds with the above question where individuals had never heard of the term green roofs. 48% of the respondents were aware that green roofs related to vegetation and in their replies mentioned that such roofs would include plants, are gardens, are roofs covered in grass or flowers. Just over 1% mentioned that the plants are not cultivated in pots and 4% mentioned that green roofs encourage or favour biodiversity. 16% mentioned that green roofs help in insulating the underlying building or that they help to regulate temperature. Almost 6% of the respondents said that green roof technology help reduce CO_2 or improve air quality. Just under 8% mentioned that the technology helps to manage run-off (absorb run-off, flood ablation) and 4% that such roofs increase the aesthetic value of the environment, enhance the urban environment and/or provide amenity. Over 6% specifically mentioned waterproofing as a component of green roofs, with an individual mentioning the need for a drainage system. Almost 5% of the replies stated that green roofs are related to the use of green/sustainable technologies such as PV panels and most did not associate green roofs with vegetation.

In question 6a-f images of various roofs were depicted. The participants were asked whether such roofs were green roofs or not. This was done to assess whether the respondents were able to identify a green roof or not. The correct answers are as follows:

Which of the following images is a green roof?	
6a	**yes**
6b	**no**
6c	**yes**
6d	**no**
6e	**no**
6f	**yes**

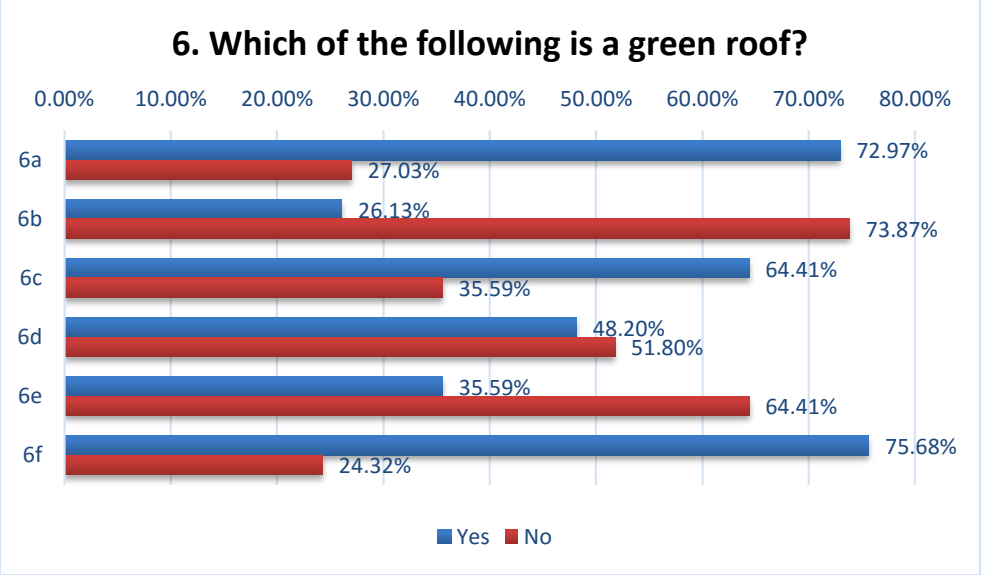
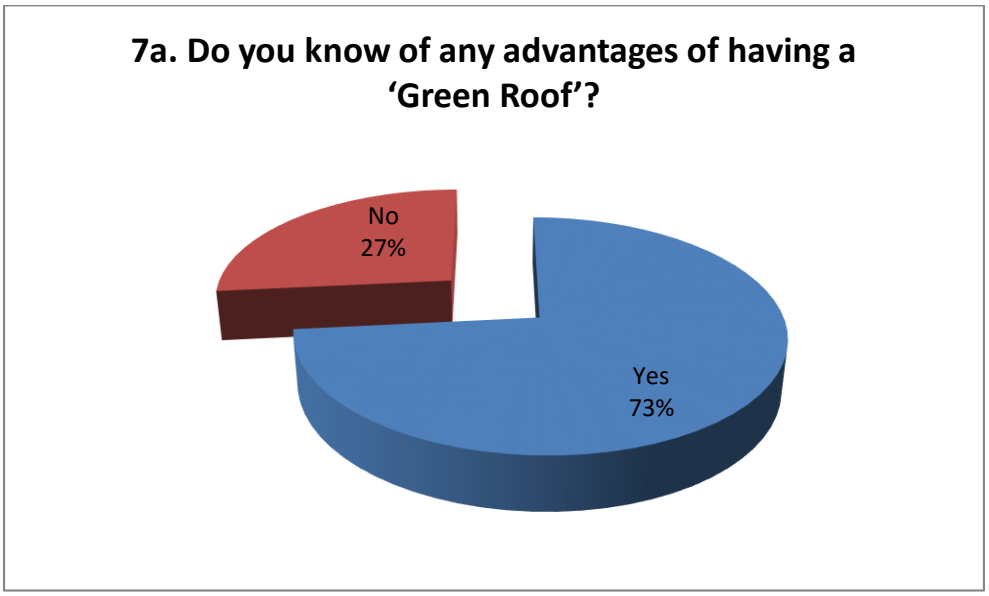
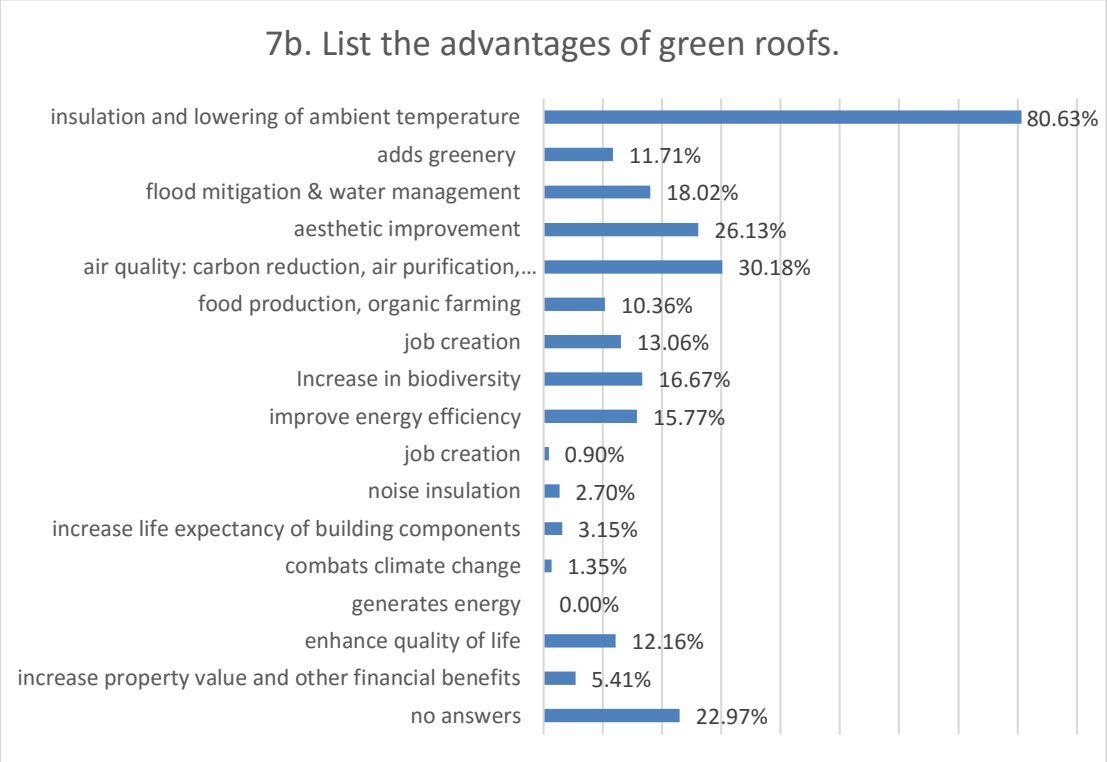


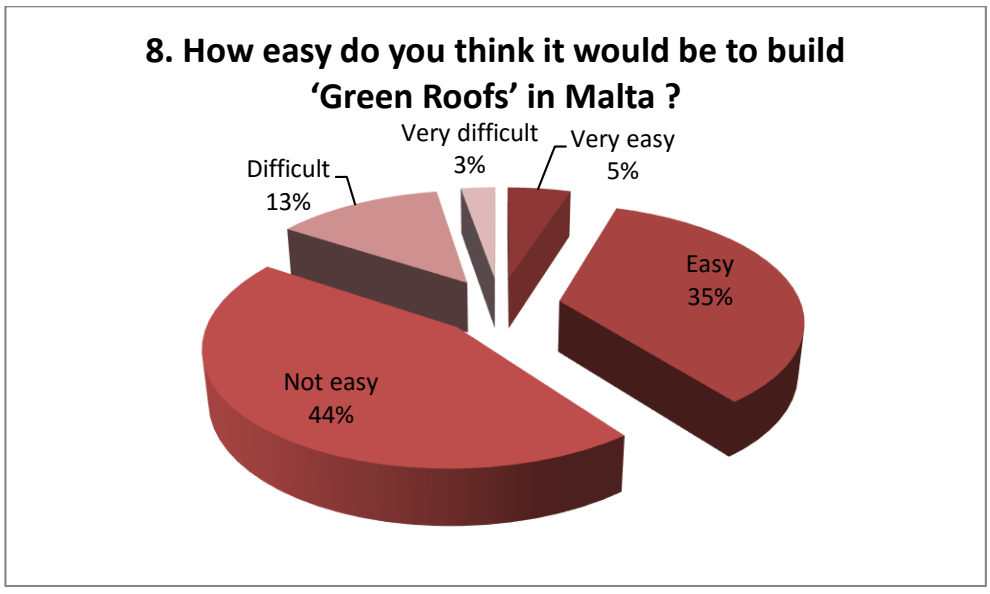
Image 6a illustrates a dwelling with a grass roof. Most of the respondents identified this as a green roof (73%) whereas 27% did not.
Image 6b constitutes a normal timber building with a conventional roof covered with a damp proofing membrane. 74% identified that the roof is not a green roof whereas 26% said that the roof is a green roof.
Image 6c illustrates a dwelling with a green roof composed of sedums. 64% acknowledged that this was a green roof while 36% of the respondents did not identify it as a green roof.
Image 6d-e illustrates a roof/terrace which had been designed for amenity purposes. Both images show a degree of planting but the composition is mainly composed of hard landscaping. Furthermore, in image 6d the plants are cultivated in pots. For image in question 6d 48% said that the image does represent a green roof whereas 52% said that it does not represent a green roof. In question 6e 36% of the individuals identified the image as a green roof as opposed to 64% who said that the image does not constitute a green roof.
Image 6f is a semi intensive green roof. 76% of the respondents did identify it as a green roof whereas 24% did not.
Questions 7a and 7b asked whether the respondents know whether green roofs are beneficial.



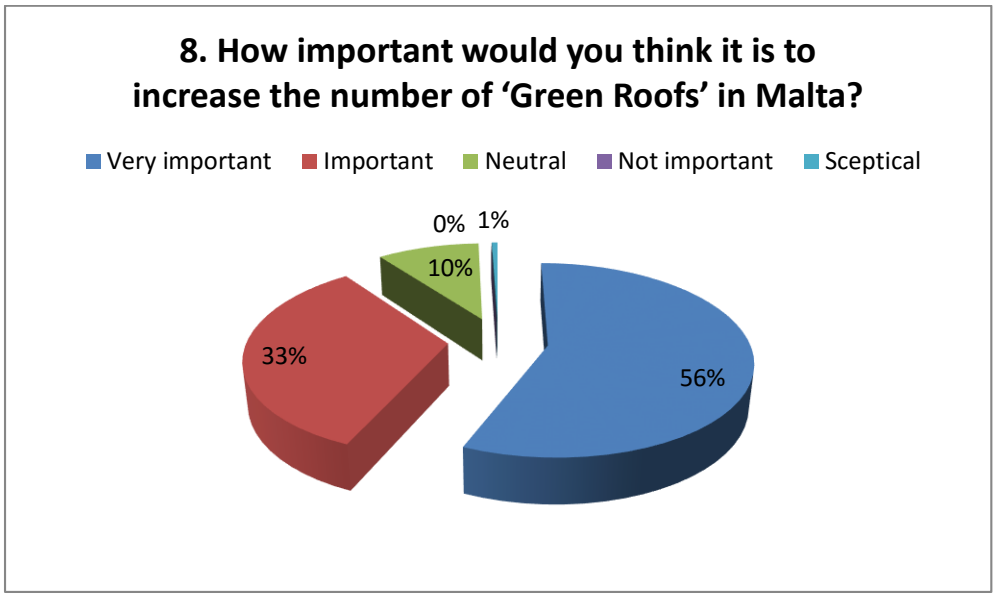
73% claimed that they are aware of benefits of installing a green roof and 27% did not.



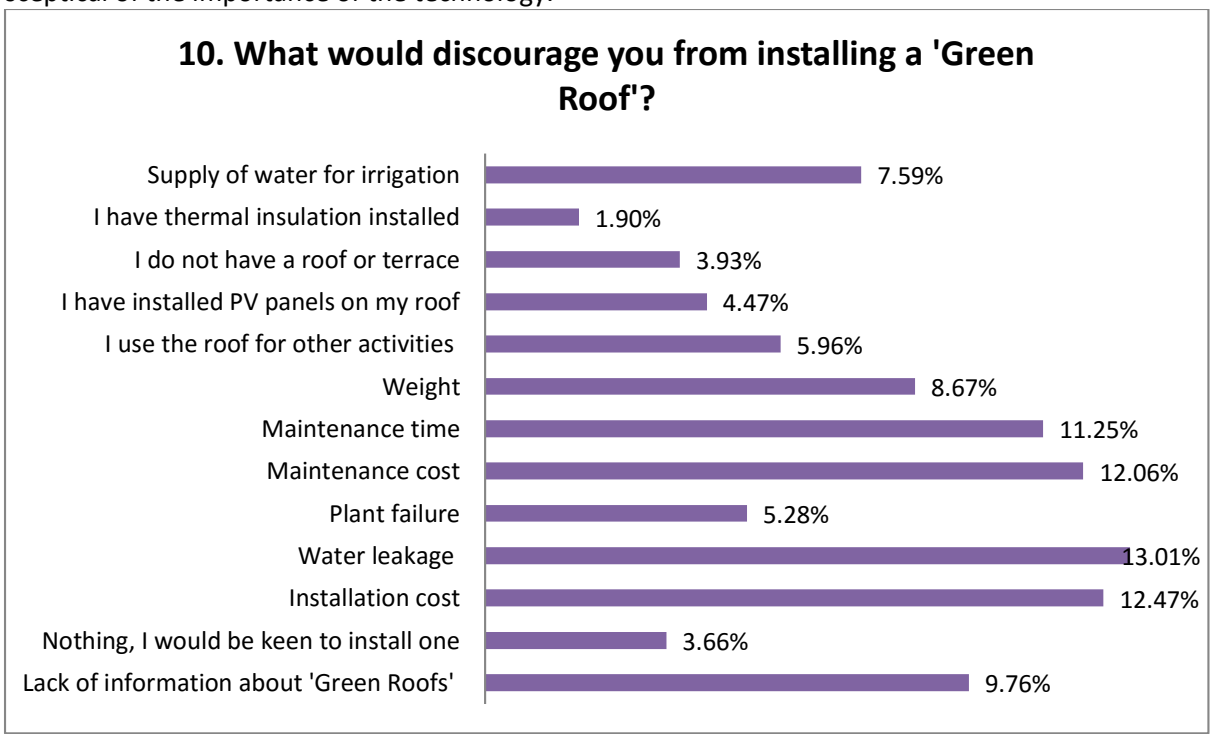
Of the total respondents, 81% indicated that they are aware that green roofs have an effect on temperature related to the building. 30% mentioned that green roofs can be used to capture pollutants from the atmosphere or/and ameliorates air quality. 26% said that green roofs can be used to improve the aesthetic value of urban areas while 18% indicated that green roofs would have an effect on flooding or contribute towards water harvesting.
23% of the respondents did not reply to this question.



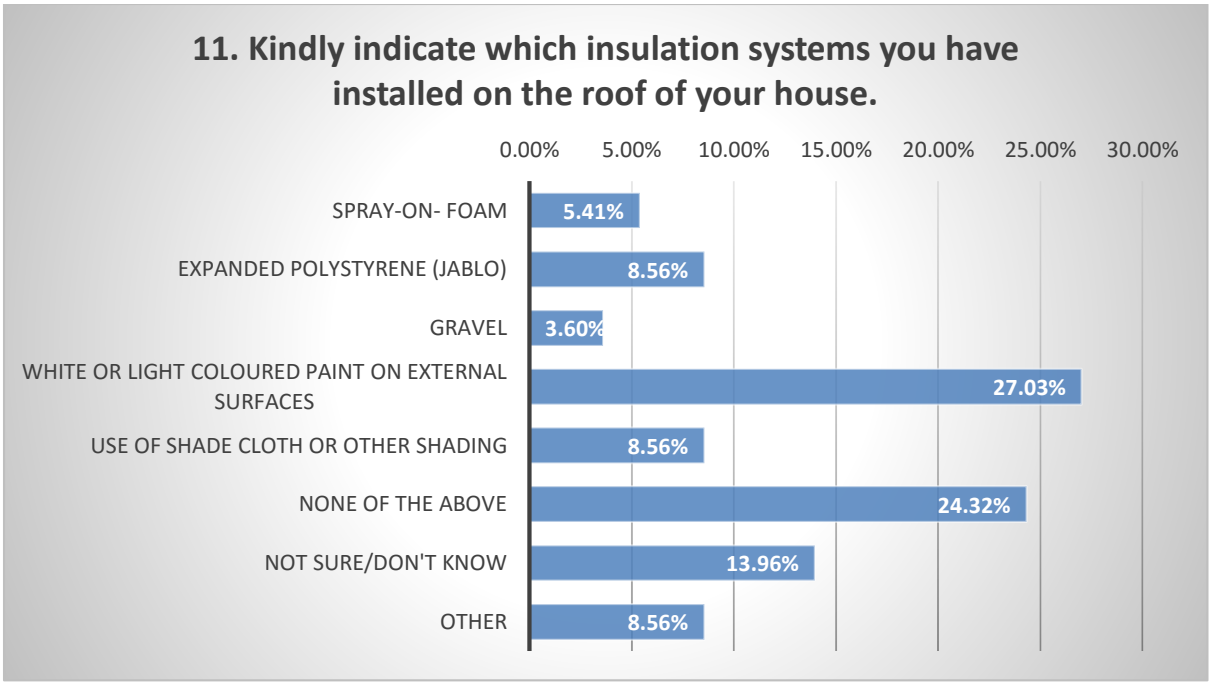
When confronted by the ease at which green roofs can be built in Malta, the majority (44%) think that it would not be easy whereas 35% think that it would be easy. 13% think that it would be difficult where as 3% think it would be very difficult.



Only 186 individuals replied to this question. 56% replied that it is very important to increase green roof coverage, 33% think it would be important and 10% of the replies were neutral. Only 1% were sceptical of the importance of the technology.



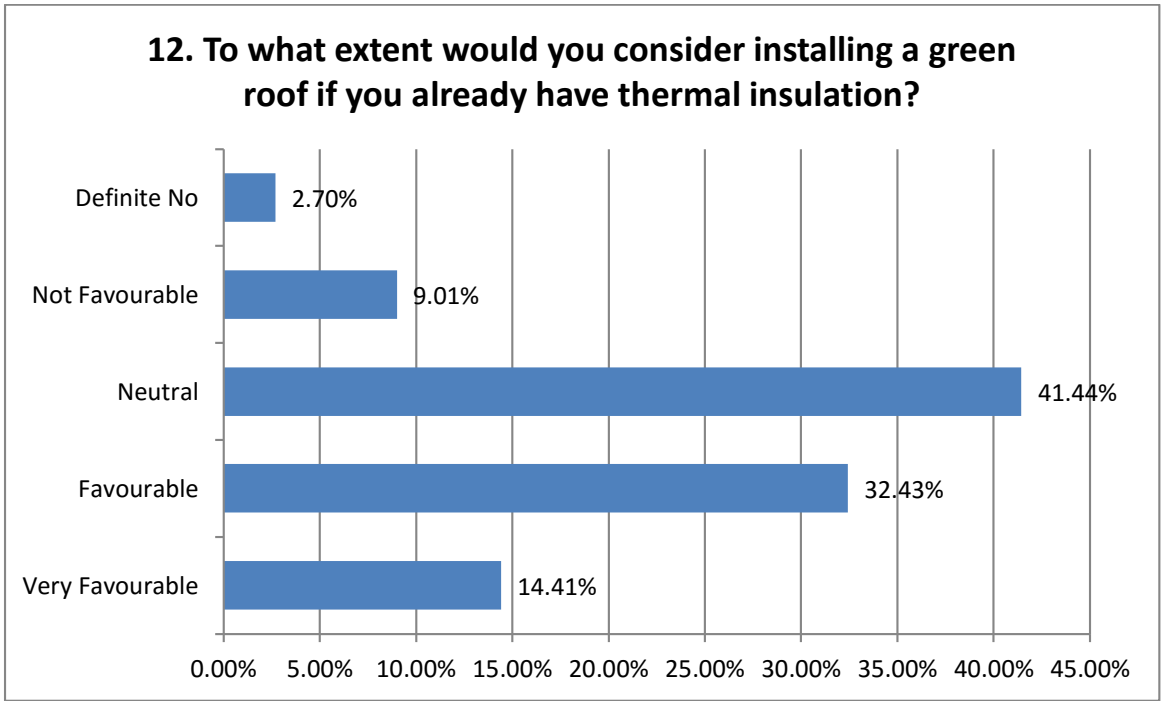
To further understand the barriers of constructing green roof we asked what would discourage the public from installing a green roof. The most common concern is water leakage followed by installation cost (96% and 92% respectively). 89% of individuals indicated maintenance cost as being a problem while 83% indicated maintenance time.



This question was asked because many households have some sort of insulation system or shading installed on the roof given that summers are very warm and a major temperature discomfort in buildings. 24% however do not have insulation systems installed. The reason behind this could either be because they simple have not done so, because they live in an intermediate or ground floor apartment other than the top floor or because they do not own/have access to the roof.

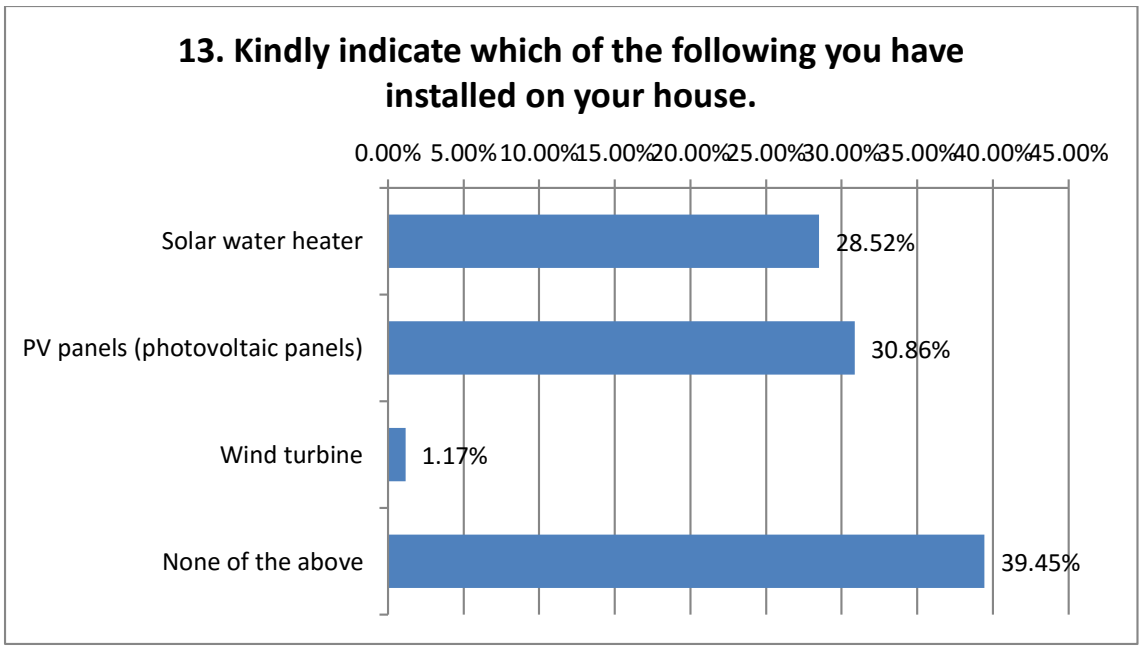
27% use light coloured surface paint on the roof to reduce heat absorption by the roof slab whereas only 5% and 9% of those interviewed have used spray-on-foam and expanded polystyrene respectively as a means of insulating the roof. This might be because such insulation is only found on buildings constructed within the last 20 years or so.

The use of a shading device such as a shade cloth is relatively common at 9% whereas 14% of those interviewed were not sure as to whether they do have insulation.

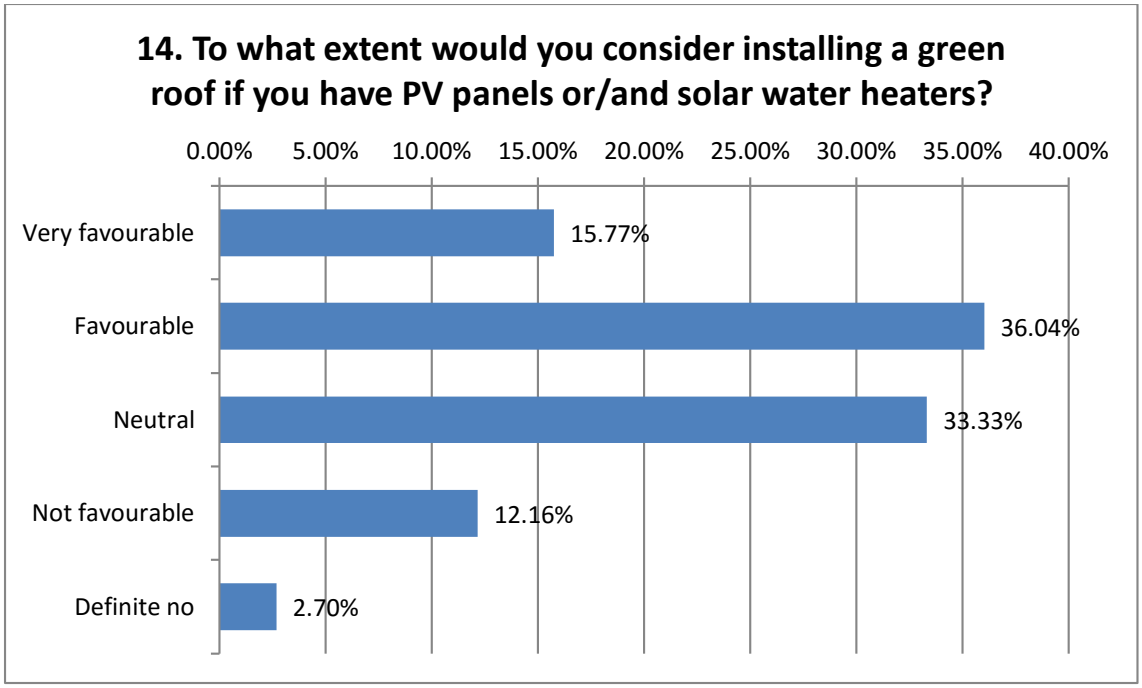


This question is relevant because as opposed to green roofing, installing insulation on the roof is an established practice especially in new and restored dwellings. From the questionnaire it transpires that 41% of the respondents had a neural attitude towards green roofs; this could indicate a lack of appreciation about the benefits of green roofs. However, 32% where still in favour of installing green roofs and 14% of those interviewed were very favourable to the idea. On the other side of the scale, only 9% were not in favour and 3% of those interviewed said that they would definitely not install a green roof.

The following questions were asked to assess the public's attitude towards alternative energy and green infrastructure.



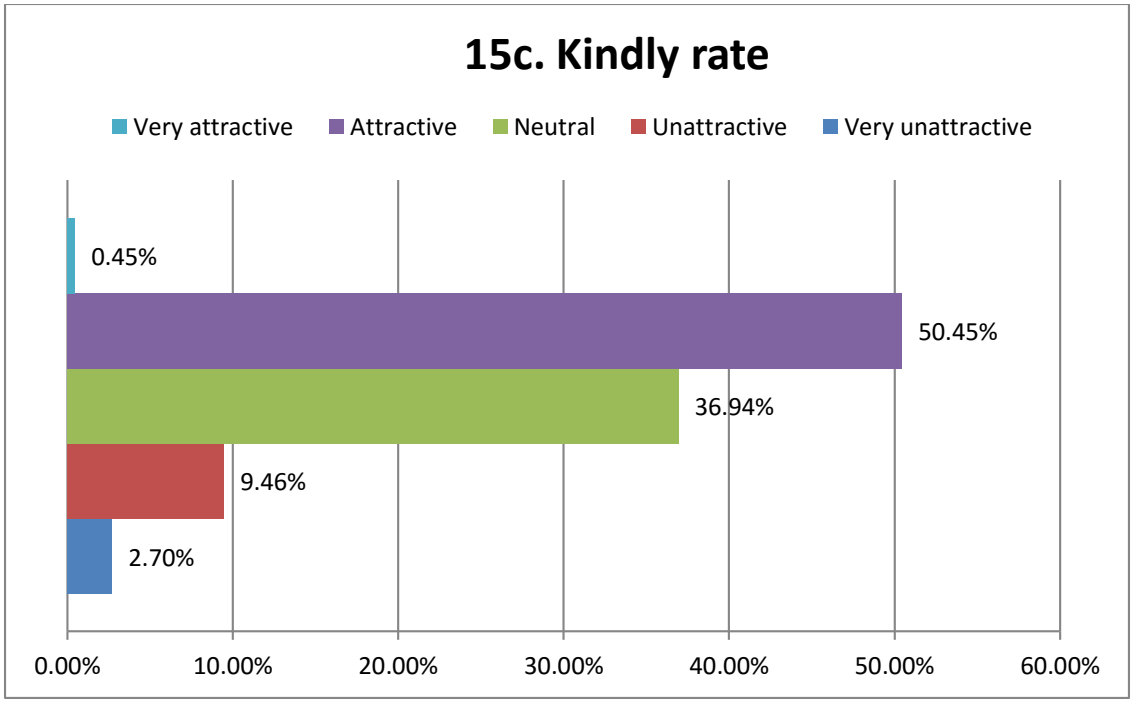
39% do not own means of generating alternative energy. 31% own photovoltaic panels whereas 29% own solar water heaters. The use of these systems has increased drastically since government grants were introduced.



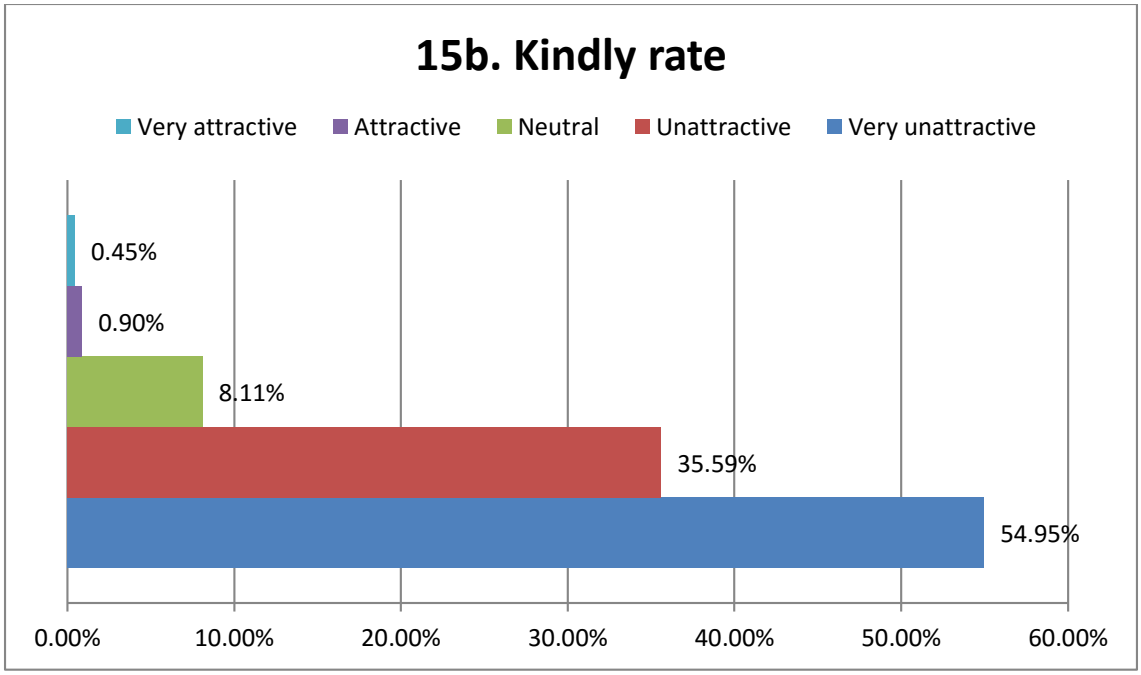
Green roofs have the ability of lowering the ambient temperature around it. This means that photovoltaic equipment would generally perform better as heat tends to decrease efficiency. PV panels tend to loose efficiency when air temperatures rise beyond 24°/25°C. Through evapotranspiration and through shading and other factors, green roofs lower air temperatures rendering such equipment more efficient.

When asked whether green roofs would be considered if PV panels and /or solar water heaters had been installed, 36% replied favourably and 16% very favourably whereas 12% and 3% of the respondents were not favourable or definitely not in favour of installing a green roof. 33% gave a neutral answer.

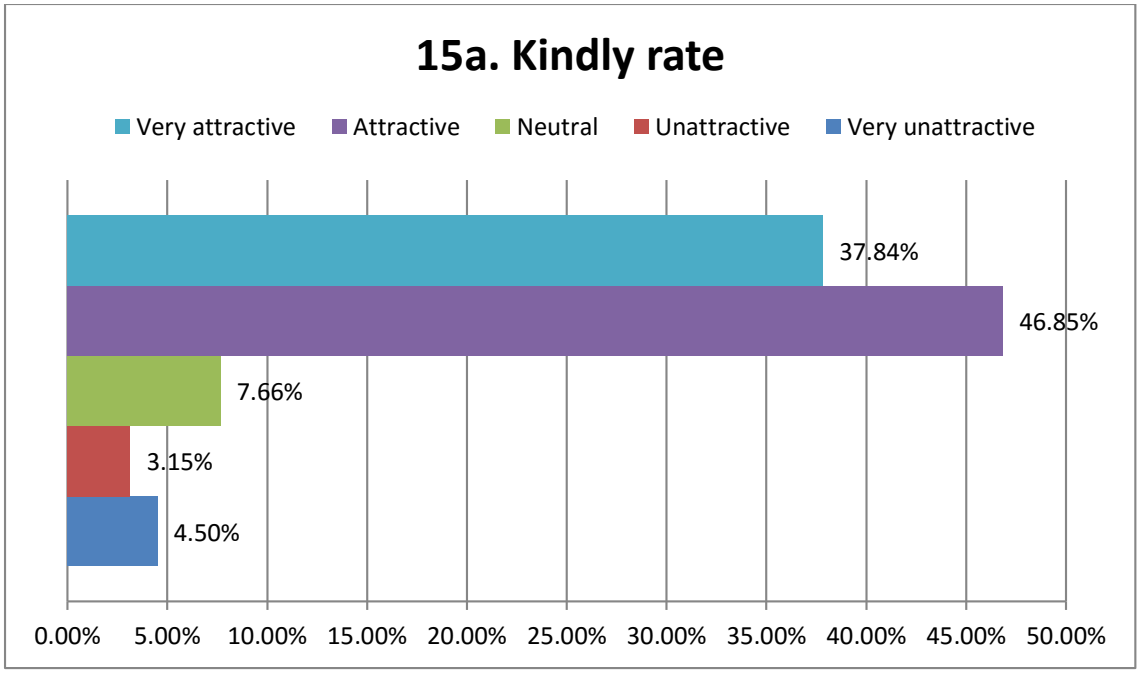
In order to further assess people's perception towards green infrastructure, individuals were shown three images of the same street with varying degree of green infrastructure. The images were composed of a street without planting, the same street with planting on balconies and another with street trees. The outcome follows:



50% of the respondents found that window boxes and other vegetation on buildings contribute towards the enhancement of the street view. 40% however expressed a neutral attitude towards the image whereas 9.5% thought that the view was unattractive. Almost 3% thought that view was very unattractive. Less than 1% of the respondents thought that the view was very attractive.

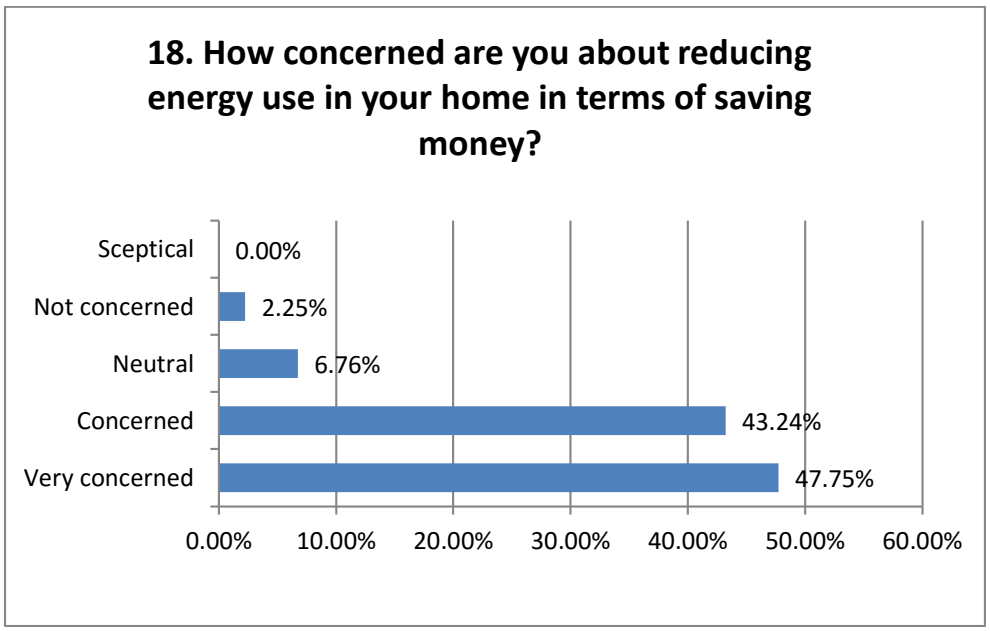


When confronted with a street view without vegetation and other green infrastructure, 55% of the respondents thought that the street looked very unattractive. Whereas 36% thought that the street looked unattractive. 8% gave a neutral response whereas 1% and .45% of the total respondents thought that the street view was attractive or very attractive respectively.

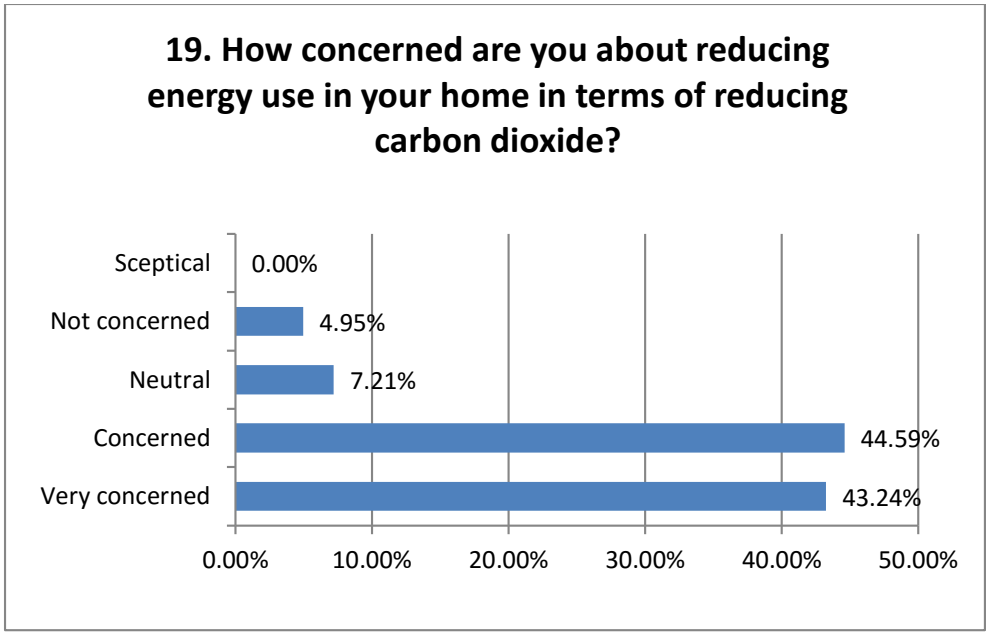


When shown the same street view but with trees incorporated in the view, 38% of the respondents rated the street view as very attractive while 47% rated the view as attractive. 8% gave a neutral response and 3% said the view was unattractive. 4.5% said the view was unattractive.

So as to understand whether the stakeholders reduced energy consumption because of financial reason or because of the threat of climate change, the following questions were asked:



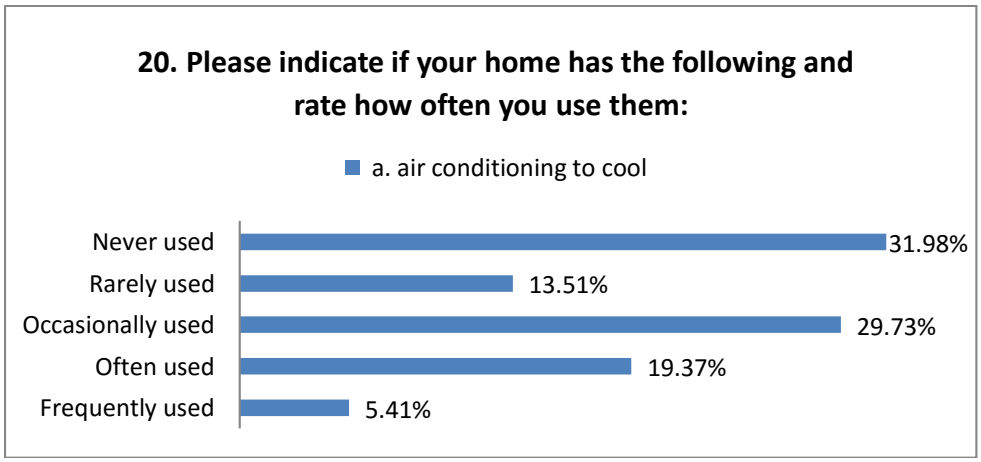
48% stated that they were very concerned with the cost of energy bills whereas 42% indicated that they are concerned. 7% gave a neutral reply and 2% not concerned.

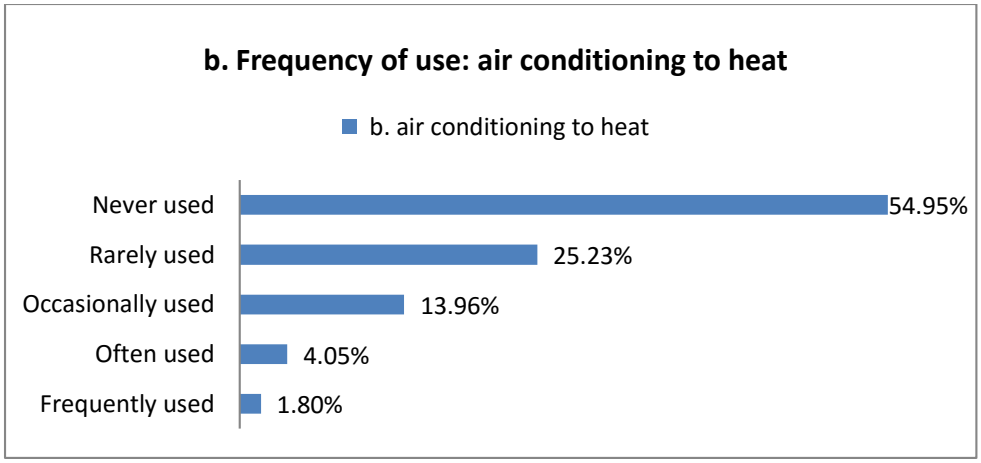


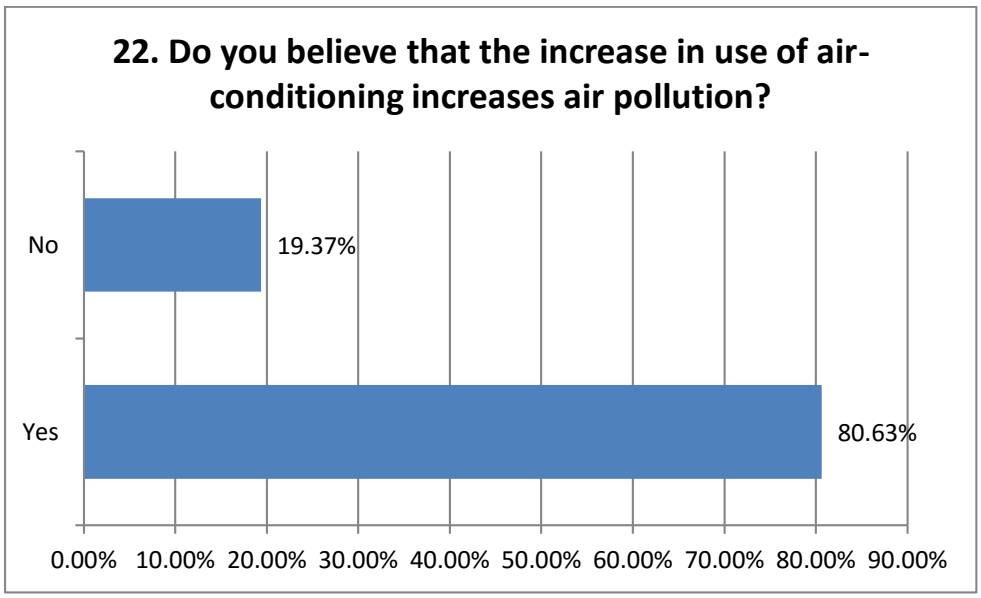
When asked about how concerned they were about reducing energy consumption in terms of reducing carbon emissions, 42% responded that they are very concerned about such emissions, 45% were concerned, 7% had a neutral attitude and 5% not concerned at all.

Thus comparing both graphs together, it transpires that, 91% of the respondents are either concerned or very concerned due to financial losses as opposed to 87.83% who were concerned or very concerned due to carbon emissions.

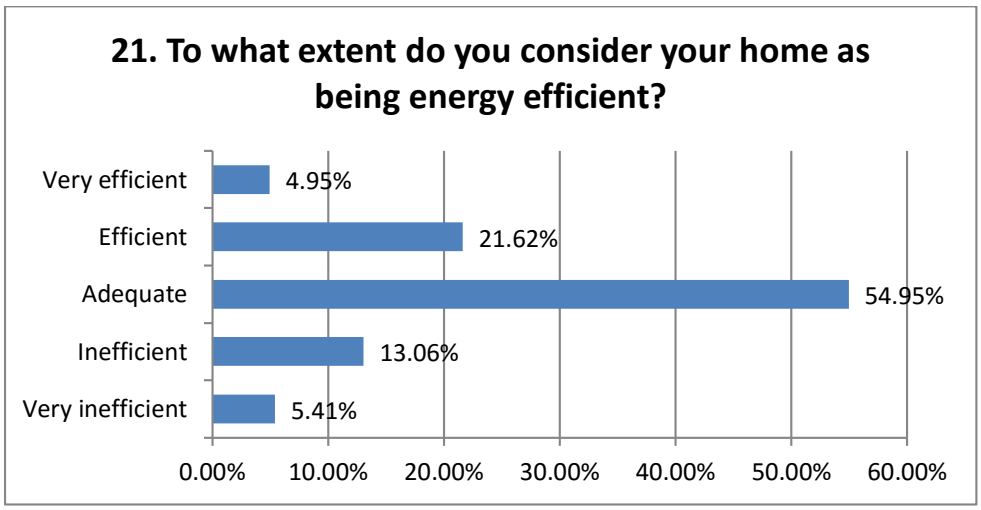
Respondents were also asked about the frequency of the use of air conditioners to cool. The majority of the respondents own and use air conditioners to varies degrees (68.02%). In fact, only 31.98% stated that they never use air conditioning.
When asked about the frequency of use of air conditioners to heat, 45% admitted making use of air conditioning as opposed to 55% who do not use air conditioning. This confirms the fact that most households use air-conditioning mainly in summer due to the high temperatures experienced in dwellings.





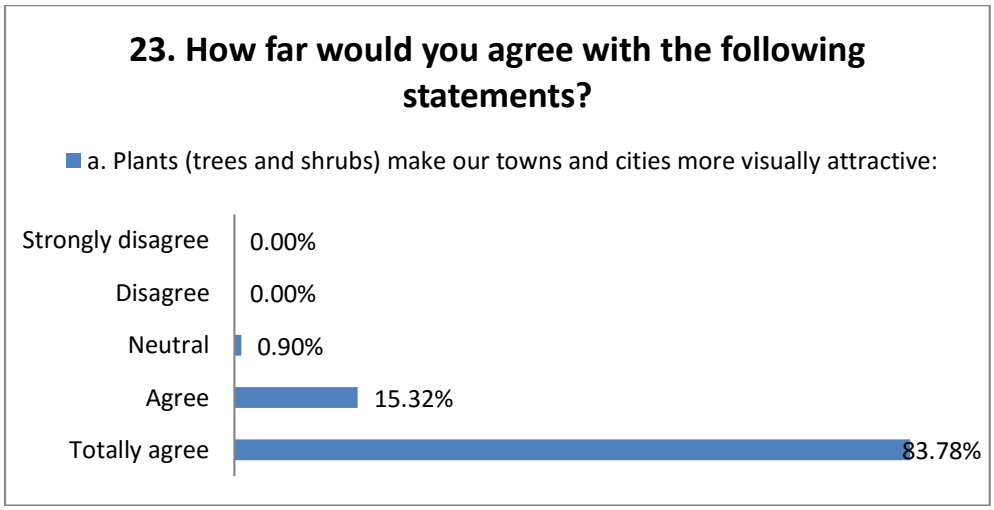


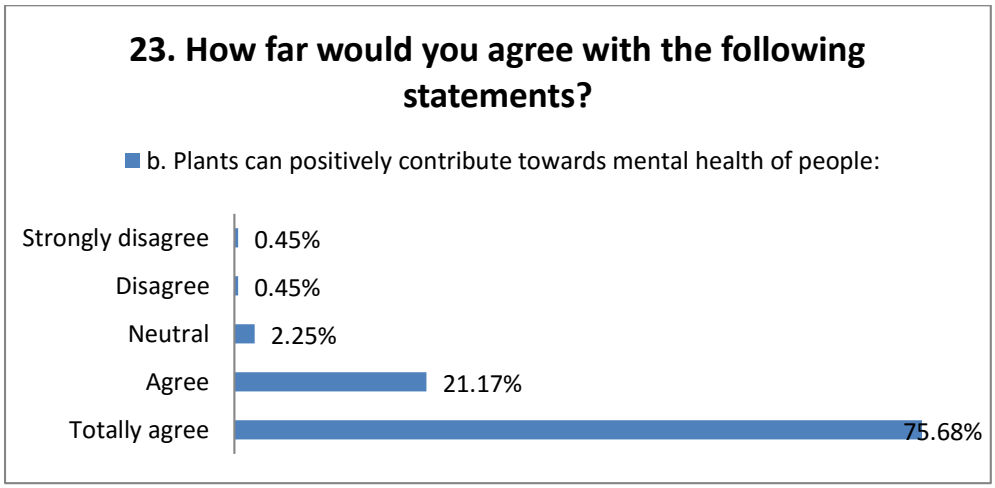
81% of the respondents are aware that air-conditioning contribute to air pollution.

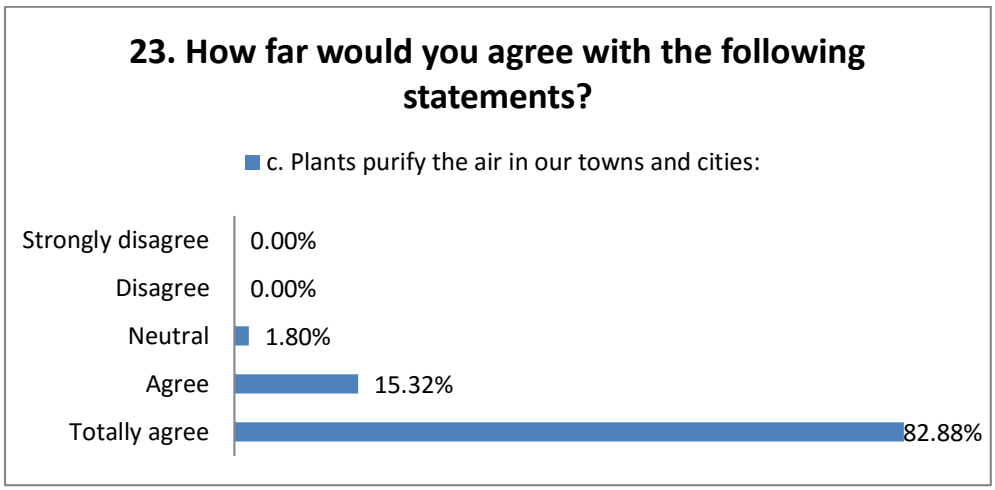


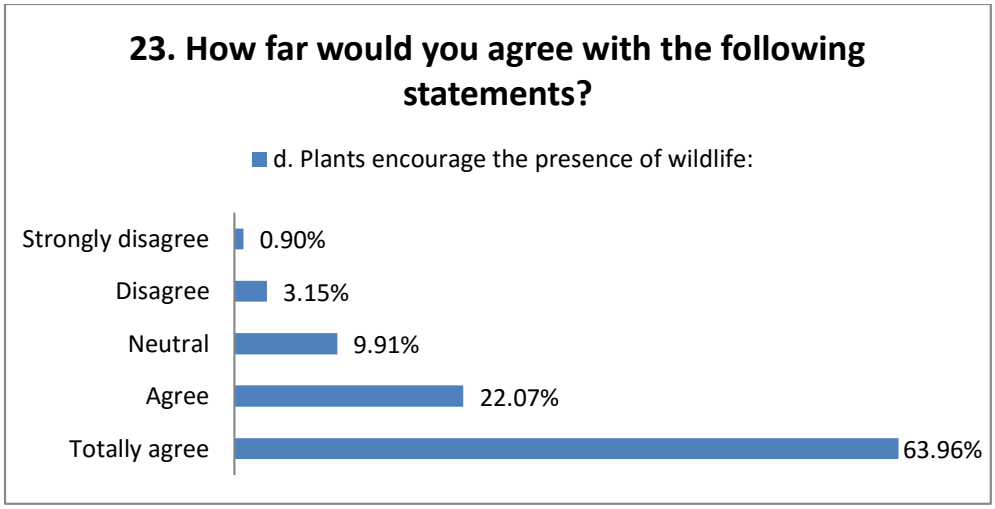
When asked about how energy efficient dwellings were, most (55%) considered their dwellings to be adequately efficient whereas only 18% (13.06% and 5.41%) considered their dwelling inefficient or

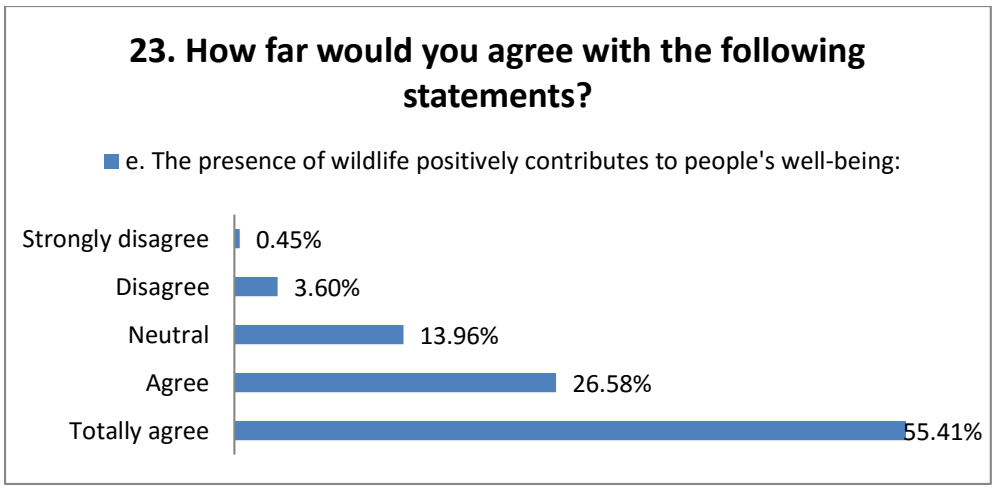
very inefficient. Only 5% consider their home to be very efficient and 22% consider their home to be efficient.











These five questions were inserted to understand better how stakeholders look at green infrastructure and wildlife with respect to people's well-being and visual amenity. This is an important aspect in the questionnaire as it could indicate how stake holders would perceive green roofs and their benefits.

From the above charts it emerged that most people appreciate the benefits that green infrastructure provides. When confronted with the statement that plants render urban areas more attractive, 84% agree totally with the concept whereas 15% agreed. Less than 1% gave a neutral response and no one disagreed or strongly disagreed.

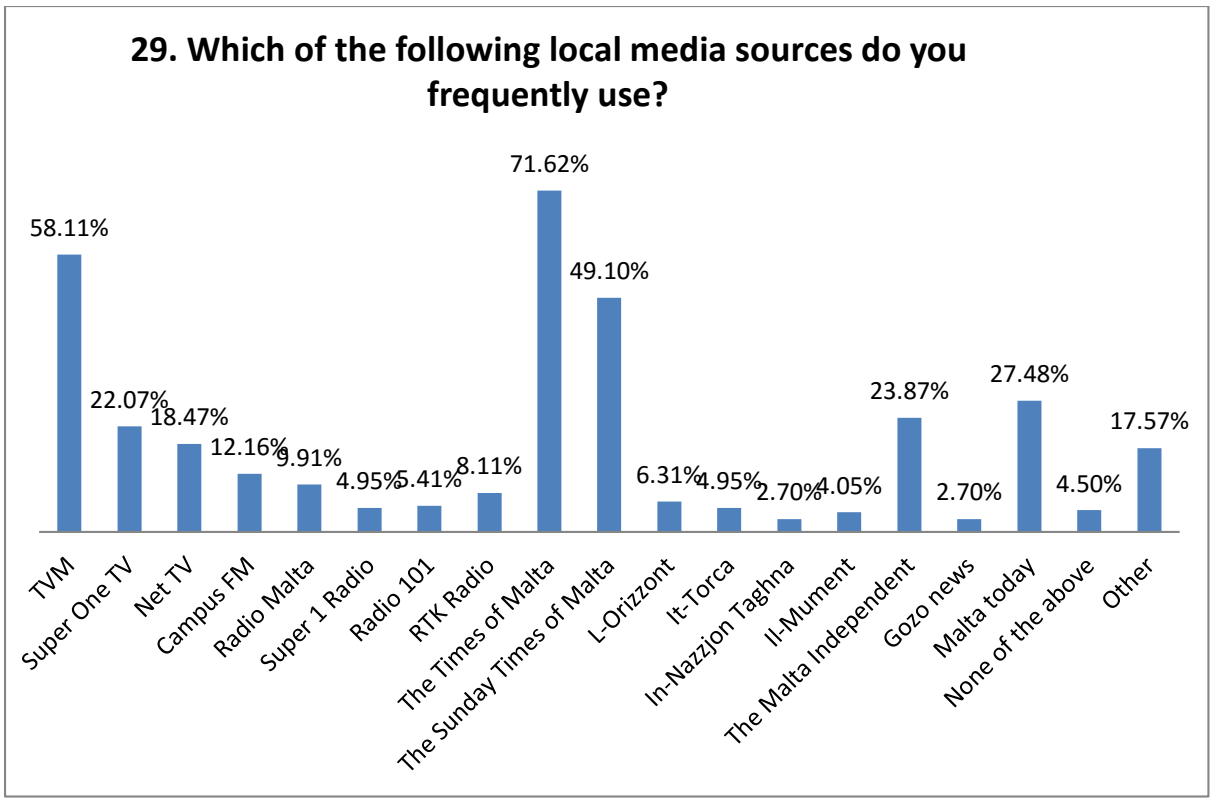
When confronted with the statement that plants can contribute positively towards mental health, 76% replied that they totally agree whereas 21% simply agreed. Just over 2% gave a neutral response and .9% is the total combined response by those who either disagreed or strongly disagreed with the statement.

Respondents also agreed and strongly agreed with the statement that plants purify the air (15% and 83% respectively). Whereas just under 2% gave a neutral response. No one disagreed with the statement.

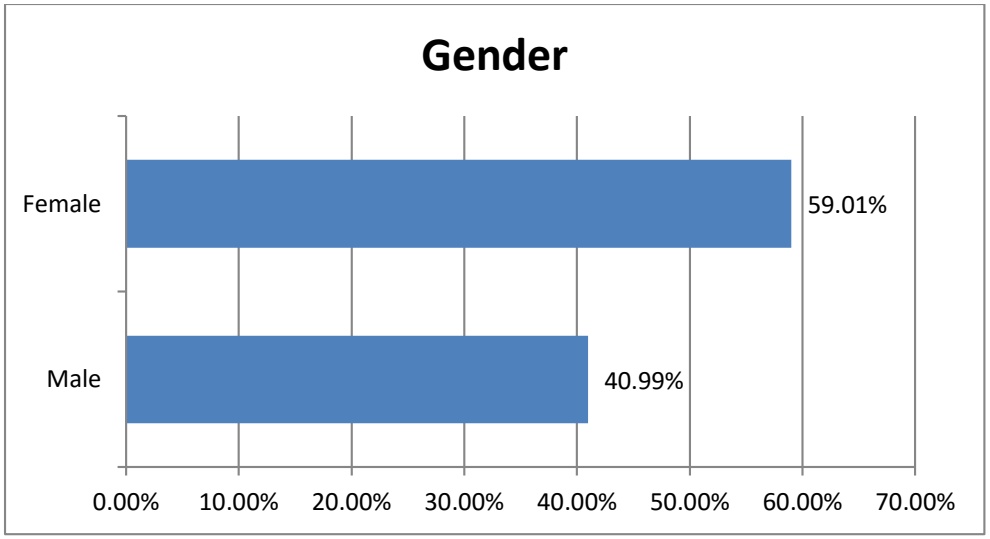
64% of respondents strongly agreed that plants are beneficial and attract wildlife and 22% agreed. 10% gave a neutral response and 4% disagreed or strongly disagreed with the statement in question.

However, only 55% of the respondents strongly agree with the statement that wildlife positively contribute to human well-being and 27% agreed. 14% gave a neutral reply and 4% disagreed and strongly disagreed with the statement.

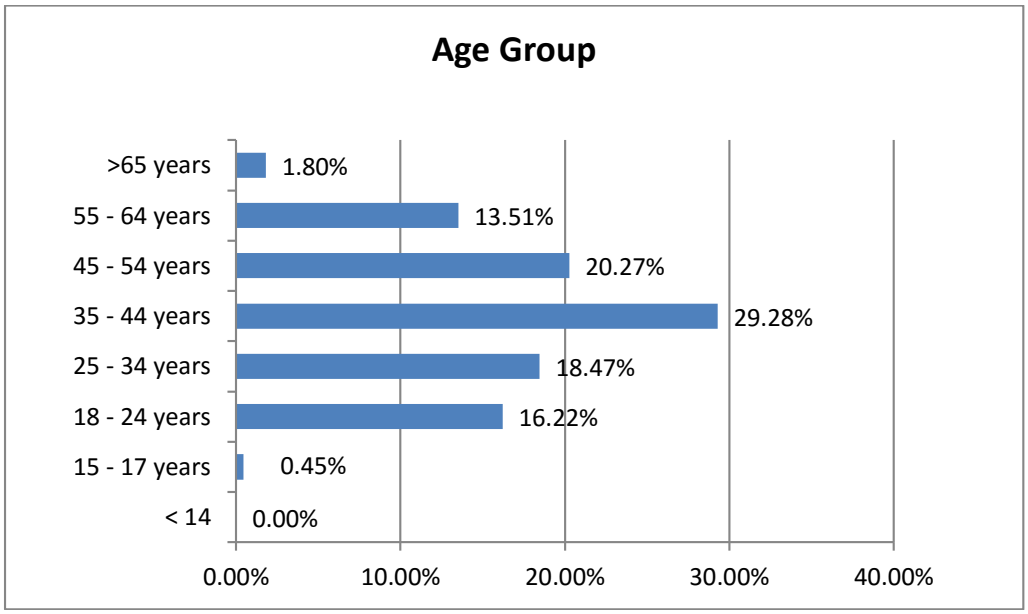
Frequency of Media Used



To assist in the dissemination of information about the LifeMedGreenRoof project, the stake holders were asked to indicate which of media channels/stations/publications are mostly used. From the above it can be seen that the most read newspapers are The Sunday Times of Malta (72%) and the Times of Malta (49%) followed by the Malta Today (27%) and the Malta Independent (24%).
The most popular TV station is the national station, TVM (58%), followed by Super One television (22%) and Net TV (18%). The most popular radio station is the university radio station Campus FM (12%) followed by the national radio station Radju Malta (10%).



59% of the respondents to the questionnaire were female while 41% were male.



Most of the respondents fell between the ages of 34-44years followed by 45-54years (20%) and 25-34% (18%). Only 2% of those who responded to the questionnaire were above 65years of age.

Discussion

From the results of this first questionnaire it is evident that the public in general appreciate the benefits of green infrastructure; at least in theory. The majority have confirmed that they agree that plants contribute to people's well-being and that they have the ability of purifying the air in urban areas. The majority have also agreed with the fact that plants contribute also to the mental health of people and make urban areas more visually attractive.

The issue of the visual benefits of vegetation was confirmed by the results obtained when respondents were requested to rate three (3) street views, two of which had vegetation incorporated and one without. Most respondents rated vegetated streets higher than non-vegetated streets; especially when the vegetation consisted of trees. This confirms other studies which state that people have an

affinity towards vegetation and that plants are visually appealing especially in urban environments where vegetation is usually lacking.

On the issue of energy use and efficiency in buildings, it transpired that the majority of the respondents make use of air conditioning and when they do it is generally for cooling purposes. This was expected as winters in Malta are mild whereas summers tend to be hot and humid. The lack of efficient building design and high summer temperatures, lowers the comfort levels in buildings. In fact, whereas only 26.6% of the respondents stated that they consider their home to be very/energy efficient, 18.5% have stated that their house is either inefficient or very inefficient. 54.95% stated that their house was adequately efficient.

With the above in mind, the absolute majority of the respondents agree with the fact that air conditioning increases air pollution. However, most individuals are more concerned about reducing energy consumption for financial reasons than they are for environmental (92% vs 87.8%). It can be said that the main reason why people install alternative sources of energy generation (60.55%) such as PV panels is mainly for economic reasons. To reduce heat stress and possibly the use of air conditioning costs, respondents (53.2%) make use of other methods to relieve heat stress. Such systems include the use of insulation such as foam and expanded polystyrene, light coloured paint on external surfaces and methods of shading the roof from direct sunlight.

From the replies it transpires that stakeholders are, to a limited extent, aware of the benefits of green infrastructure. The results have shown that generally people are more conscious of the need to reduce energy consumption due to financial purposes although pollution and the carbon footprint are a concern.

When confronted with the issue of green roofs, the majority of the respondents claim that they have heard about green roofs either through media sources or out of personal interest. Most claim that they have heard about the technology through the internet. Of the popular media sources, television and local newspapers have scored the highest marks in informing stake holders about green roof technology.

When asked how they would describe green roofs, the main item which surfaced in the description included the presence of vegetation (48.2%) on the roof. 16.2% mentioned that green roofs have insulation and temperature control properties. Other benefits mentioned include storm water management, biodiversity, air quality, aesthetic and amenity purposes.
Just under 40% of the respondents did not describe what a green roof was. This corresponds to the 41% of respondents who claimed to have not heard of the term green roof. The 2% discrepancy could refer to individuals who have attempted to define the term green roofs by making sense of the term. To test whether individuals really understood what green roofs are, six images were shown and respondents were asked to identify which of these constituted a green roof. Generally, the majority of respondents answered the questions correctly. They were able to identify a conventional roof from a green roof. However, an images illustrating a seating areas with a number of potted plants did create some uncertainty. This uncertainty was expected as the image was somewhat vague and subject to interpretation.

From the replies it is clear that respondents were aware of the benefits of green roofs. Most mentioned the insulation benefits and air quality/ pollution control. Aesthetics and flood mitigation were also mentioned together with increase in biodiversity and the improving of the energy efficiency of the building. Other benefits mentioned to a lesser extent included job creation, noise insulation, mitigation of climate change and increase in property value.

It is apparent that the majority of respondents agree that green roofs are an important addition to our townscape. However, the majority (60%) think that locally, the construction of green roofs is challenging. Issues like leaking roofs, installation costs and maintenance costs scored high as factors which would discourage the installation of green roofs. Lack of information has also scored high (10%), (preceded by water leaks, installation cost maintenance cost and time). These results are somewhat expected given the fact that green roof technology has not been widely adopted.

Conclusion

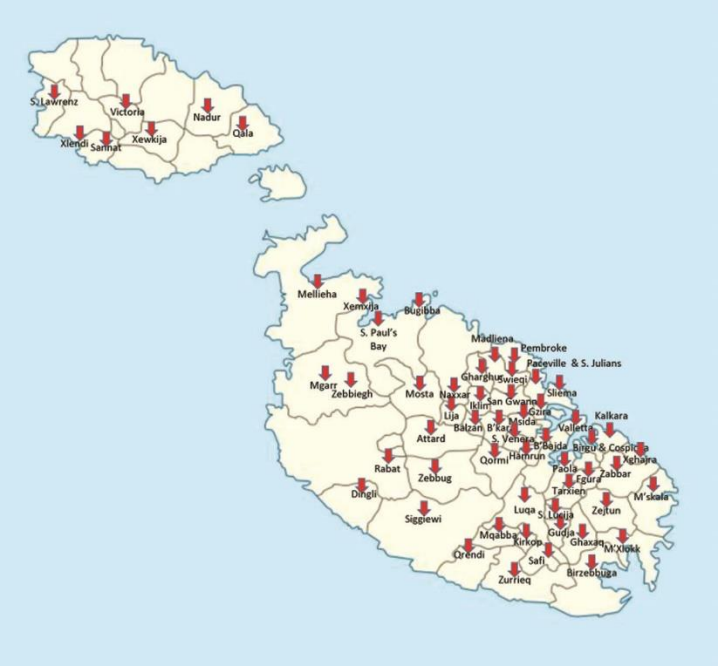
It can be said that most of the individuals interviewed understand the benefits of green infrastructure. However, the link between green infrastructure and quality of life is not always fully appreciated. Furthermore, stake holders acknowledge the need to reduce the carbon footprint of buildings even if it is not necessarily for environmental reasons. It seems however contradictory that most of the individuals interviewed make use of energy hungry technology but would find it difficult to adopt more environmentally friendly approaches.

Most of the respondents are aware of green roofs and their benefits however there is a clear indication that most have the impression that locally green roofs are difficult to maintain successfully due to issues such as climate, maintenance cost and construction anomalies such as water leaks.

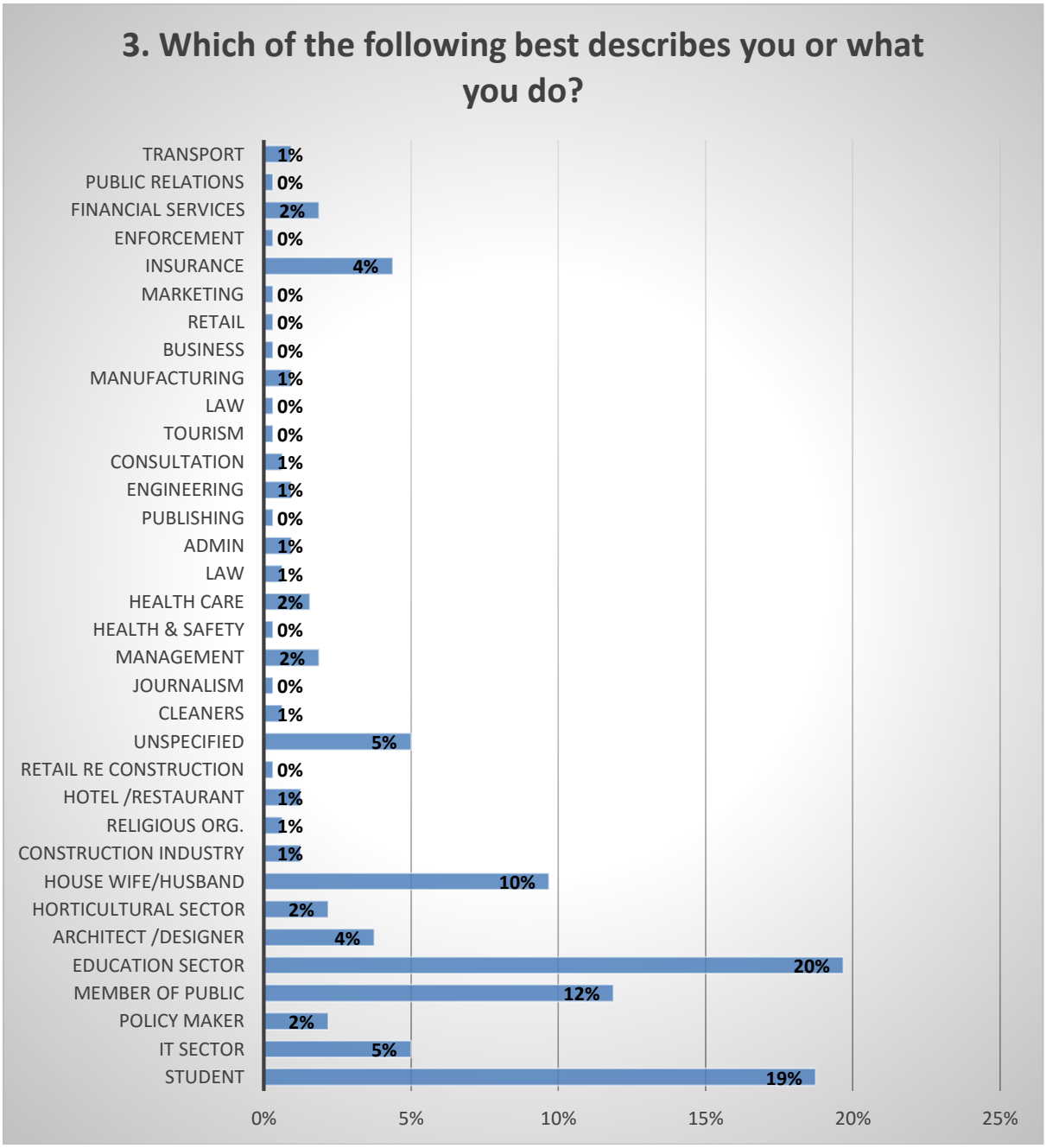
The internet seems to be the most powerful tool in disseminating information due to the popularity amongst the public in general. Newspapers and television also carry weight but most of all personal-interest is what seems to drive people to find out more about the technology. This indicates the importance education/information has in encouraging stake holders to be informed more. The internet is an important media (website but mostly Facebook) and featured articles on newspapers and TV would supplement information.

Follow-up questionnaire (Q2)

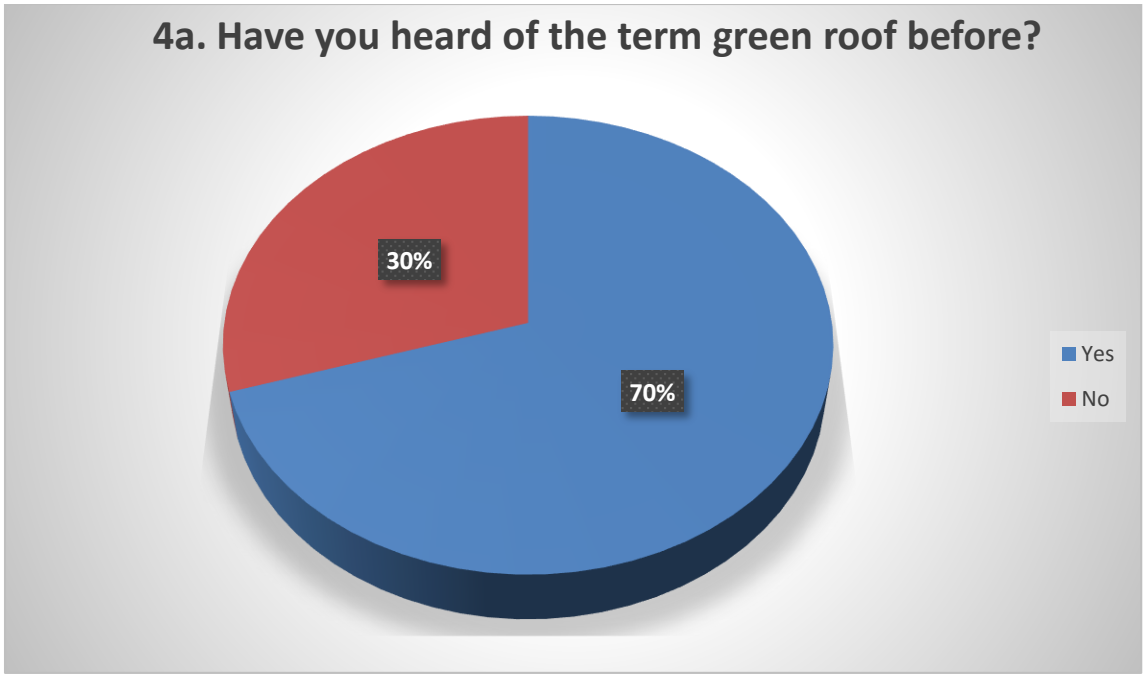
1. Where in Malta do you live?



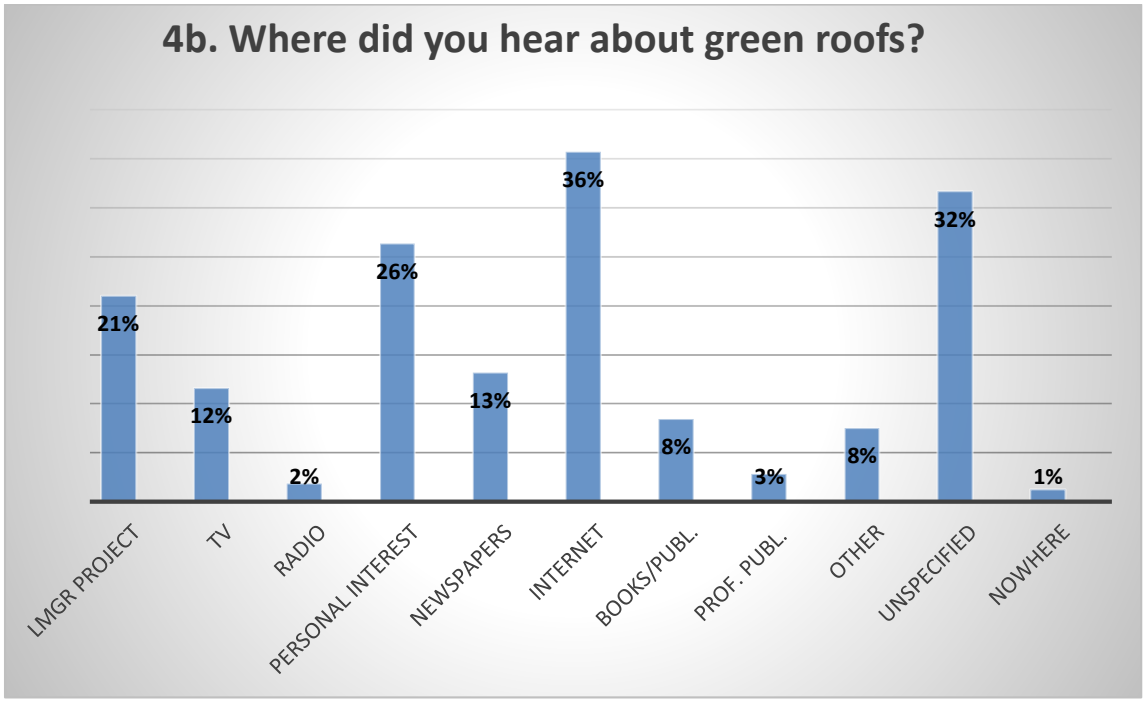
The above image shows the wide distribution of the respondents' with the Maltese islands. The distribution covers many of the towns, villages and cities in Malta and Gozo.



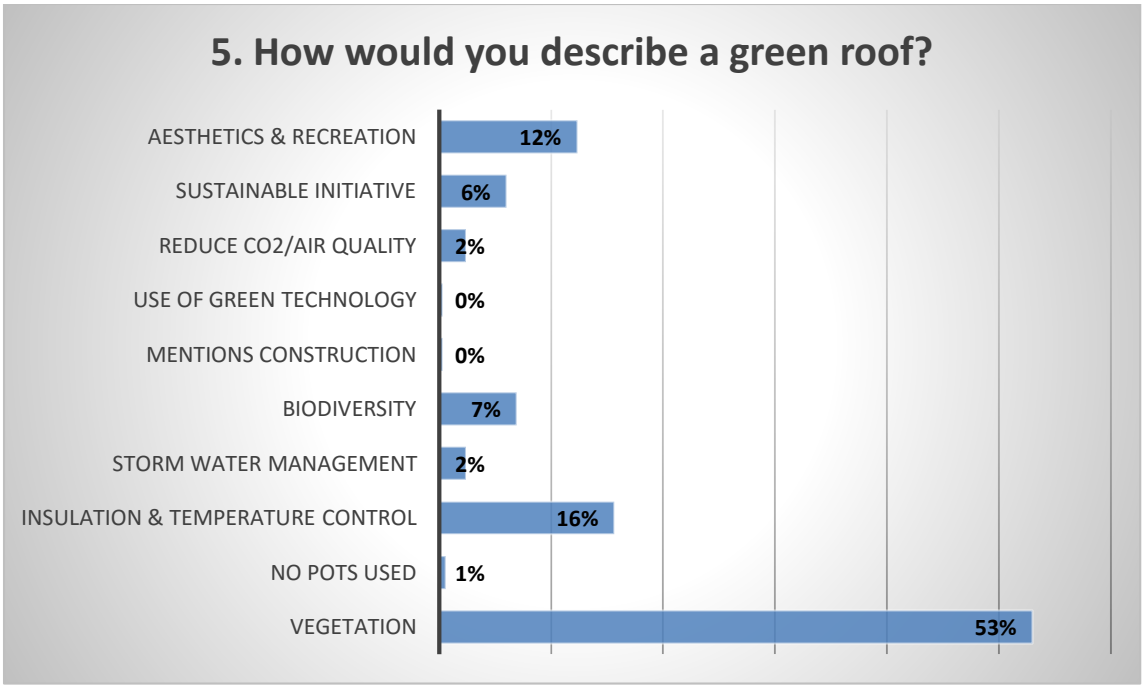
The above graph shows the back ground of every respondent to the questionnaire. 20% of the respondents come from the Education sector and 19% were students, 12% identified themselves as members of the pubic whereas 10% are House wives/husbands. Policy makers accounted for 2% of the respondents, 4% come from the design sector (Architects and other designers). Others include the horticulture, health and insurance sector.



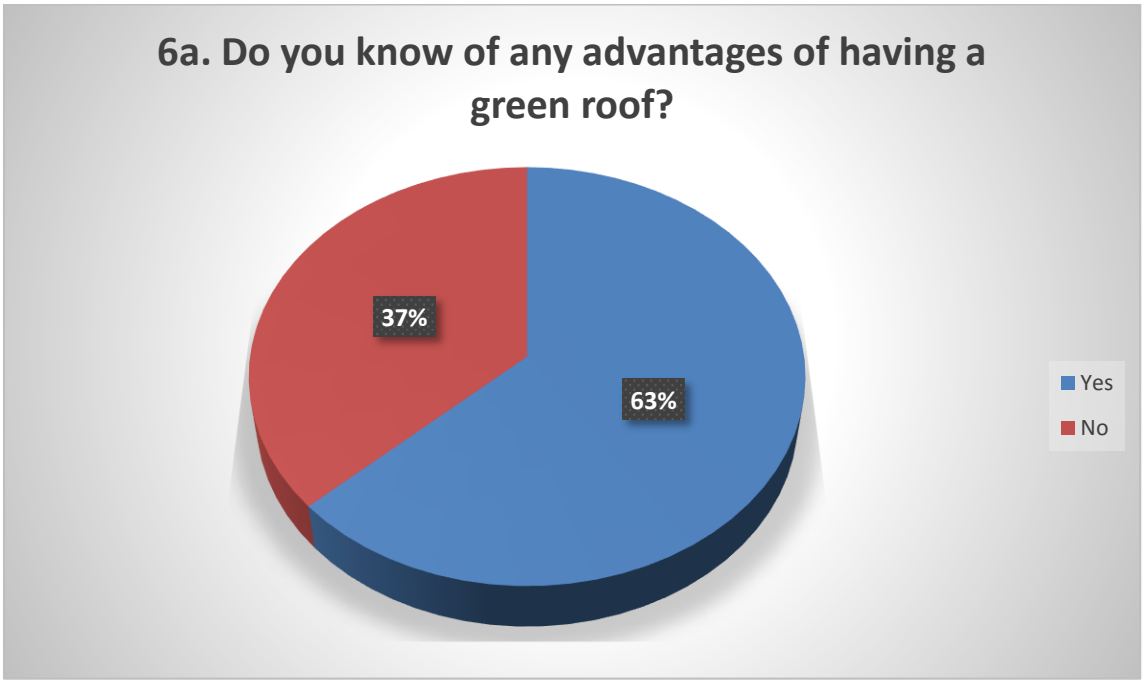
When asked whether they had heard of the term 'Green Roof', 70% of the respondents claim they had while 30% had not.



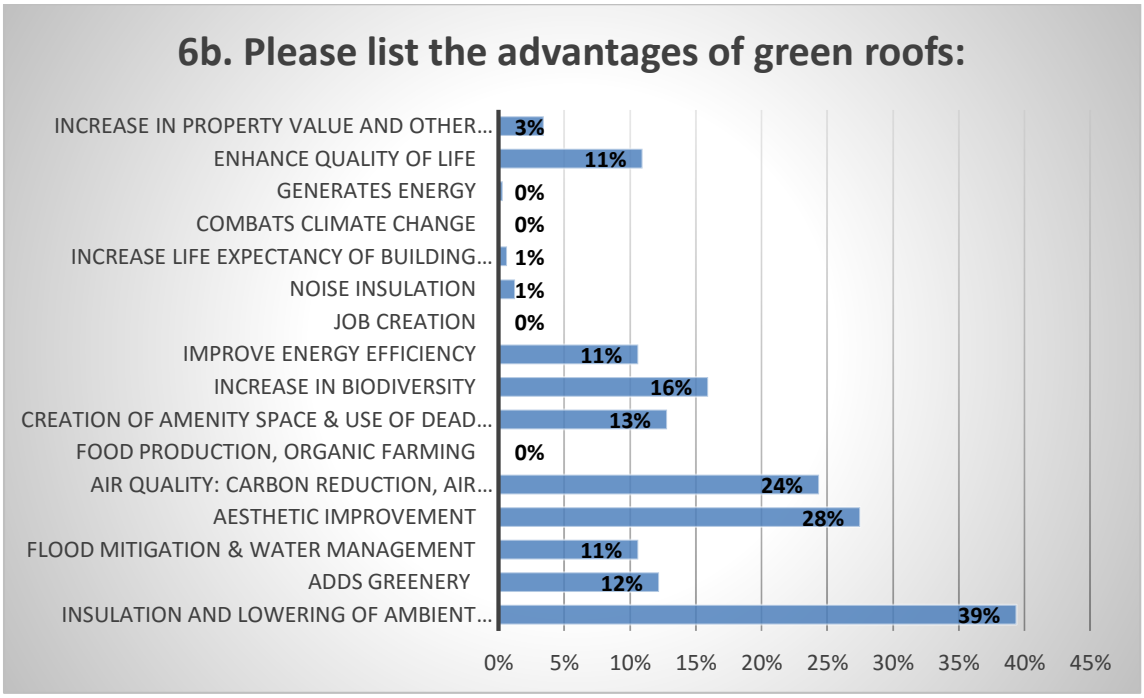
The internet is where participants claimed they heard about green roofs (36%), 32% failed to respond to the question. 26% have heard about green roofs through personal interest whereas 21% through the LifeMedGreenRoof project. 8% of the respondents had heard about green roofs from books and other publications whereas 12% and 13% of the individuals heard about green roofs from television and the local newspapers respectively. 3% heard about green roofs from professional publications, 2% from the radio. 8% claim to have heard of green roofs from other sources including lectures and presentations conducted by the project office at university or public activities.



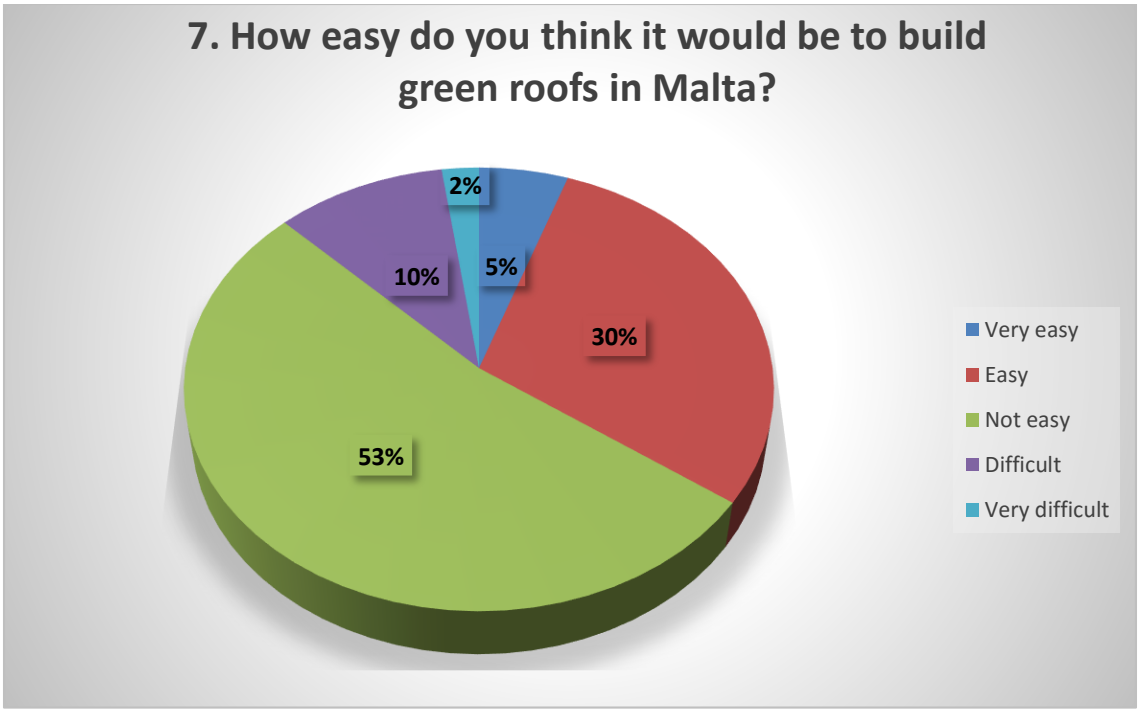
Question 5 was an open ended question. The respondents were asked to describe what they understood by a 'green roof'. 53% of the replies were aware that green roofs related to vegetation and in their replies mentioned that such roofs would include plants, are gardens, are roofs covered in grass or flowers. 7% mentioned that green roofs encourage or favoured biodiversity. 16% mentioned that green roofs help to insulate the underlying building or regulate internal temperatures of buildings. 2% of the respondents claimed that green roofs help reduce CO_2 and/or improve air quality. Another 2% mentioned that the technology helps to manage run-off (absorb run-off, flood mitigation) and 12% that such roofs increase the aesthetic value of the environment, enhance the urban environment and/or provide amenity. 6% of the replies mentioned that green roofs are related to the use of sustainability. None of the respondents associated green roofs with green technology (PVs, insulation material etc) or mentioned construction methods.
Question 6a and 6b asks about the advantages of green roofs.



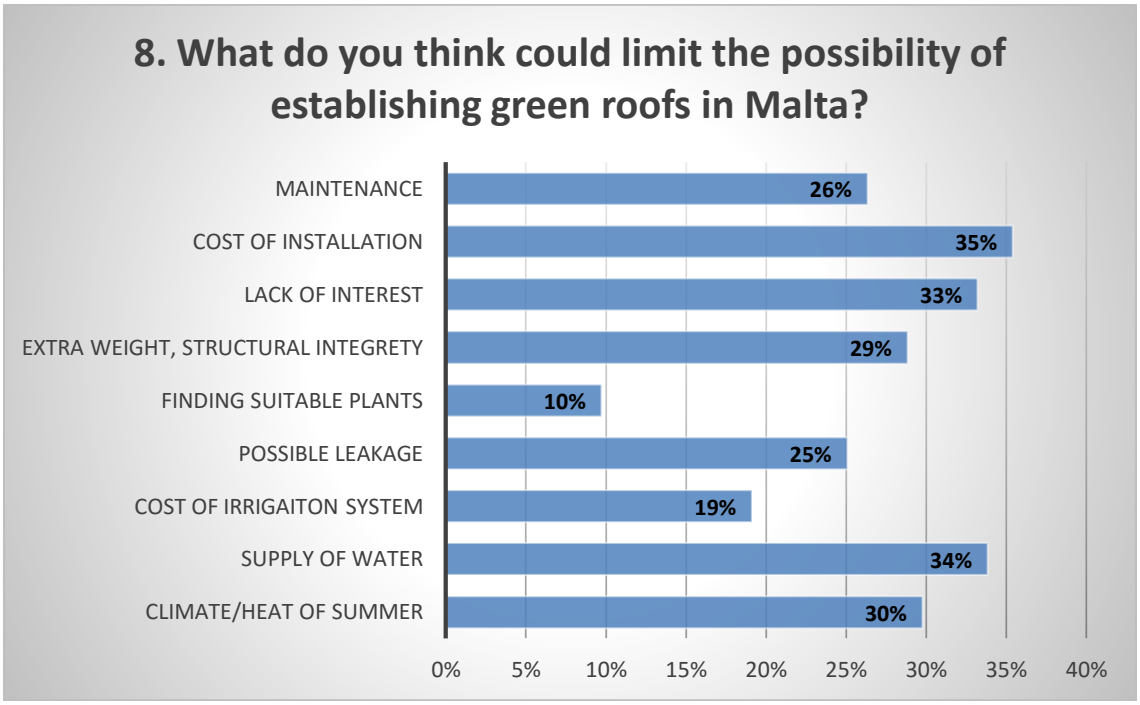
63% claimed that they know that green roofs provide advantages, 37% did not.



This question was also an open ended question and respondents were given the opportunity to describe or list the advantages which they thought are associated with green roofs. Of the total respondents, 39% indicated that they are aware that green roofs insulate and/or lower ambient temperatures. 24% mentioned that green roofs can be used to capture pollutants from the atmosphere or/and ameliorates air quality. 28% said that green roofs can be used to improve the aesthetic value of urban areas while 11% indicated that green roofs would have an effect on flooding or contribute towards water harvesting. 16 % identified that green roofs benefit biodiversity and 13% said that green roofs add to amenity space and make better use of what otherwise could have been a dead space. 11% mentioned that green roofs enhance quality of life in urban areas and improve the energy efficiency of buildings.

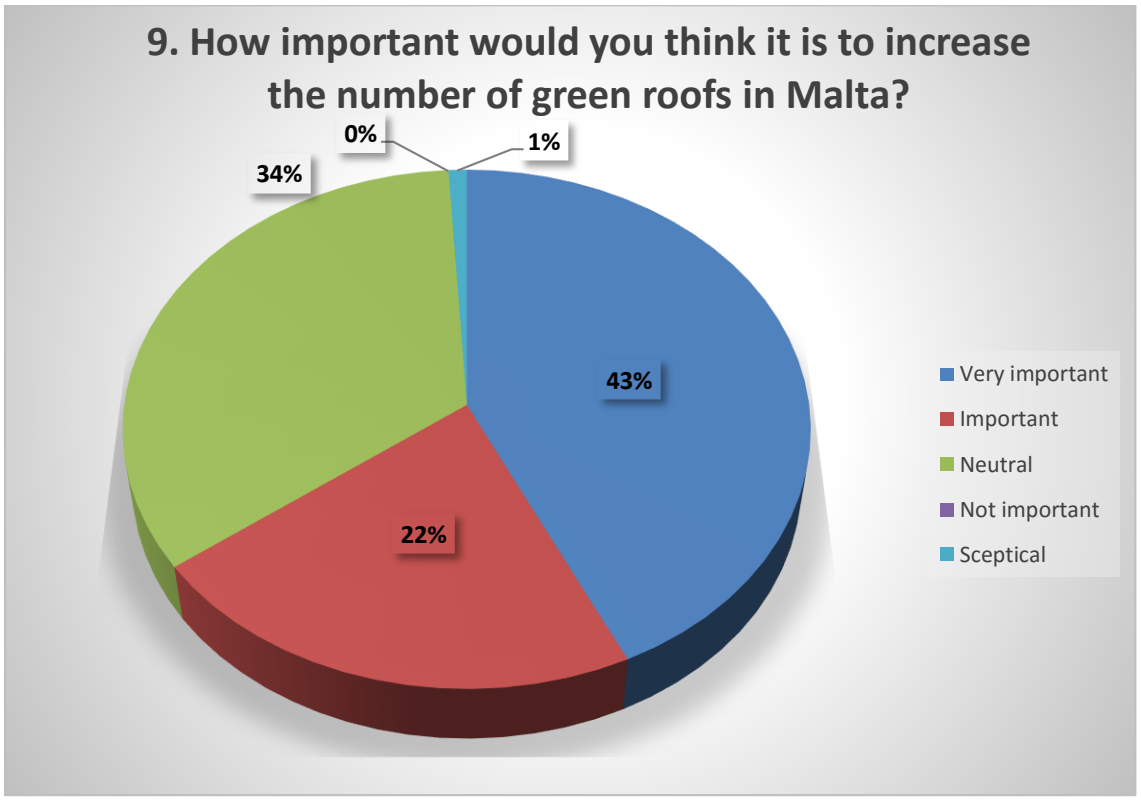


Many respondents had the impression that the cultivation of plants in Malta is difficult due to climatic factors. When asked about the ease at which green roofs can be built in Malta, the majority (53%) responded that it would **not be easy**, whereas 30% think that it would be **easy**. 10% think that it would be **difficult** where as 2% think it would be **very difficult**. 5% think that constructing a green roof would be **very easy** in Malta.

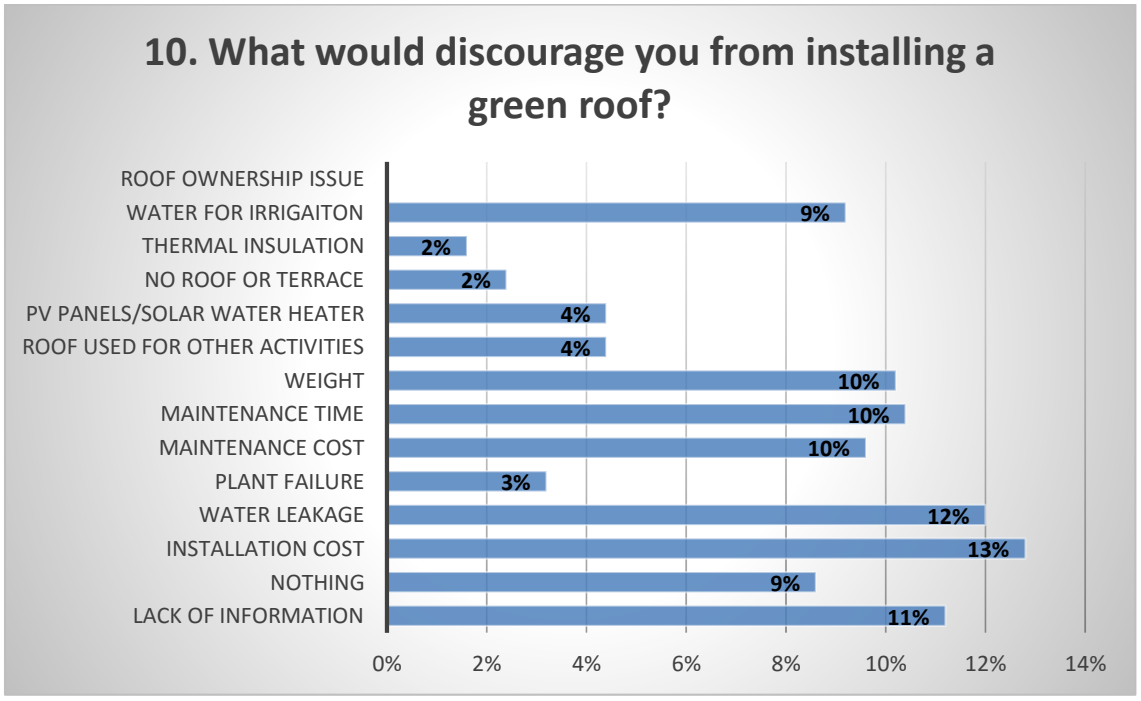


The respondents' concern about what could limit the establishment of green roofs locally mainly concerned **installation cost** (35%) and the **supply of water** (34%) for irrigation followed closely by **lack of interest** (33%). Concern about the **local climate** also scored high at 30% and **maintenance** at 26%. Finding **suitable plants** (10%) was not a major concern to the participants. Only 19% of the

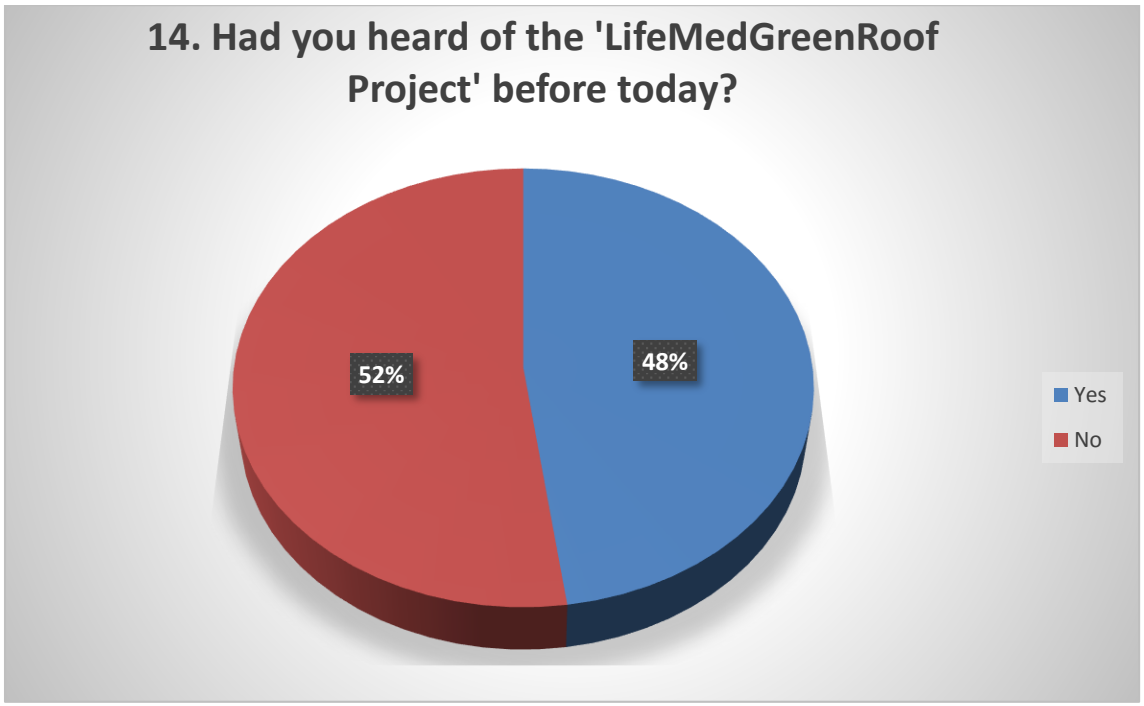
respondents thought that **cost of the irrigation** system would be a limiting factor and 25% of the respondents thought that **leaks** could contribute to the limitation of the uptake of green roofs.



43% replied that it is **very important** to increase green roof coverage, 22% think it would be **important** and 34% of the respondents gave a **neutral** response. Only 1% were **sceptical** of the importance of the technology and no one thought that green roof was **not important**.

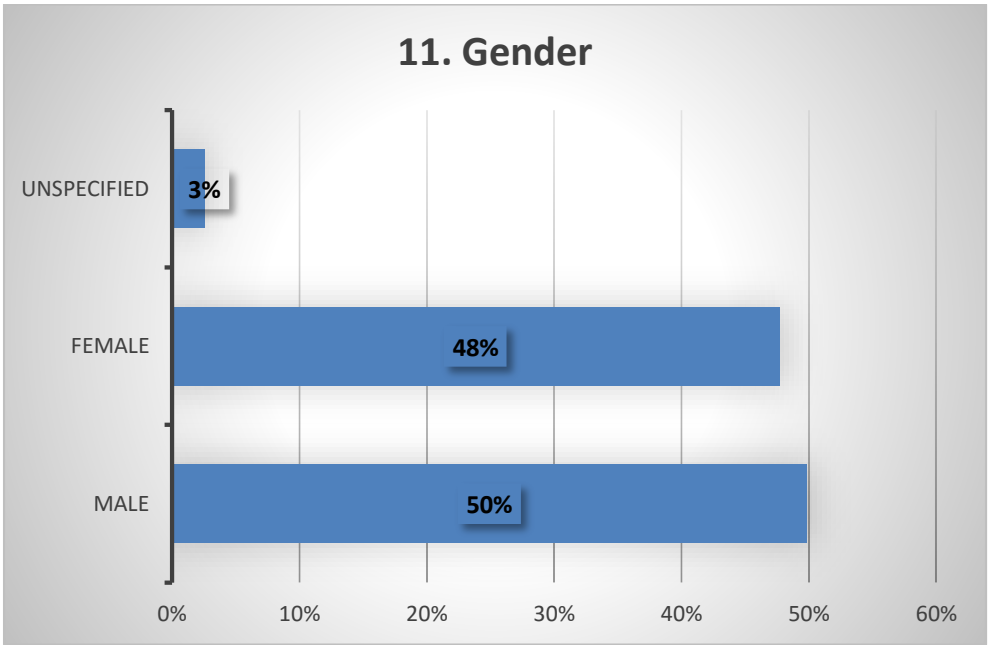


On asking about factors which would discourage respondents from installing green roofs, the feedback was as follows: Initial capital layout was the most common concern at 20%, followed closely by the fear of water leaks at 19%. 18% thought that lack of information constitutes an issue and 16% of participants indicated weight of the green roof and time needed for maintenance as being stumbling blocks. 15% of respondents indicated maintenance cost as being barrier and water for irrigation followed at 14%. Minor concerns included the presence of PV panels on the roof and the fact that roofs are used for other activity (both at 7%). Plant failure was only of concern to 5% of the respondents.

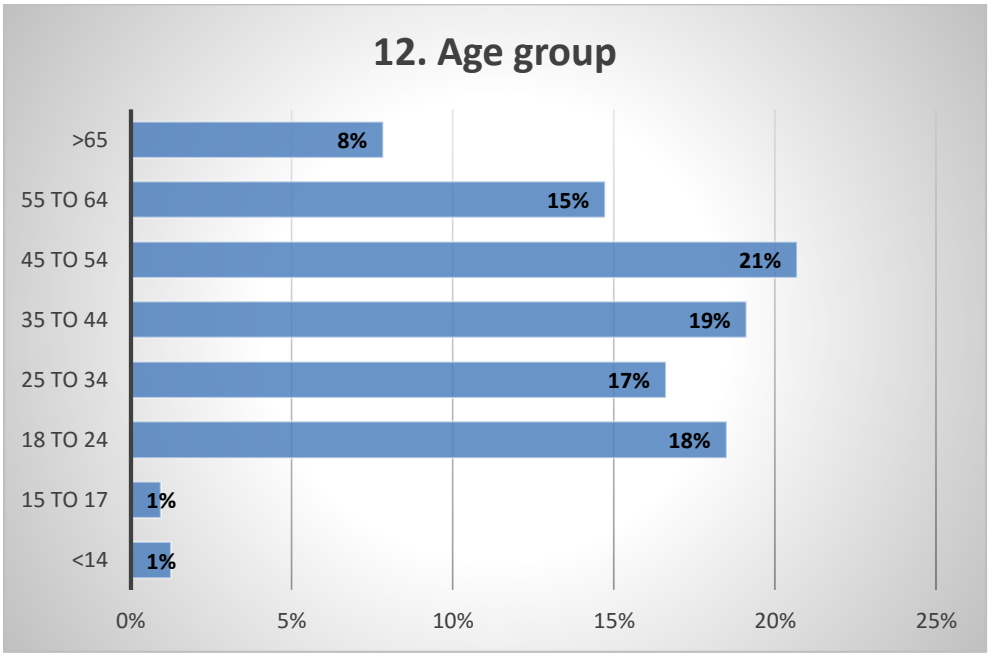


The participants were asked whether they had heard of the LifeMedGreenRoof Project prior to filling in the questionnaire. 48% said they had whereas 52% had not.

For statistical purposes the questionnaire asked the following personal questions.

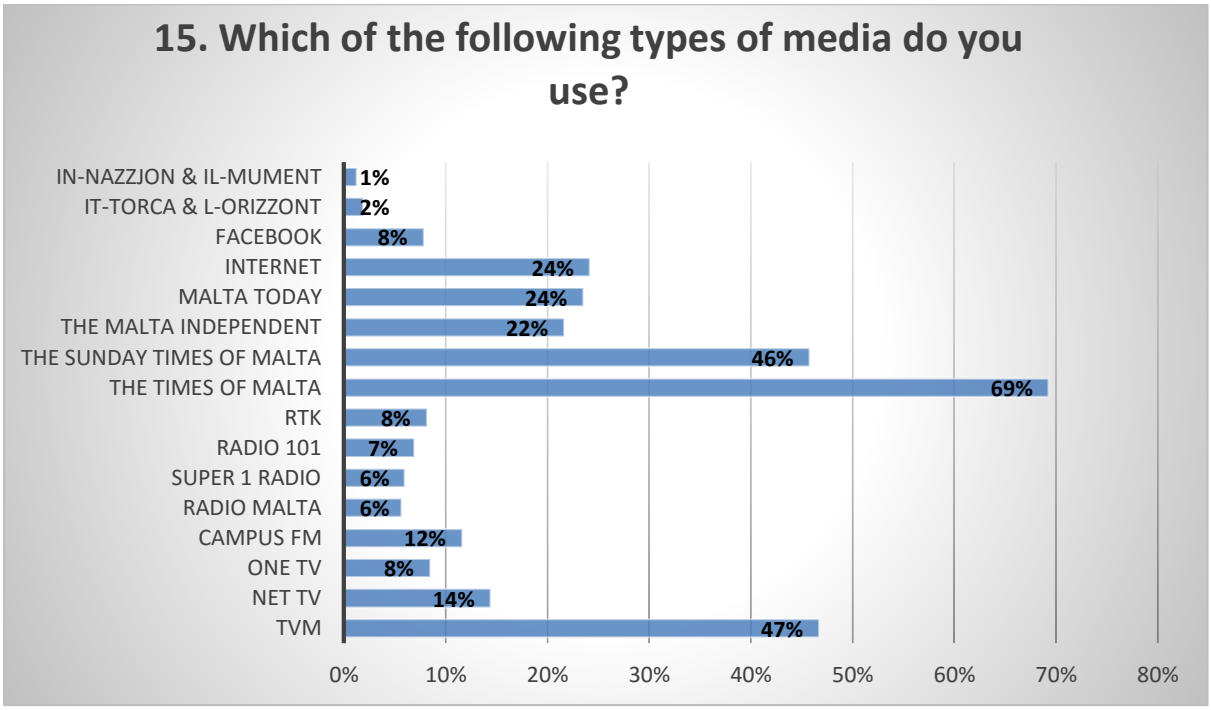


48% of the respondents were female whereas 50% were male. 3% failed to specify their gender.



Most of the participants to the questionnaire were aged between 45 and 54 years of age. 19% were aged 35 to 44 years of age and 18% aged between 18 to 24 years of age. 17% were aged 25-34% and 15% were between 55 and 64 years of age. Over 65 made up 8% of the respondents and 2% were under 17 years of age.

Frequency of media used:



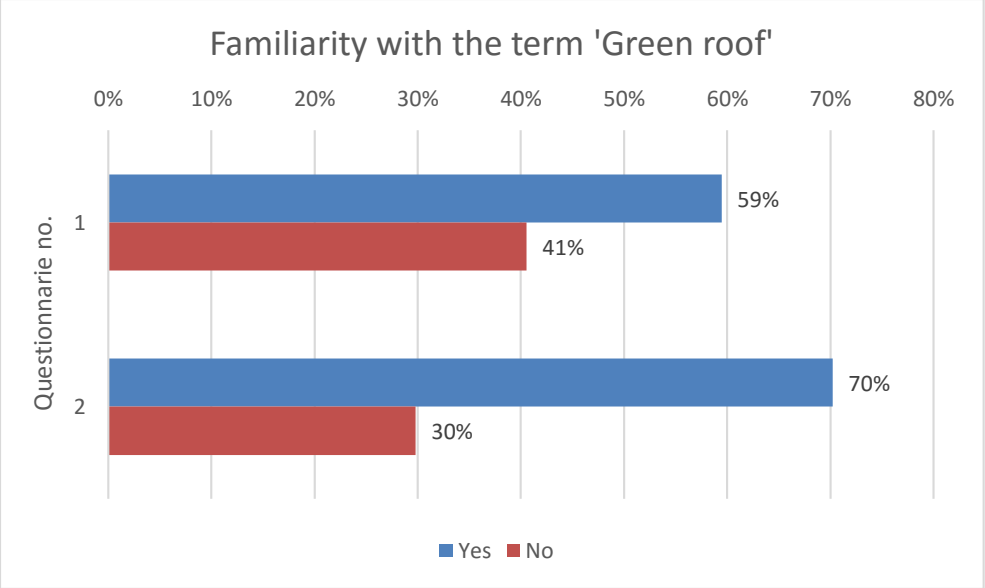
Stake holders were also asked to indicate which of media channels/stations/publications are mostly used. From the above it can be seen that the most read newspapers are The Times of Malta (69%) and the Sunday Times of Malta (46%) followed by the Malta Today (24%) and the Malta Independent (22%).

The most popular TV station is the national station, TVM (47%), followed by Net television (14%) and One TV (8%). The most popular radio station is the university radio station Campus FM (12%) followed by RTK (8%) and Radio 101 (7%). The national radio station Radju Malta and super one radio were both selected at (6%).

Discussion

This section will attempt to compare the first two questionnaires and analyse the results achieved.

From the results of both questionnaires, it became evident that more people are now familiar with the term 'green roof' than when the project first began. This is evident by the fact that when asked about whether participants were familiar with the term green roofs, there is an increase of 11% between the first and second questionnaire.

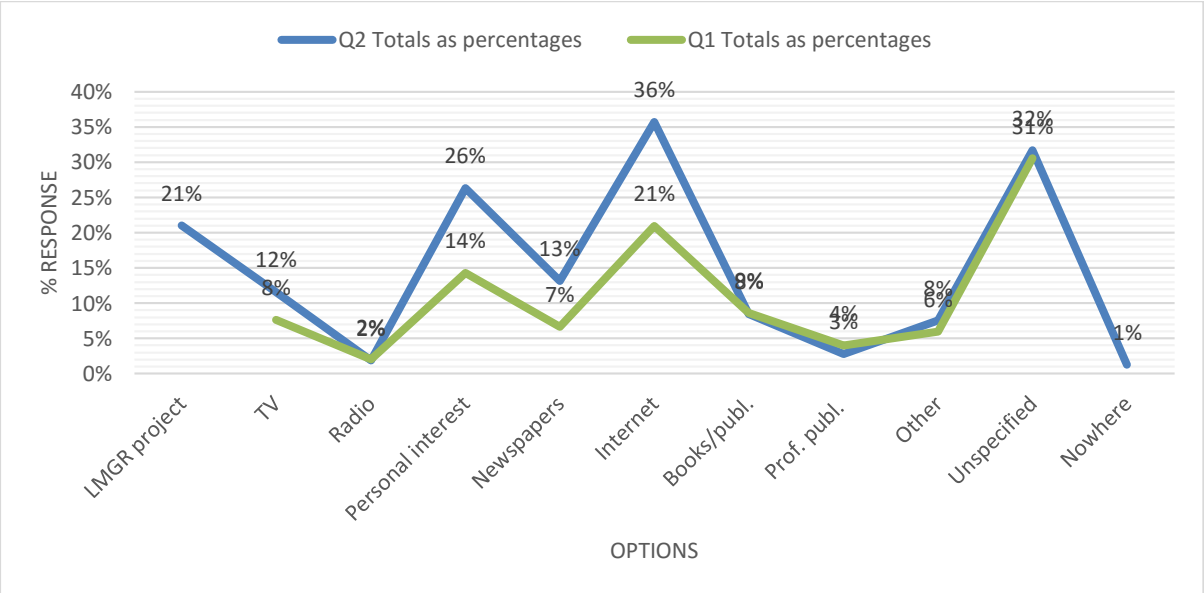


The project has published numerous articles and press releases and has also participated on radio interviews to increase media coverage. Influential figures were also invited to visit the green roof and such visits were followed by press releases as well as updates on Facebook which were also shared with a number of groups.

So, this increase in familiarity with the term green roof can be attributed to the following sources:

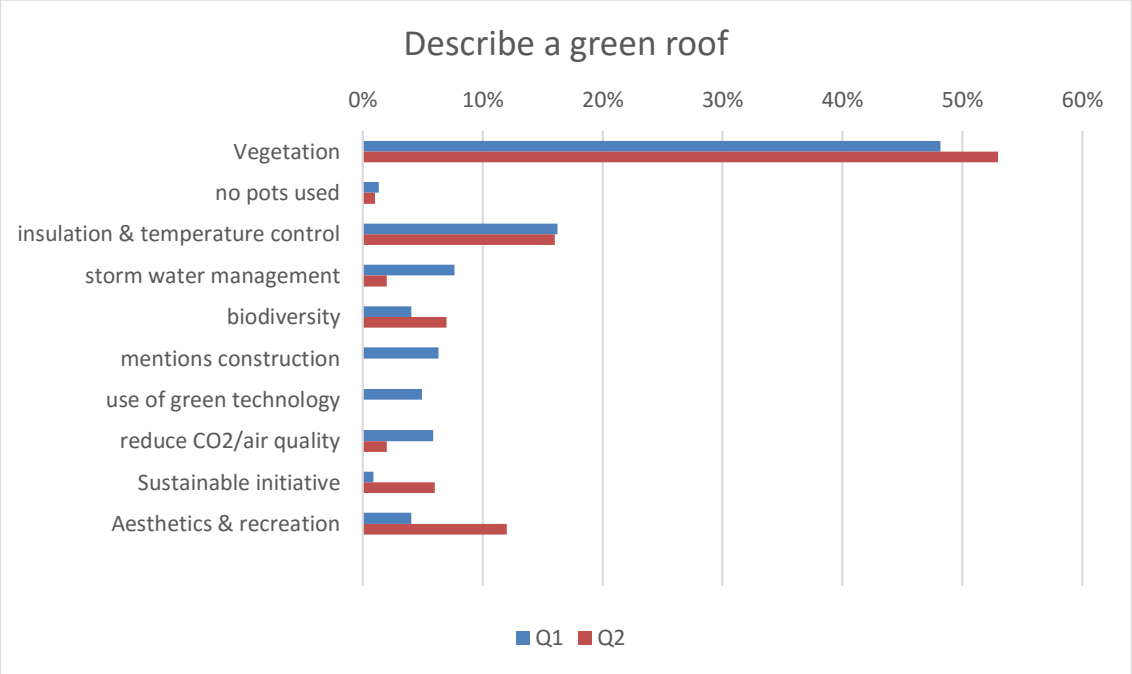
- The internet
- Personal interest
- Media

In both the 1st and 2nd questionnaires participants claimed that they heard about green roofs from the internet (21% and 36% respectively). Internet would encompass both website and social media. Personal interest also plays an important role. Individuals interested in green infrastructure would make an effort to research such technology (generally over the internet) and also subscribe to facebook groups and other blog pages. This would explain why most often respondents hear about green roofs over the internet.

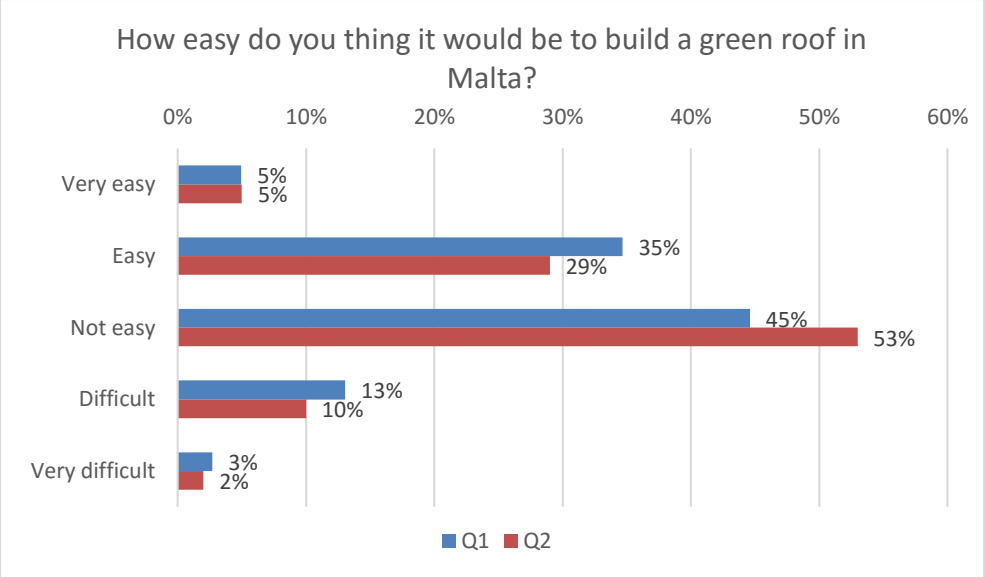


The media also plays an important role in disseminating information about green roofs. In the first questionnaire, 17% of respondents indicated that they heard of green roofs from Radio programmes, TV and newspapers articles. In the second questionnaire 27% of the respondents claimed that they heard of green roofs from Radio, TV and newspapers. Of particular note is that 21% of the participants of the second questionnaire claimed that they heard about green roofs through the LifeMedGreenRoof project. This shows that the efforts conducted by the project have been fruitful in disseminating information to stake holders.

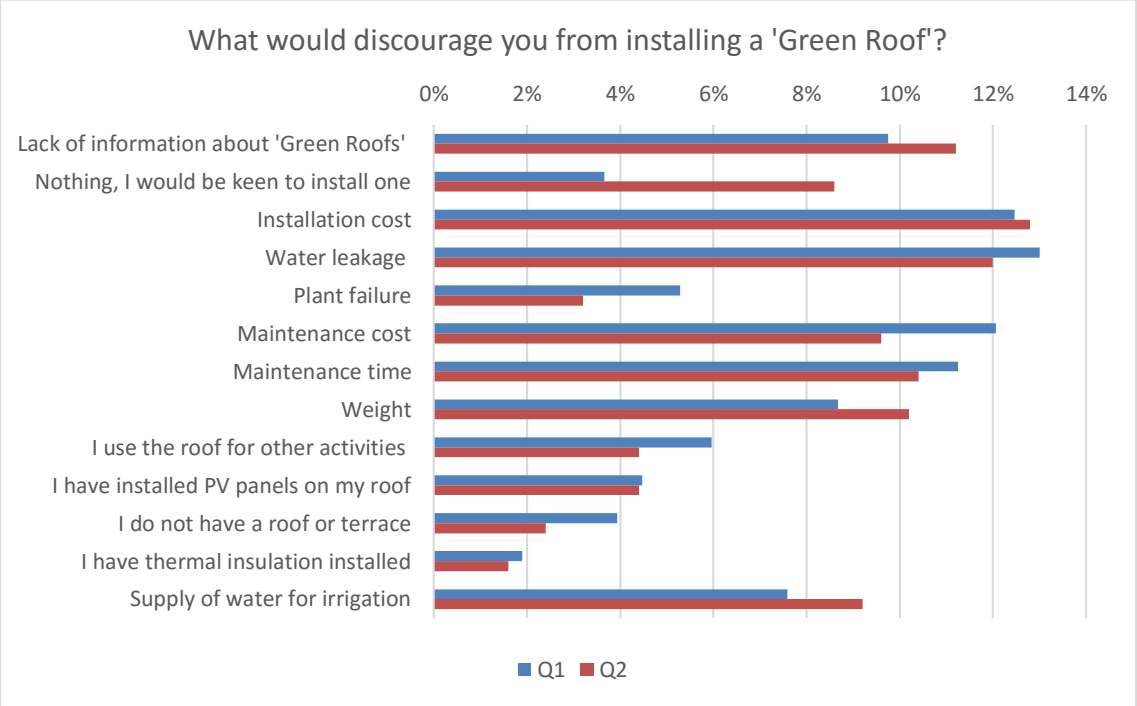
When asked to describe a green roof, participants in the second questionnaire seem to be more aware that green roofs involve the cultivation of vegetation (at roof level). This is further highlighted by the fact that, in contrast with the first questionnaire, no participants made reference to green technology (such as the use of PV panels, insulation and the like).
In both questionnaires, respondents stated that greened roofs increase the insulation properties of a building and have the capacity of rendering ambient temperatures more comfortable. The number of respondents who mentioned insulation was practically even. Fewer respondents in the second questionnaire mentioned the reduction of the carbon footprint of buildings and increased air quality due to green roofs.



It is clear from the results achieved that green roofs are seen as a sustainable initiative. Additionally, more participants seem to be aware that green roofs have aesthetic and recreational benefits. This has come out quite clear in the responses received when comparing both questionnaires. From the above, it seems that stake holders have a clearer picture of what green roofs are.



In the second questionnaire, less people thought that green roofs were very easy or easy to construct. However, on the other hand less individuals think that green roofs are not easy, difficult or very difficult to construct when compared to the results of the first questionnaire. It can be argued that this highlights the fact that demonstration green roofs are needed to give stake holders a better picture of the ease of green roof construction.



The construction of green roof for demonstration purposes would give a better picture of what green roofs are. Changing people's perception is very difficult. Continuous dissemination of information is needed to render stake holders aware of the benefits of green roofs to society and to render urban areas more sustainable.

Many of the concerns that appear in both questionnaires, are echoed in a number of scientific studies as indicated in the underlying table - taken from (Morris, 2016)

Barrier	Reference
Increase in maintenance cost	Peck and Calleghan (1999) Ngan (2004)
Increase in design and construction cost	Ngan (2004)
Lack of incentives from government towards owners of the existing building	Getter and Rowe (2006)
Technical difficulty during the design and construction process	Peck and Calleghan (1999) Getter and Rowe (2006)
The age of existing building	Townshend (2007)
Weak structural loading for applying extensive green roof system	Townshend (2007)
Lack of awareness on extensive green roof system in public sectors	Hui (2006)
Lack of promotion from the government and social communities among the public and private sector	Townshend (2007)

Although such perceived barriers are real, many can be overcome. For instance, public authorities could intervene by offering incentives to reduce construction costs. Good working practices could alleviate workmanship fears such as water leaks. Other misconceptions regarding maintenance time and cost could be reduced with the choice of plants and construction detailing. The LifeMedGreenRoof project has seen to these issues by: 1. Meeting up with policy makers to show the progress made by the project and to discuss with them the possibility of introducing green roof policies, 2 Take part in information dissemination activities for the general public, professionals, and educational institutions to disseminate information about green roof construction and benefits.

Another positive issue which came up in comparing both questionnaires was the fact that more individuals claim to be prepared to install green roofs on their property. This illustrates that information dissemination effort carried out by the LifeMedGreenRoof project has been effective.

Conclusion

The demographic distribution of the second questionnaire was much broader, probably due to the way it was disseminated/circulated (electronic and paper copies). The occupation groups varied and included policy makers and the design industry although most of the respondents came from the education sector.

On analysing the replies to the questionnaires, it can be concluded that most of the participants had heard the term green roof through the internet. It could be argued that this reflects peoples' interest in the subject. People who are interested in a specific topic tend to research the topic more often over the internet. The questionnaire also indicates that the efforts of the LifeMedGreenRoof project to disseminate information on green roofs using printed and electronic media has paid off. The questionnaire results show that the internet (including social media) is more effective at influencing the public's understanding of green roofs than conventional media such as the TV, radio and newspapers.

It was evident that holders are now more aware of what green roofs involve and what their benefits are. The majority of respondents understand that green roofs involve the cultivation of plants on roofs and that they provide benefits including insulation. The responses show that there was a shift in what people perceived as green roofs. In the first questionnaire, respondents were more likely to think of green roofs as being roofs that used technology such as PV panels and solar water heaters. During the period of the second questionnaire, it appeared that there is a better understanding that green roofs involve the use of plants. The majority stated that green roofs offer advantages related to the lowering of ambient temperature and the insulation of buildings. From the results it can also be said that stake holders understand that green roofs, like any other green infrastructure, provide a variety of benefits such as aesthetic improvement and improvement of air quality. Although increase in biodiversity and increase in quality of life still featured in the replied they scored less points. This

could indicate that the public still does not associate the health of the ecosystem with the increase in quality of life. It also transpires that what is less understood by the respondents is the fact that green roofs can increase the lifespan of structures and also value of property.

By comparing both questionnaires, it transpires that people's impression on how easy it is to have a green roof is still somewhat negative. Most respondents are of the opinion that it is not very easy to install a green roof. However, on a positive note, far less participants thought that building a green roof is difficult or very difficult.

The limitations to the establishment of green roofs in Malta indicate clearly the need for both incentives and demonstration projects. The cost of installation was selected as the most limiting factor followed closely by the lack of interest. Having to import most of the components for green roof construction renders the technology prohibitively expensive for many. Financial incentives would ease the capital cost and encourage more the dissemination of green roof technology.

For government and other public institutions to install green roofs on public buildings would give a clear message on the benefits of green roof and the need for their dissemination on a national scale. For these two reasons the LifeMedGreenRoof project has published a policy document and a socio-economic benefit document which highlight these issues. The project is also lobbying government and other policy makers to push towards the introduction of policies favouring green roof dissemination through incentives, regulations and demonstration projects.

Demonstration green roofs can also be constructed on corporate buildings. It would be in the interest of corporations to have green roofs both in terms of creating a green image and in creating more sustainable and desirable office space.

Understandably, water consumption is of concern to the public when it comes to maintaining green roofs. This concern is justifiable given that many buildings constructed in the last 20 years or so have failed to include water reservoirs even though required by law. Given the lack of precipitation in Malta especially during summer, some irrigation is necessary on green roofs and its volume is dependent on the species selected for cultivation. The questionnaire has highlighted other concerns by the public including the weight of the green roof. This is especially true with old dwellings having beams and masonry slabs (xorok) for a roof. Buildings with concrete roof slabs should not pose an issue; it is always advisable to consult a structural engineer.

Other concerns participants highlighted include maintenance and possible leaks. Although these concerns are justified, they relate generally to good workmanship. The project, through the partner MCCAA has published a national standard for green roofs (SM3500/2017) which provides guidelines to good installation practice and would therefore alleviate such concerns. From the experience gained in maintaining the demonstration green roof as part of the LifeMedGreenRoof project, it transpired that maintaining a green roof requires little energy or time but the species selected would influence this. Some plant species require more attention than others.

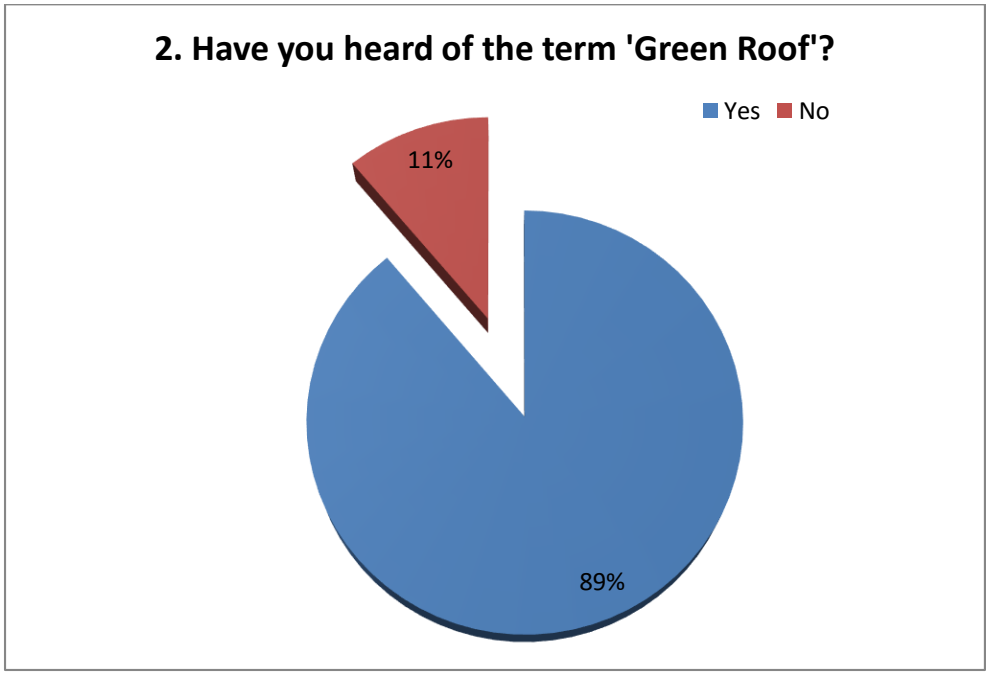
Notwithstanding the above, respondents still recognise that green roofs are very important or important in increasing the quality of life and well-being of people. Only a negligible number of individuals were sceptical about the benefits of green roofs and only a small number had a neutral attitude towards them.

The design profession

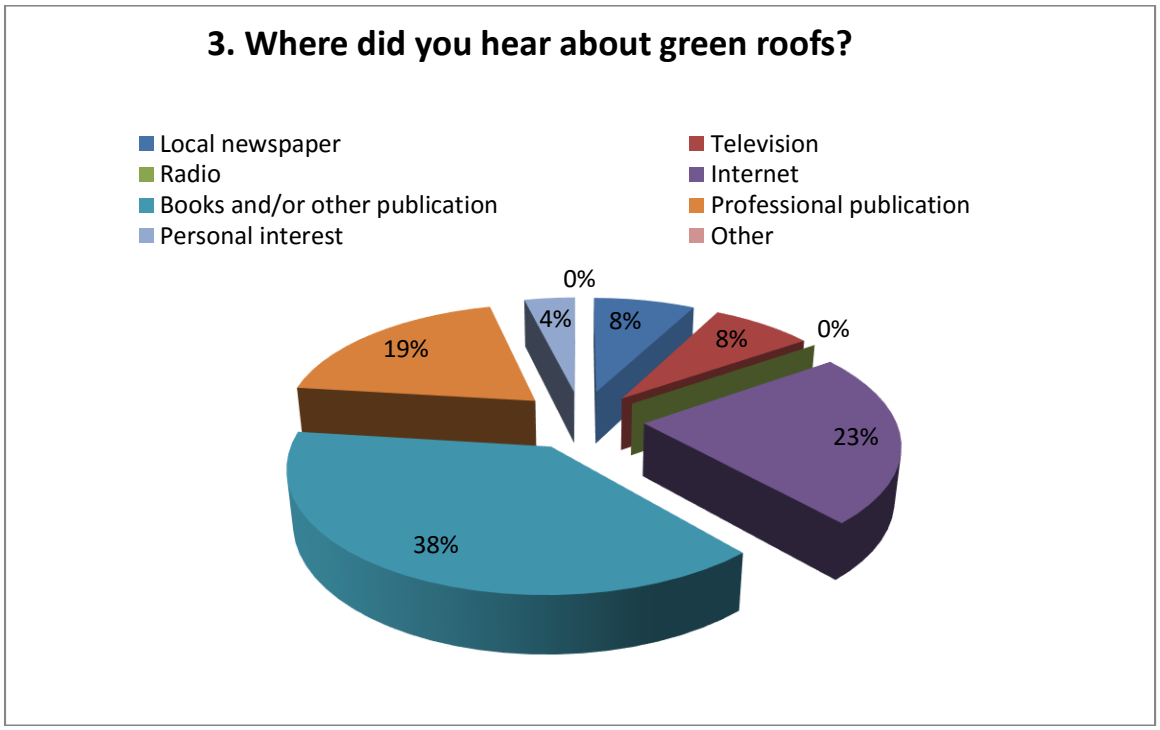
Getting hold of the design professionals proved challenging and as such it was decided that rather than conducting the interviews electronically, a face-to-face interview would be more appropriate. An interview was arranged with a number of architectural firms. Getting an appointment proved challenging as many firms did not have the time to dedicate for an interview. However, 27 interviews were confirmed with different design/architectural firms. This constitutes to around 12% of the architectural firms advertised in the yellow pages directory which is Malta's most popular business directory.

The layout of the questionnaire follows closely that of the general public although some questions have been omitted as they did not fit the context.

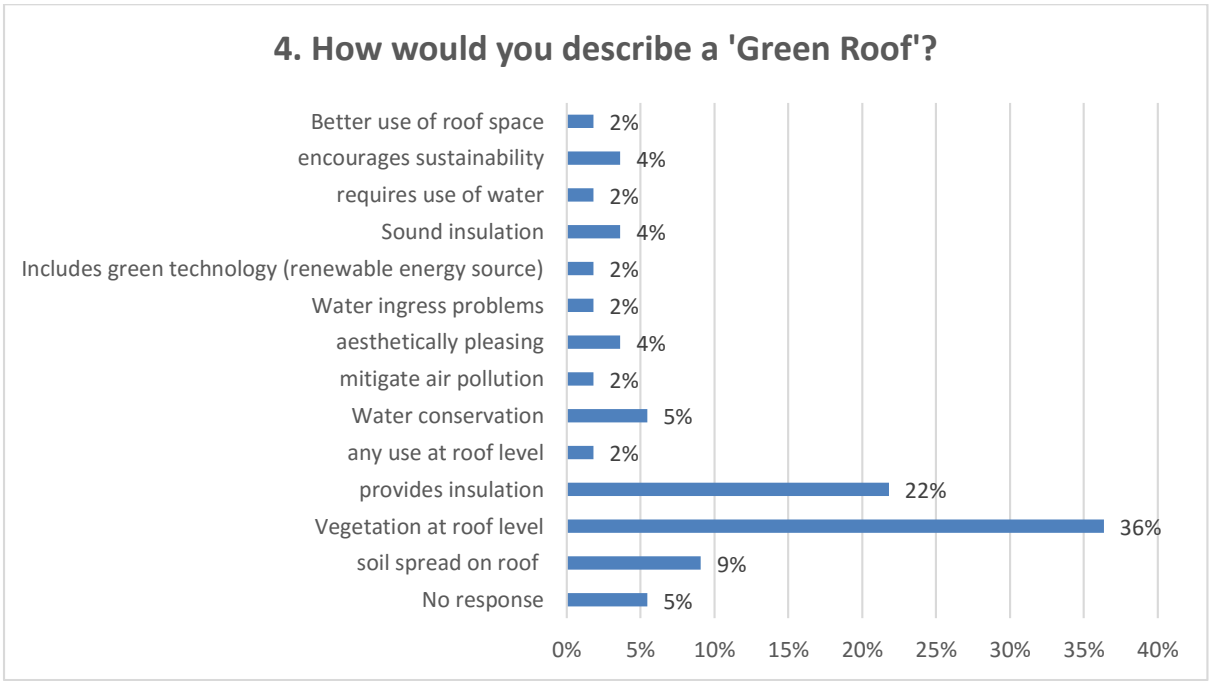
The above image illustrates the distribution of the respondents' over the Maltese islands. The distribution is fairly consistent with the distribution of the high density urban areas in Malta.



Of the 27 design firms 11% claimed that they have never heard of the term ‘green roof’, this accounts for 3 firms.



Most of the respondents who heard about green roofs said they did so from books and other publications (38%) whereas 23% claim they heard about green roofs from the internet. Professional publications account for 19% of the replies. Radio did not score any points whereas television and local newspapers account for 8% each of the replies. Only 4%, i.e. one individual claimed to have learnt about green roofs through personal interest.



36% of the replies did mention that green roofs involve the use of vegetation at roof level. 22% of the respondents mentioned the use of green roofs for insulation purposes however, very few replies made reference to water conservation (5%), and pollution mitigation (2%). No one mentioned flood mitigation however sound insulation (4%) and aesthetic benefits (4%) were also used to describe a green roof. Other characteristics mentioned of note include the problem of water leaks and the need of water for irrigation. These illustrate concerns towards the technology.

In question 5a-f images of various roofs were depicted and asking whether the same roofs were green roofs or not. This was done to assess whether the respondents were able to identify a green roof or not. The correct answers are as follows:

Which of the following images is a green roof?	
5a	**yes**
5b	**no**
5c	**yes**
5d	**no**
5e	**no**
5f	**yes**

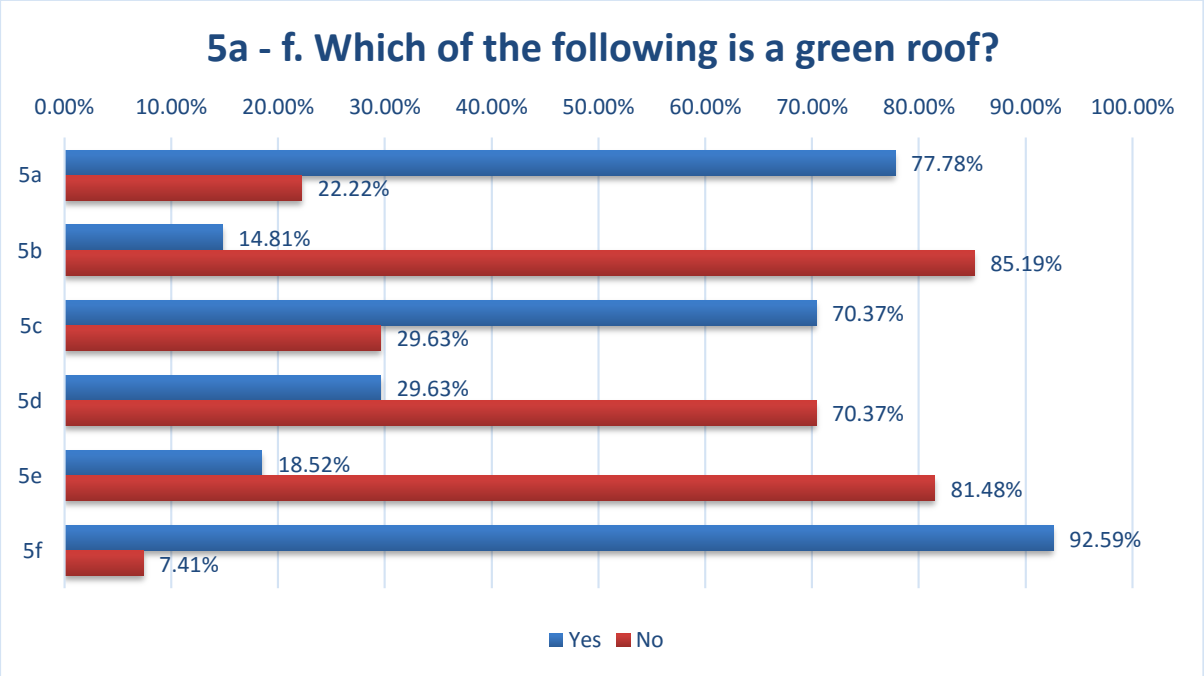
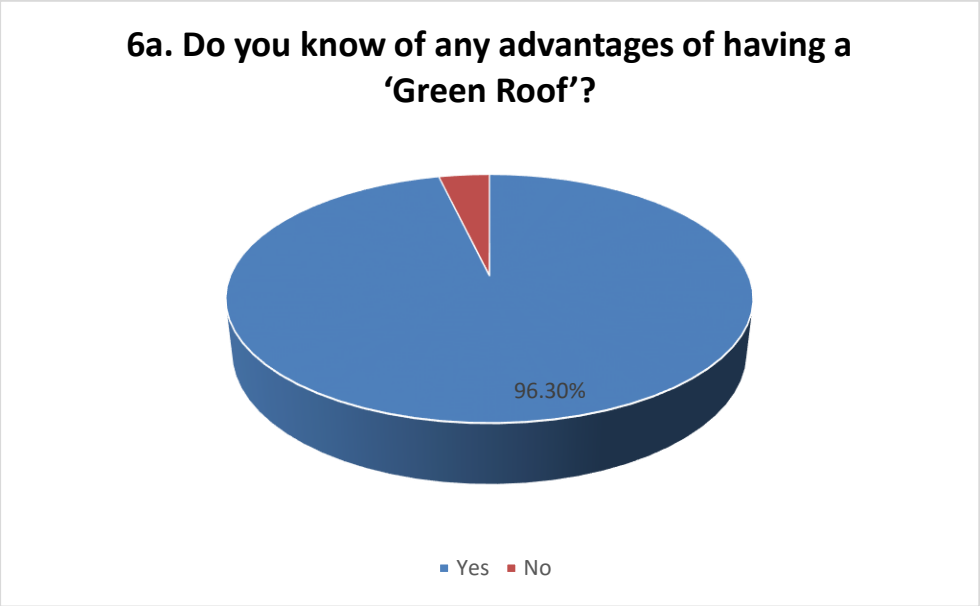
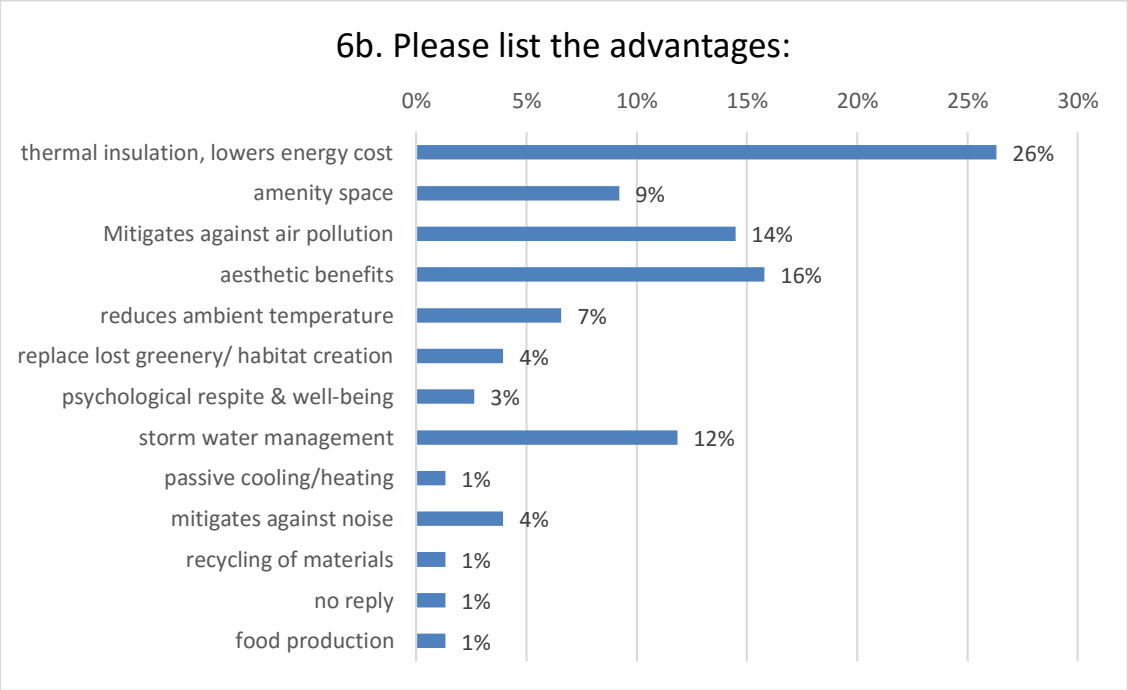


Image 5a illustrates a dwelling with a grass roof. Most of the respondents identified this as a green roof (78%) whereas 22% did not.
Image 5b constitutes a normal timber building with a conventional roof covered with a damp proofing membrane. 85% identified that the roof is not a green roof whereas 15% said that the roof is a green roof.

Image 5c illustrates a dwelling with a green roof composed of sedums. 70% did acknowledge that this was a green roof while 30% of the respondents did not identify it as a green roof.
Image 5d-e illustrate a roof/terrace which have been designed for amenity purposes. Furthermore, in image 5d the plants are cultivated in pots. For image in question 5d 30% said that the image does

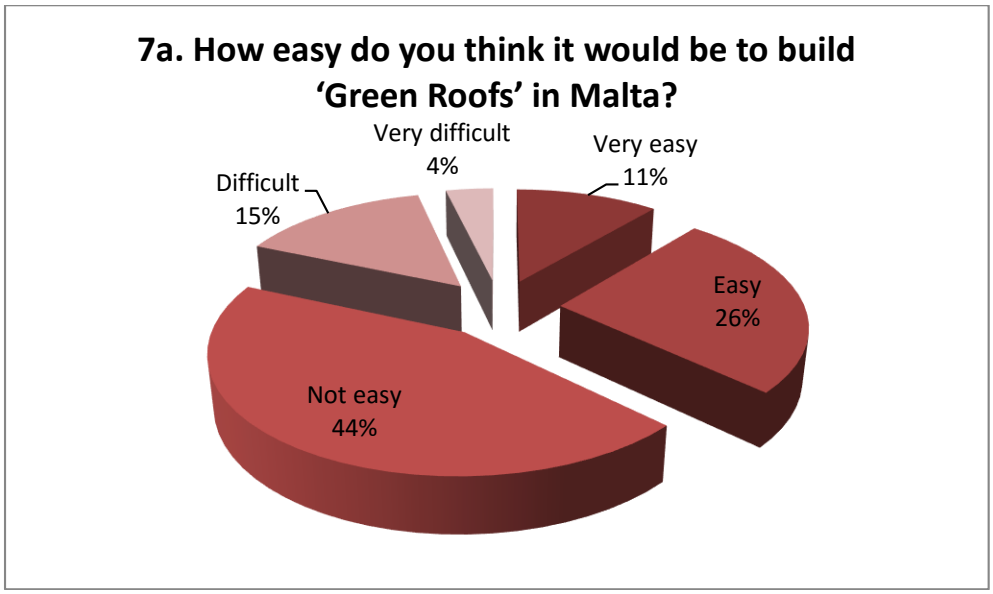
represent a green roof whereas 70% said that it does not represent a green roof. In question 5e 19% of the individuals identified the image as a green roof as opposed to 81% who said that the image does not constitute a green roof.
Image 5f is a semi intensive green roof. 93% of the respondents did identify it as a green roof whereas 7% did not.
96% of the respondents claim they are aware of advantages of having a green roof.



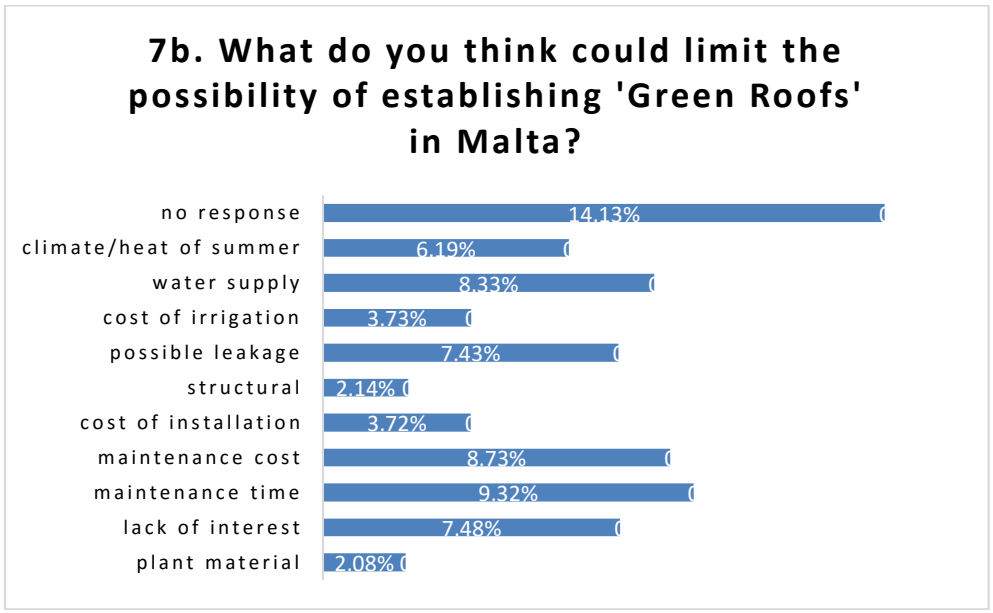


The major percentage of respondents (96%) are aware that green roofs provide advantages to the urban environment. 26% of the listed replies mentioned thermal insulation, followed by aesthetic benefits which constitute 16% of the replies while the mitigation of air pollution scored 14%. 12% of the replies referred to storm water management whereas 9% referred to the creation of amenity space. Other advantages listed included the replacement of lost habitats (4%), noise suppression (4%), and psychological respite and well-being (3%). Recycling of material, passive cooling, and food

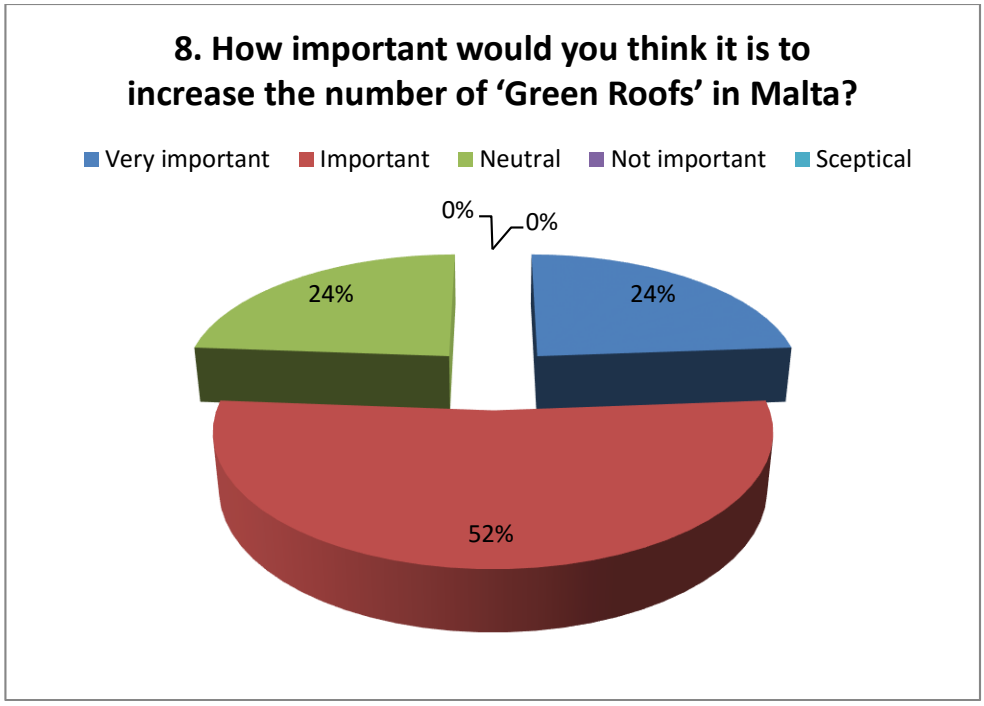
production were also mentioned (3% in total). 1% of the respondents chose not to reply to this question.



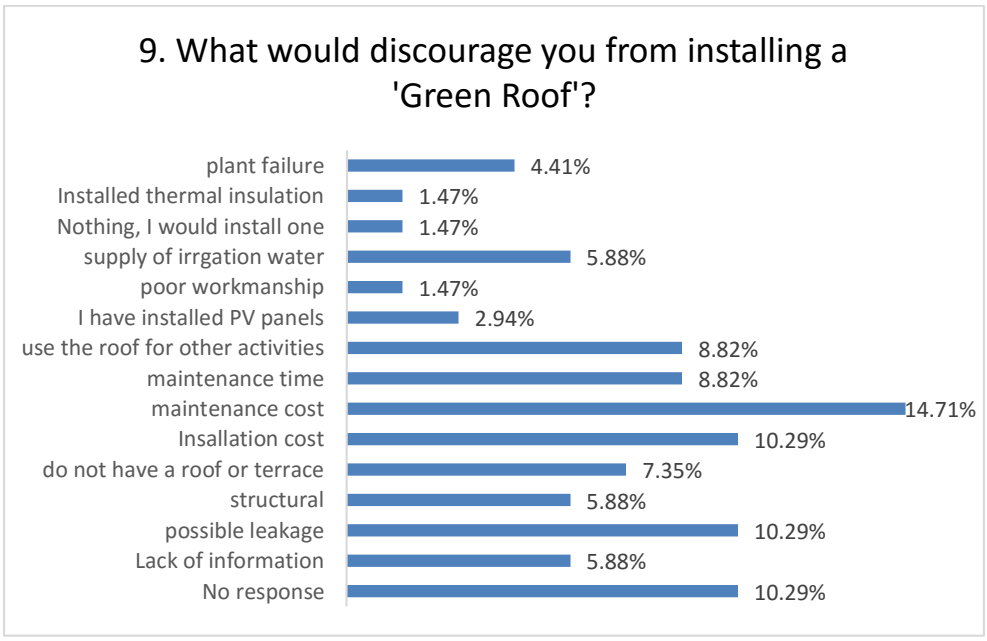
From this question it transpires that 44% of the design professionals think that green roofs are not easily built whereas 26% think that is easy. Only 4% think that green roofs are very difficult to construct and 15% think they are difficult. 11% responded to very easy.



This question listed a number of limitations which the respondent could select. 14% of the respondents did not reply to this question for some reason. The largest limitation selected was maintenance time and cost (9.32% & 8.73% respectively). Water supply for irrigation is also of concern (8.33%) as is the possibility of water leaks (7.43%). Lack of interest from the general public also scored high with 7.46%. Only a minority view the availability of plant material as a limitation for the establishment of green roofs.

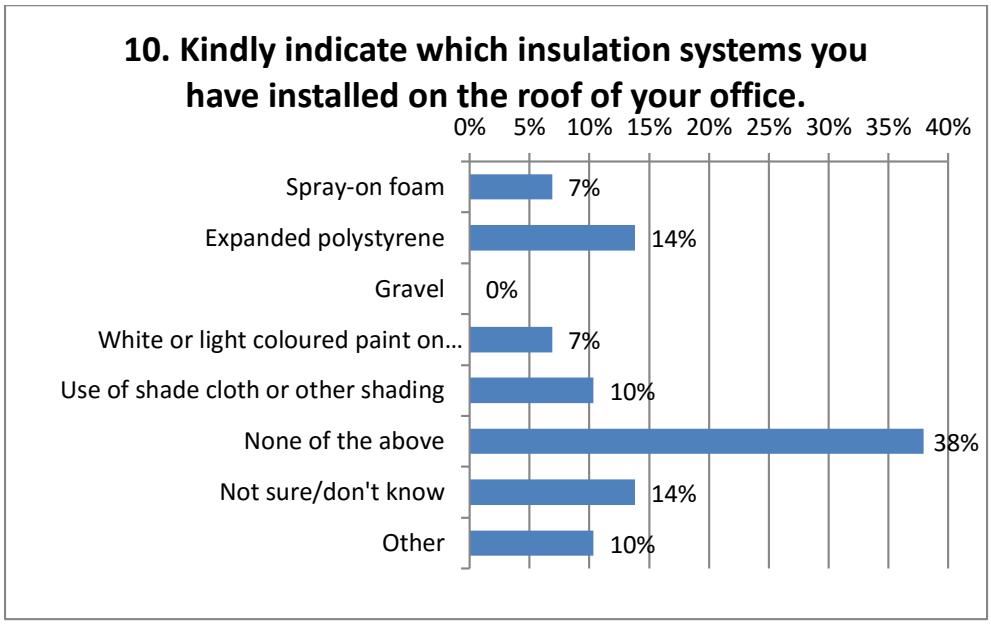


It resulted that most of the respondents think that increasing the number of green roofs is important with over 52% of the responses and 24% think that it is very important. 24% consider the increase in number of green roofs as being of neutral importance. None of the respondents consider the increase in green roofs as being either 'not important or of being 'sceptical' towards the increase in green roof numbers.

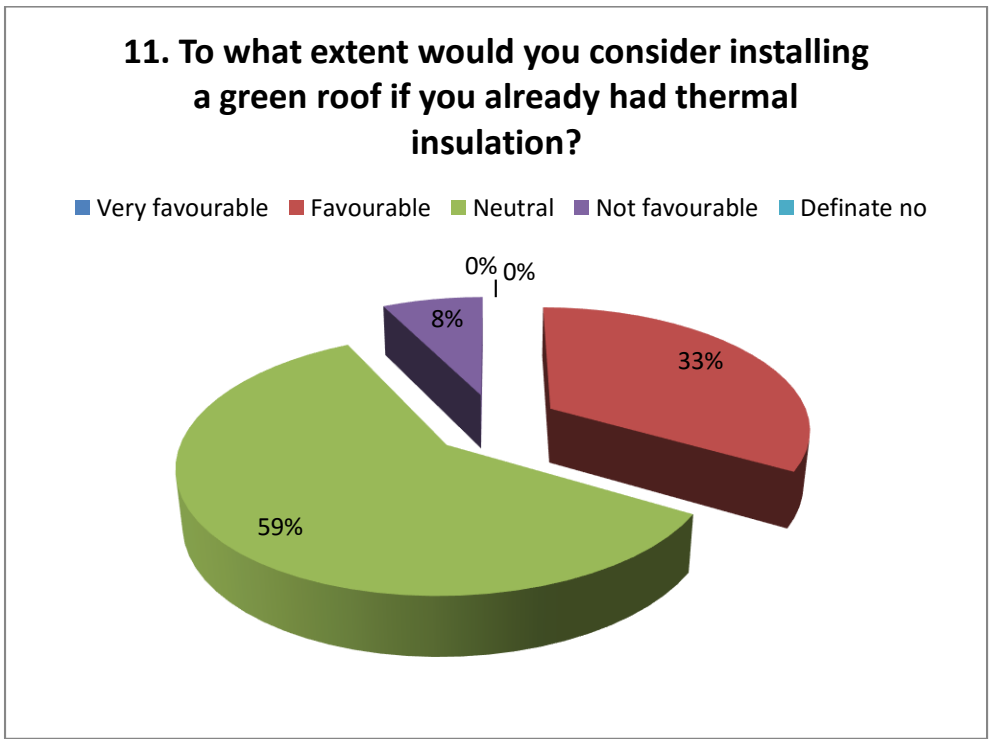


10% of the respondents did not respond to this question. Maintenance cost (14.71% of the total responses) is the factor which discourages the installation of green roofs. Possible leaks and installation cost (10.29%) are also of concern. Maintenance time and the use of the roof for other activities also limit the installation of green roofs (almost 9% of total respondents) together with lack of information and the supply of irrigation water (5.88%). The items of least concern are plant failure

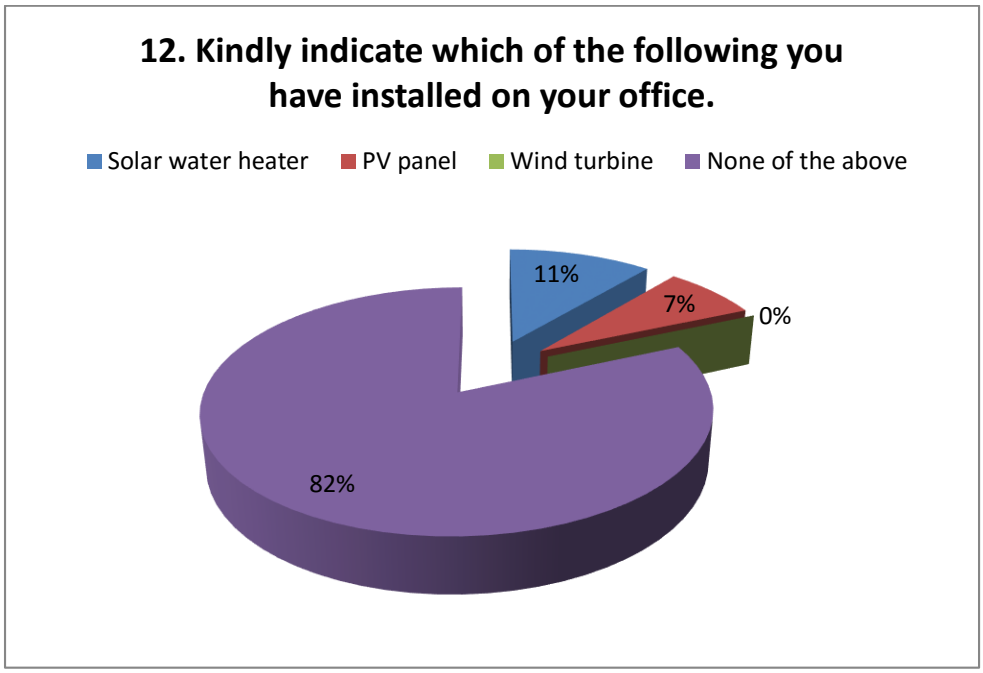
and poor workmanship. Only one percent claimed to be willing to install a green roof. A further 1% claimed they would not install a green roof due to the presence of roof insulation.



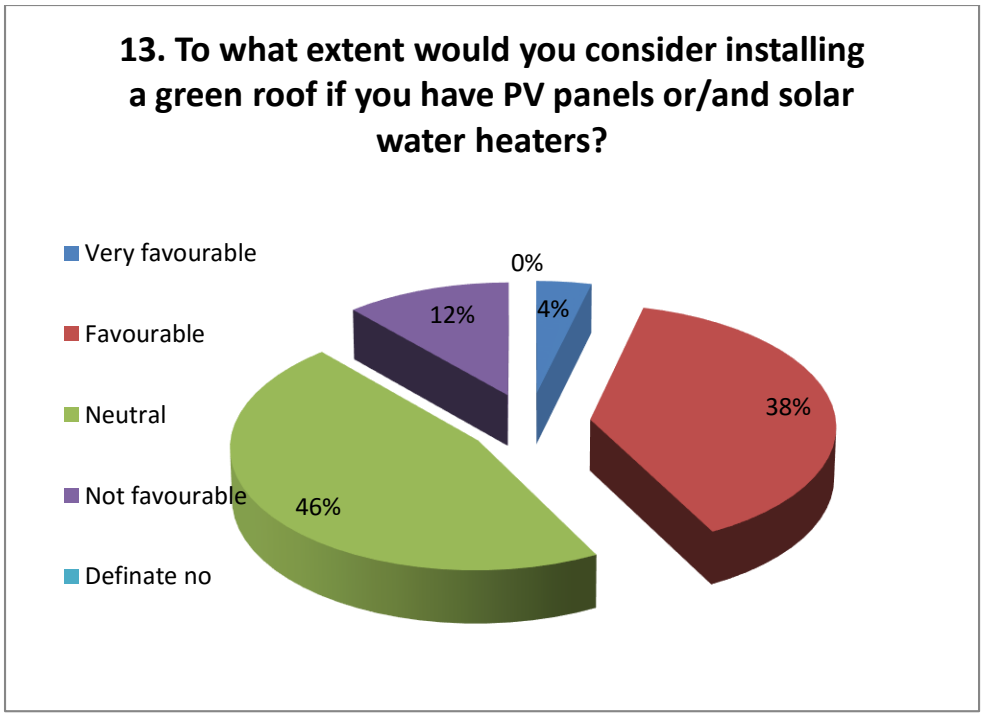
When asked about which insulation system was installed on the office building, 38% replied that no insulation was present whereas 14% were unsure whether the roof was insulated and if it were, what type it was.



This question analysed the respondents' willingness to install green roofs for other benefits other than that of insulation. It transpires that 59% of the designers gave a neutral reply, however 33% still would consider installing a green roof in the presence of thermal insulation. 8% would not consider installing a green roof. However, none of the respondents were either very favourable or very unfavourable on the matter.



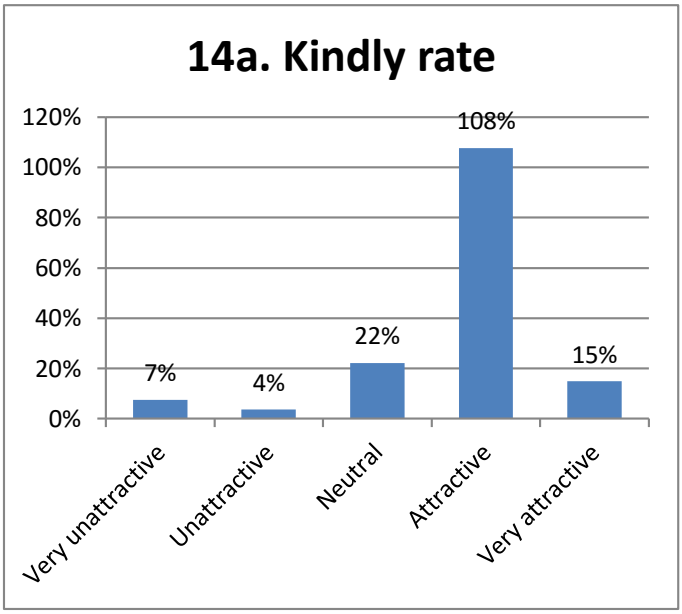
It resulted that 82% of the respondents do not use alternative energy sources at the office and only 11% have installed a solar water heater. 7% have installed photo voltaic panels and no one makes use of wind turbines.



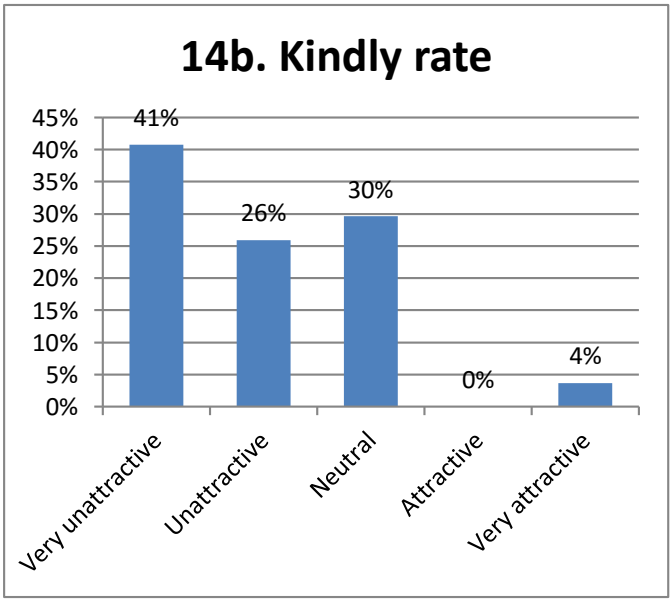
Green roofs have the ability of lowering the ambient temperature around it. This means that equipment would generally perform better as heat tends to decrease efficiency. PV panels tend to loose efficiency when air temperatures rise beyond 24°/25°C. Through transpiration and through shading and other factors, green roofs lower air temperatures rendering such equipment more efficient.

When confronted with the above question, designers, response was mainly neutral (46%) whereas 38% claimed that they would still consider the installation of green roofs. Only 12% were not in favour and 4% were very much in favour. None of the respondents were absolutely against the installation of green roofs in such a situation.

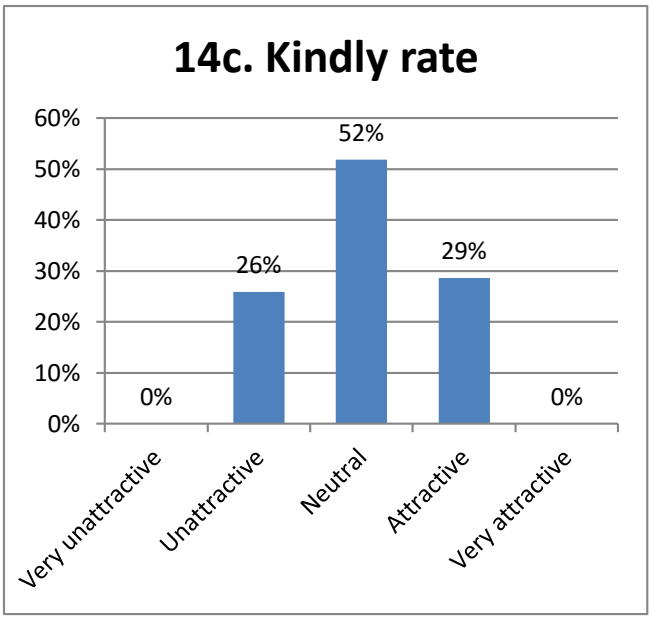
To assess the perception of designers towards green infrastructure, respondents were presented with three images of the same street but with varying degree of green infrastructure. The images were composed of (a) a typical street with street trees incorporated, (b) the same scene but without planting, and the last image (c) illustrated the same street but with window boxes and other plants. The outcome follows:



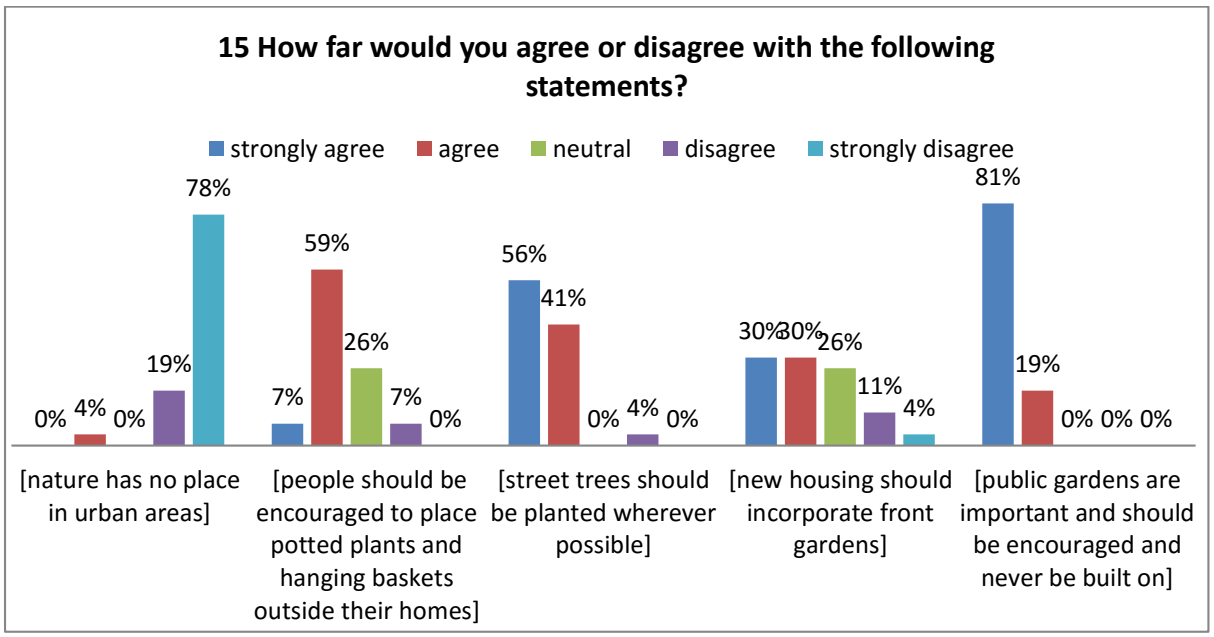
The majority of the respondents rated the scene as attractive (108%) whereas only 15% rated it as very attractive. 22% of the respondents gave a neutral response whereas 4 % and 7% rated the scene as unattractive and very unattractive respectively.



The majority of the respondents indicated that the street looked very unattractive (41%) were as 26% rated it as unattractive and 30% as neutral. None of the respondents considered it as attractive and only 4% thought that the street view was attractive.



The last image illustrated the same street with window boxes and other vegetation. Most of the respondents rated the scene as neutral wheras 26% and 29% rated the scene as unattractive and attractive respectively. No one rated the scene as very unattractive or very attractive.



The respondents were asked to indicate whether they agreed or disagreed with a series of questions related to the presence of green infrastructure in urban areas.

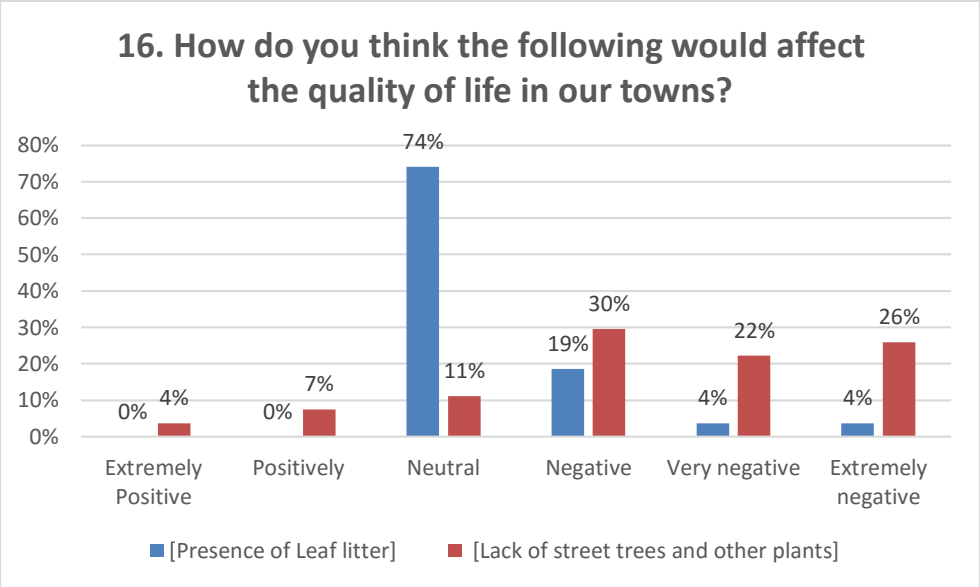
When asked whether nature has **no** place in urban areas, most (78%) strongly disagreed, whereas 19% disagreed. Thus 96% agreed that nature has a place in urban areas. Only 4% agreed with the statement that nature has no place in urban areas.

When confronted by the statement as to whether potted plants and hanging baskets should be encouraged outside dwellings, 7% strongly agreed and 59% agreed with the statement. 26% gave a neutral response and only 7% disagreed. None of the respondents strongly disagreed with the statement.

When asked to rate whether street trees should be planted wherever possible 56% strongly agreed with the statement and 41% agreed. Only 4% disagreed and none of the respondent gave a neutral response or a strongly disagree response.

Concerning the incorporation of front gardens in new housing schemes, 30% strongly agreed and another 30% agreed with the statement. 26% gave a neutral response and 11% disagreed. 4% strongly disagreed.

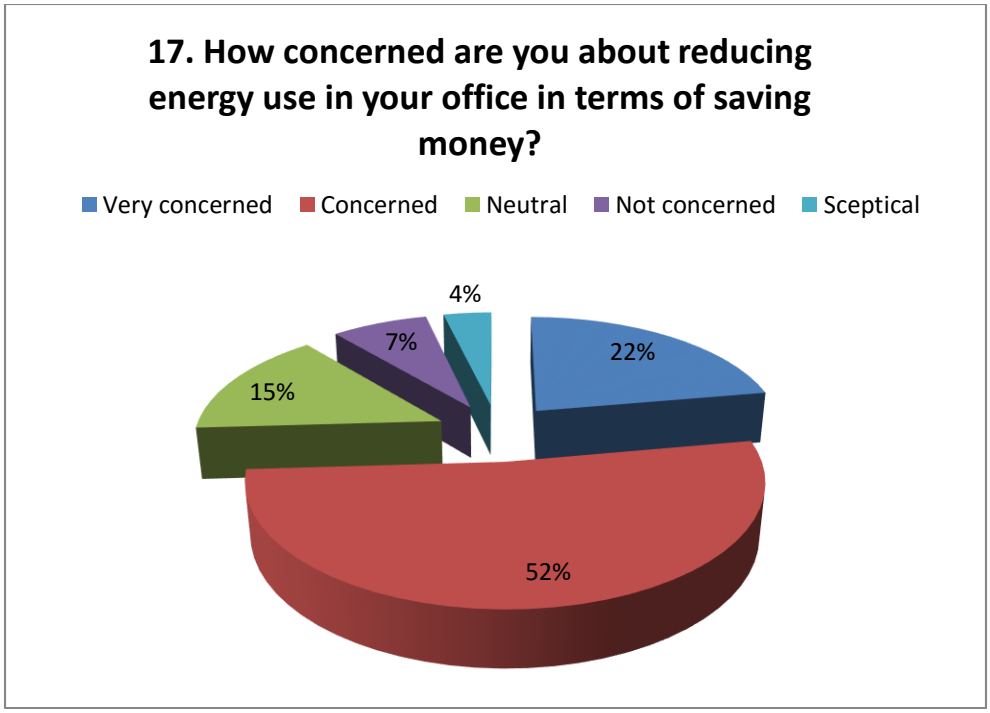
Finally, 81% strongly agreed that public gardens are important and should be encouraged and never be built upon. Whereas 19% gave an agree response. None of the respondents gave a 'disagree' or 'strongly disagree' response.



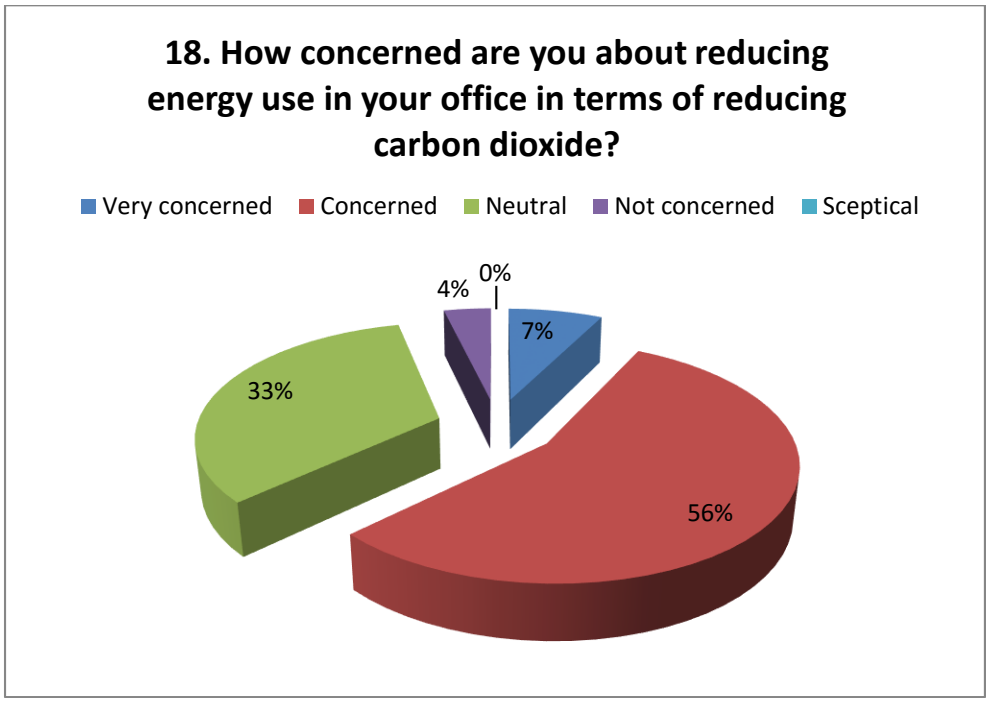
The excuse of leaf litter is one reason why many street trees are removed from the streetscape and never replaced. When asked whether leaf litter affects the quality of life in towns, most of the respondents gave a neutral response (74%) whereas 19% gave a negative response. Very negative and extremely negative were both indicated by 4% of the respondents.

Lack of street trees was regarded as extremely negative by 26% of the respondents and very negative by 22% of the respondents. 30% regard the lack of street trees as negative whereas 11% rated the situation as neutral. 7% of the individuals regard the lack of street trees as positive were as 4% regard it as extremely positive.

It often seems that people adopt environmentally sustainable attitudes for the wrong reason i.e. for financial reasons rather than for the sake of sustainability. The following questions have been asked to test this issue.



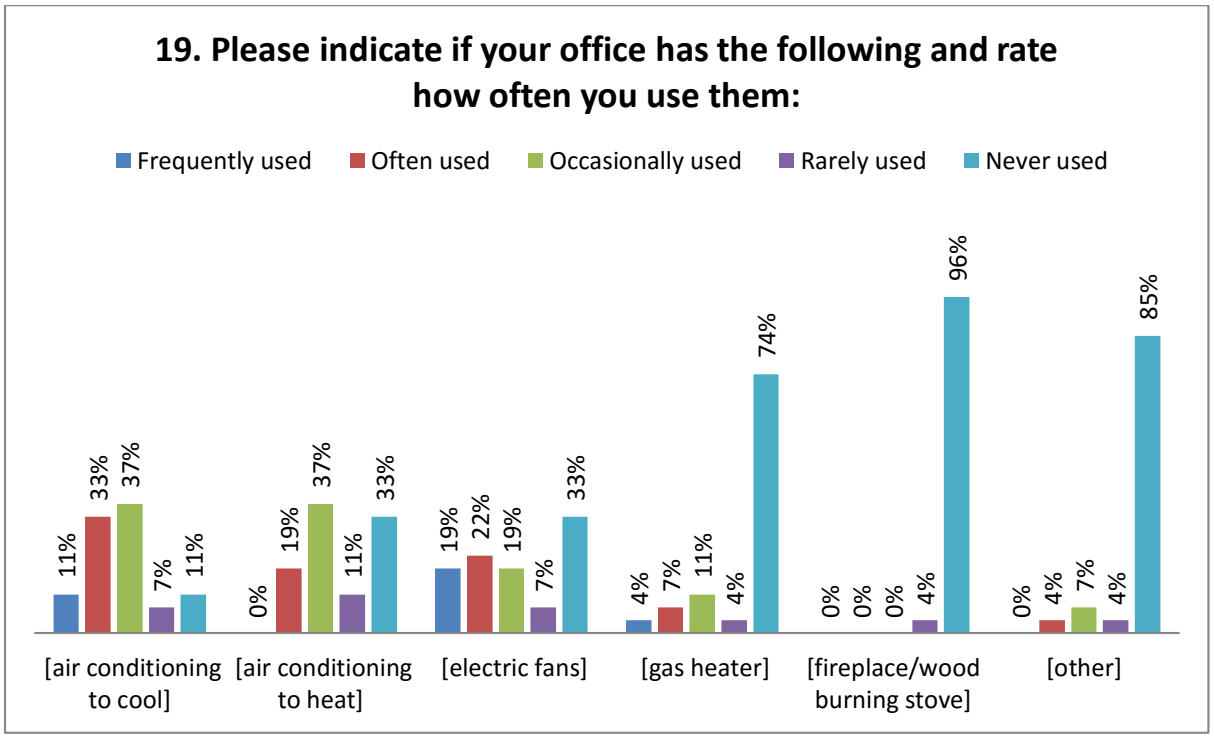
From the replies received, it is evident that most individuals are 'very concerned' and 'concerned' about reducing energy consumption for financial reasons (52% and 22%). 15% replied that they are passive about the issue, whereas 11% are either 'not concerned' (22%) or 'sceptical' (4%).



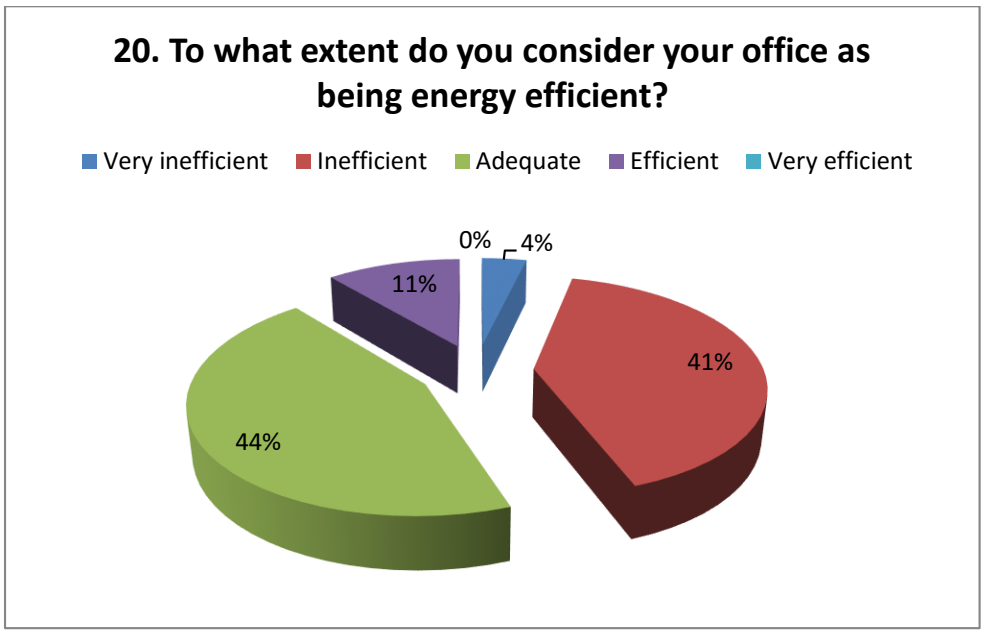
When asked about their concern about reducing energy consumption to reduce carbon dioxide 56% responded that they are 'concerned' whereas 7% are 'very concerned'. 33% of the respondents gave a 'neutral' response whereas 4% indicated that they are 'not concerned' at all.

By comparing the results of the last two, it transpires that more individuals reduce energy consumption for financial reasons as opposed to those who reduce energy due to carbon emissions (74% vs 63%). More individuals are passive in terms of reducing energy to reduce the carbon footprint

(33% vs 15%). However, more individuals are 'not concerned' and 'sceptical' when it comes to reducing carbon dioxide for financial reasons (11%) than for reducing CO_2 (4%).

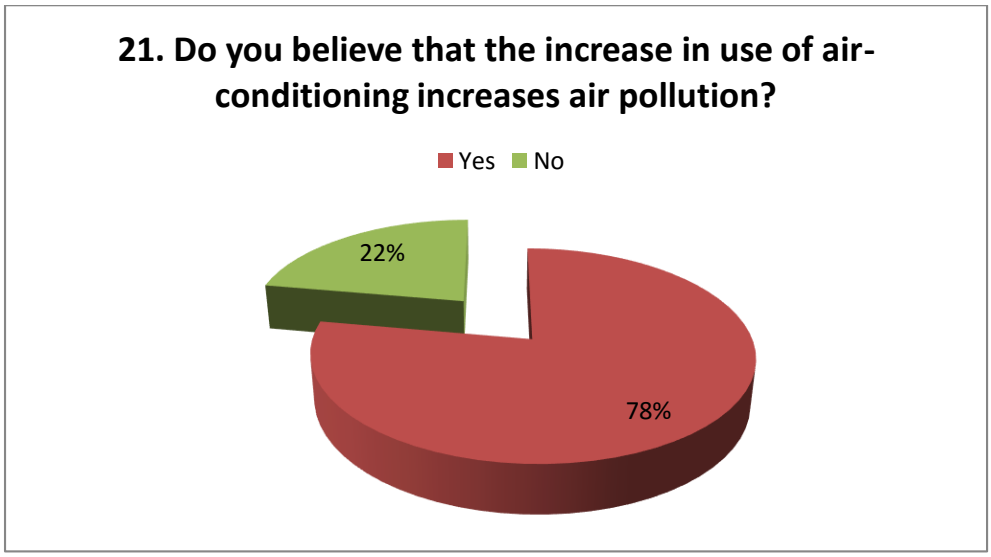


From the above it results that:
81% of the respondents use air conditioners to cool whereas only 56% use them to heat. This reflects the fact that our summers can create uncomfortable indoor environments due to the warm weather whereas our winters are mild rendering indoor environments less uncomfortable. This can also be observed when analysing the use of electric fans (^0% of the respondents use fans 'frequently'/'often' and 'occasionally' as opposed to gas heaters in winter (22%).

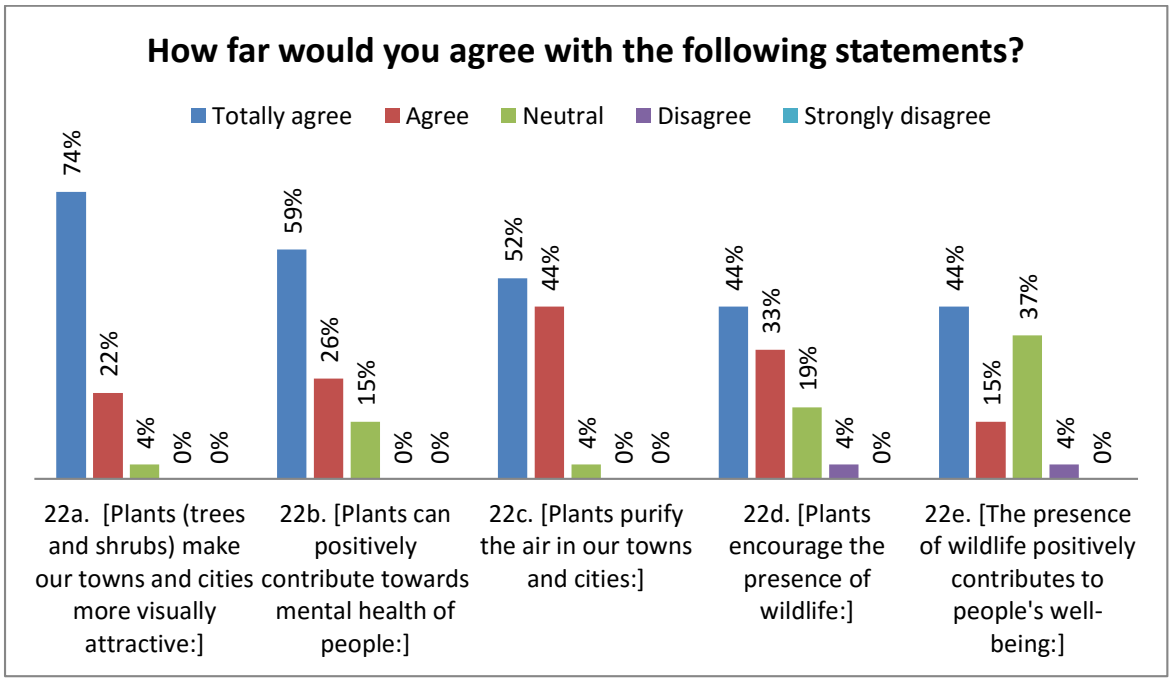


When considering energy efficiency, 4% of the respondents claimed that their office is 'very inefficient' and 41% consider the office as being energy 'inefficient' (giving a total of 52%). 44% consider their

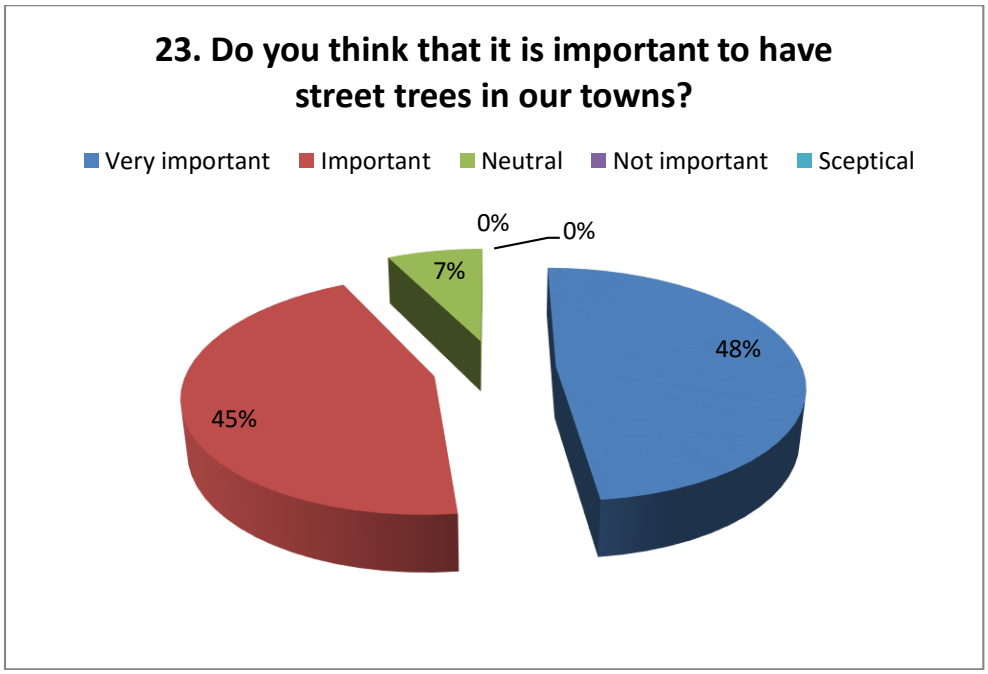
office to be 'adequately efficient' whereas only 11% consider their office to be efficient. None of the respondents consider their office as being 'very energy efficient'.



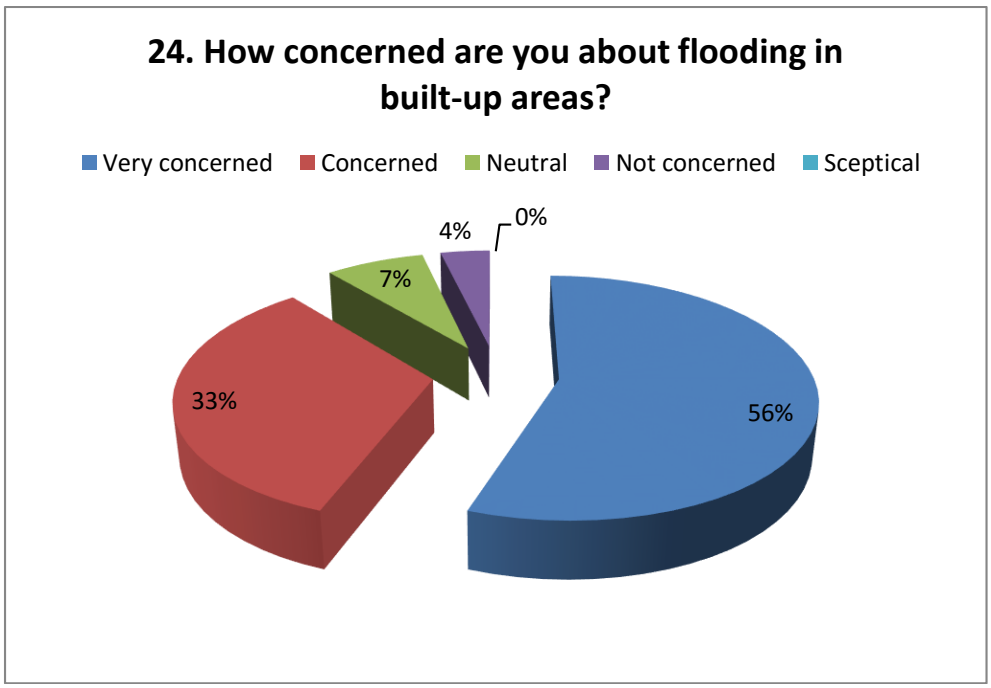
Most of the respondents (78%) believe that air conditioning contributes to air pollution.



The above questions tested the subjects' perception on the benefits of green infrastructure. In 22a. virtually all subjects agree that plants contribute to the visual amenity of the townscape &4% totally agree, 22% agree whereas only 4% gave a neutral reply.
When asked whether plants contribute towards mental health 85% agree or totally agree while 15% gave a neutral response.
96% agree that plants purify the air in urban areas. Only 4% gave a neutral response.
However, whereas 77% agree or totally agree that plants encourage the presence of wildlife, 19% gave a neutral response and 4% disagree with such a statement.
Whether wildlife contribute towards people's well-being, 49% totally agree or agree, 37% gave a neutral response and 4% disagreed.

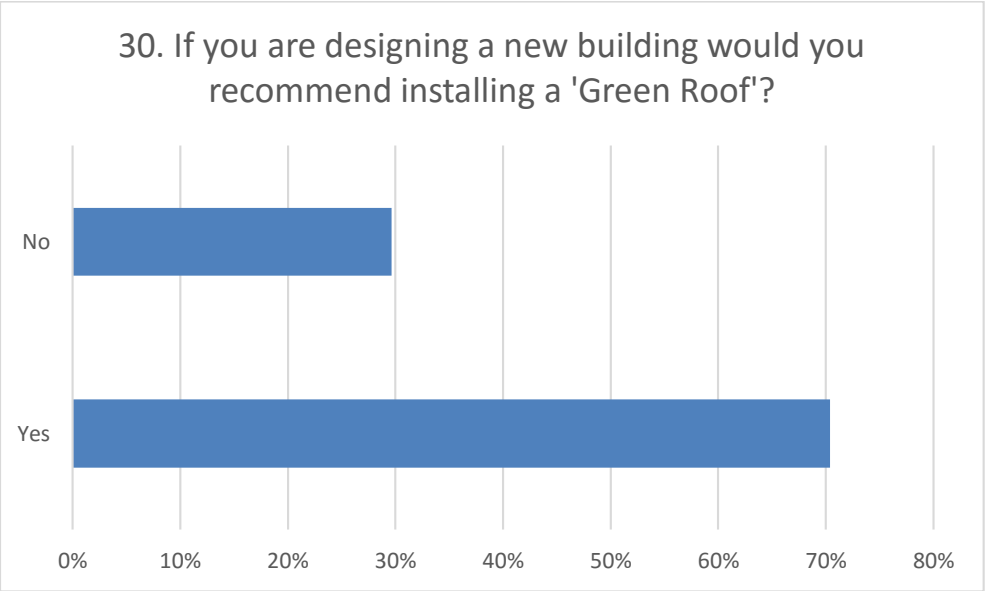


Considering the fact that most of our streets are devoid of trees and considering the fact that there is a perception that the public are sceptical about the benefits of street trees, designers were asked their opinion about whether street trees are important in urban areas. 48% of the subjects responded that street trees are very important however, 45% replied that trees are important. 7% gave a neutral response and none were sceptical or think trees are not important.



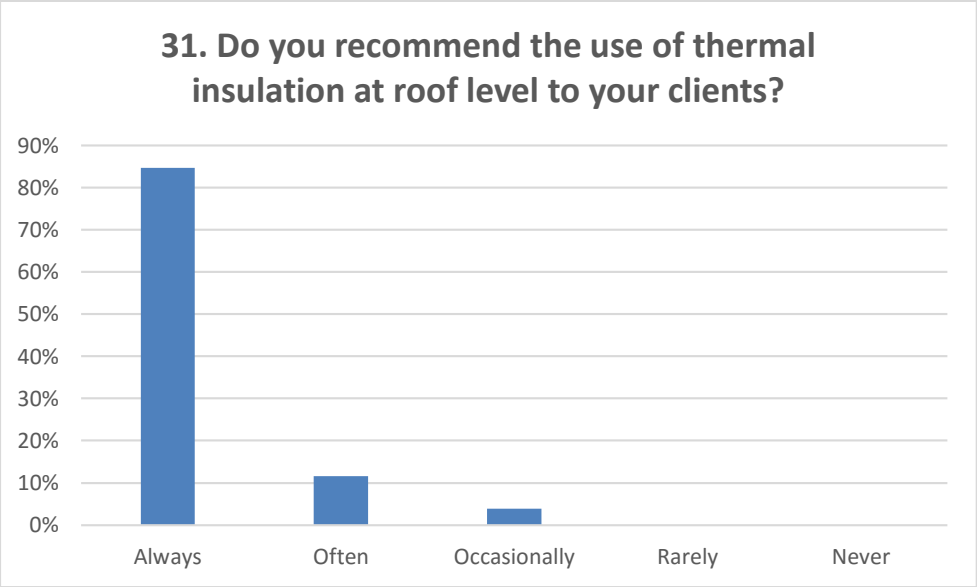
Flooding is an urban related problem generally linked to soil sealing and the disruption of natural water catchment areas. Green roofs can contribute to mitigating flooding and as such a question was asked about the concern of flooding.

The majority (56%) of the respondents are very concerned about flooding in built up areas. 33% indicated that they are concerned whereas only 7% gave a neutral response. 4% were not concerned at all and none of the subjects were sceptical.



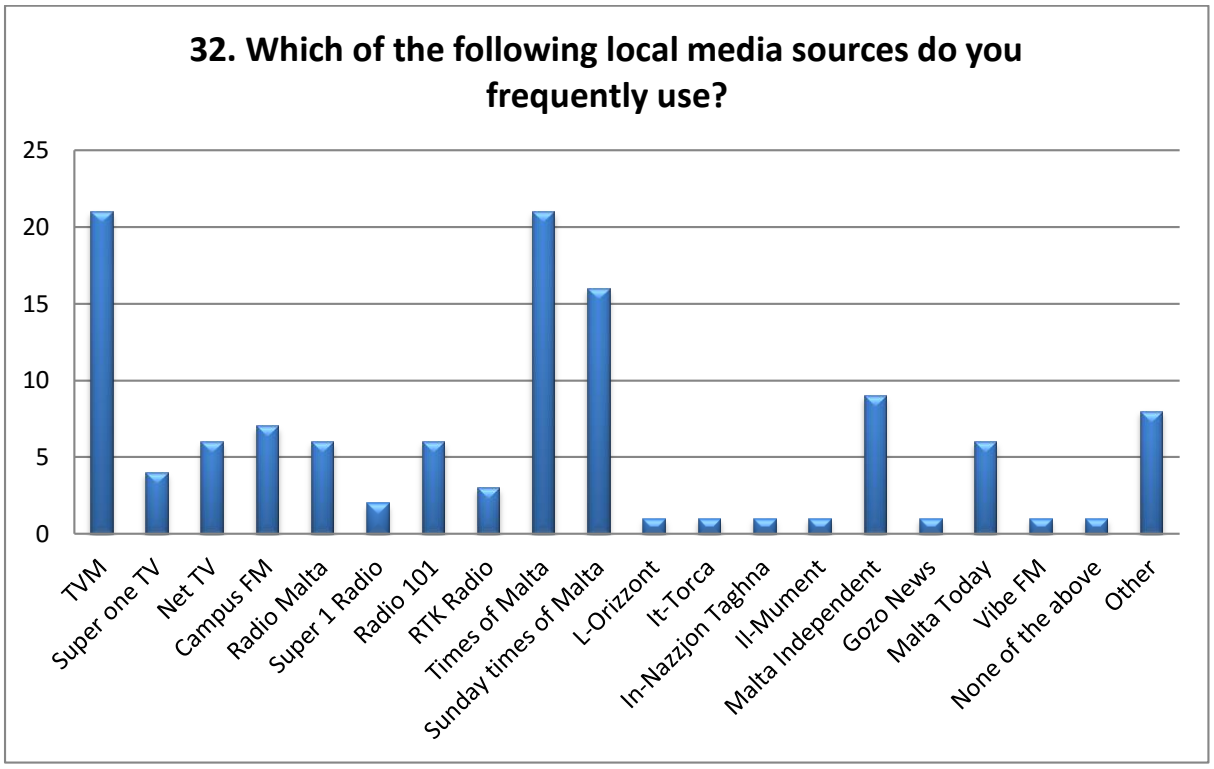
Most of the subjects (70%) claim that if designing a new building they would recommend the installation of a green roof. Those who did not were then asked to explain their answer. The reasons for not recommending a green roof include:

- The technology is not yet sufficiently established
- Low priority with the public
- Problems such as water leakages
- Difficulty for future maintenance
- Reduction in water collection that could be utilised elsewhere.



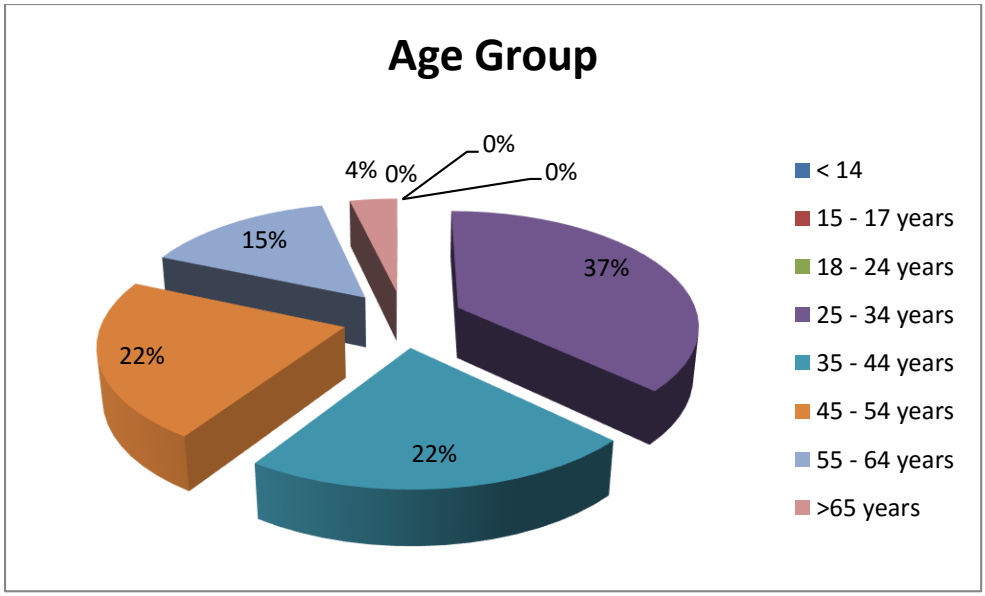
The use of thermal insulation is pretty much an established practise. This is reflected in the responses gathered where 85% of the designers replied that they always recommend roof level insulation. 12% often recommend insulation whereas 4% only recommends insulation occasionally.

The main reasons given for recommending insulation relates to the reduction in carbon dioxide by reducing air conditioning use. Also, to increase the comfort level of dwellings.

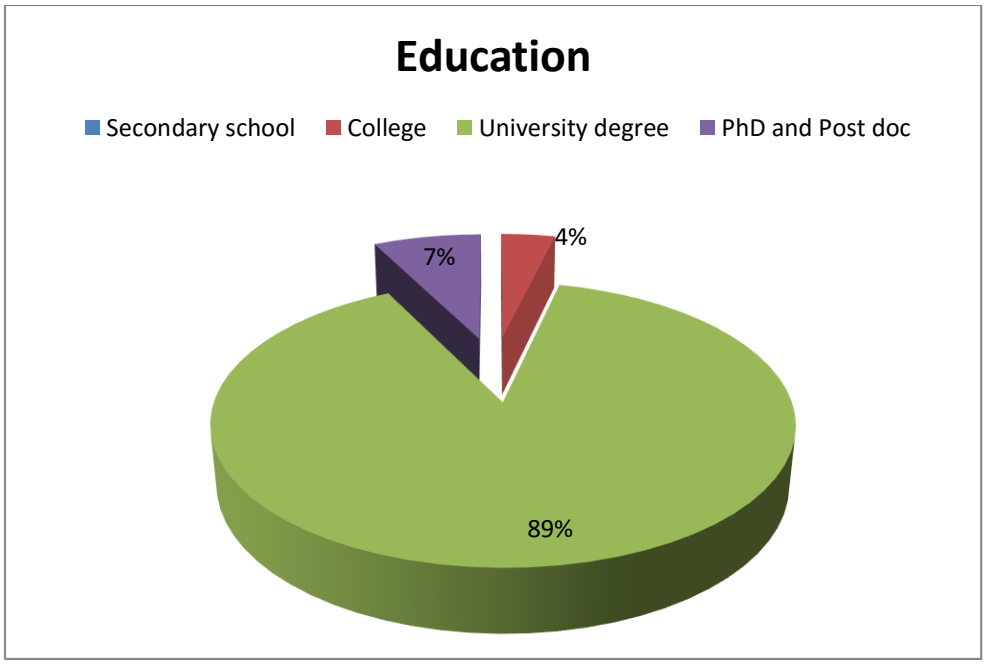


To target the right media sources for our education/information effort, it is important that we identified which radio station, TV channel and newsprint is most commonly used by the respondents.

From the above it transpired that the national TV station (TVM) is the most watched local TV channel. Campus FM (the University's radio station), Radio Malta (the national radio station), and Radio 101 (a politically run station) are the radio stations most followed. Times of Malta, The Sunday Times of Malta and the Malta Independent are the newspapers most viewed.



Most of the individuals interviewed fall within the age group 25-34 years, followed by 35-44 years and 45-54 years. 15% of the respondents were aged between 55-64years whereas only 4% were over 65 years of age. None of the respondents was aged 24 and younger.



Most (89%) of the individuals interviewed possessed a university degree. 7% have a PhD or a post doc degree and 4% completed a college certificate.

Discussion

It transpires that most designers are aware of green roofs and green roof technology. Most of the subjects interviewed have claimed that they have heard about green roofs either from publications or through the internet. A fair number of designers have claimed that they have heard about green roofs from professional publications.

Most respondents have shown at least a minimal knowledge of what green roofs are even in terms of identifying green roofs from other types of roof typologies. However, it seems that most designers were not fully aware of the benefits green roofs convey to the urban environment as very few individuals mentioned other benefits other than insulation and the improvement of air quality. Aesthetic benefits as also high on the list that is somewhat debatable given that most green roofs are not visible from street level or the most populated areas of a town or city.

Most designers have the impression that green roofs are difficult to construct and establish because of problems such as the possibility of bad workmanship that would lead to water leaks, lack of water for irrigation and the maintenance time and cost required for the upkeep of a greened roof. The issue of bad workmanship and the idea that it would be very costly to repair roof problems with a green roof installed seems to be a persistent issue. On the other hand, issues such as the structural integrity of buildings did not score high on the list of problems probably due to the fact that the solution of such an issue falls within the knowledge and knowhow of the architects interviewed.

Notwithstanding these issues, it seems evident that most designers acknowledge the fact that green infrastructure is of benefit to the urban dweller, in terms of the aesthetic and general well-being. Thus, it is clear that designers acknowledge that roof greening is important because they convey numerous benefits to the urban environment. It seems rather contradictory therefore that they keep back from proposing the installation of green roofs. It appears that lack of knowledge and the lack of a successful green roof model discourages the technology's dissemination within the island. Other aspects which discourage the dissemination of roof greening include the cost of installation, maintenance, the use of roof for other activities and the quantity of water needed for irrigation purposes.

It has to be admitted that installation cost can be quite expensive especially when compared to other European countries. The high cost is generally attributed to two aspects, 1. The lack of local materials adequate for use as green roof substrate and secondly the cost of transportation of such green roof substrate.

Maintenance cost and time depend very much on the type of green roof constructed. The LifeMedGreenRoof Project is concentrating on extensive green roofs that are defined as those roofs with shallow substrate depth and low maintenance native plant species. From the current findings of the project, it can be said that both maintenance time and cost can be reduced to a few hours per month.

Water use as irrigation also depends on the type of vegetation used. Native plant species that are found growing spontaneously in arid habitats generally require less water especially in the wet winter months. It is however acknowledged that during the dry summer months some sort of supplementary watering would be needed to sustain plant growth and survival. The amount of water needed however is dependent on the species of plants cultivated. However, given that most modern mid-rise buildings and apartment blocks lack water harvesting measures, such as a well, as requested by local legislation, irrigation could prove an issue.

The issue of using roofs for other activities can be mitigated by the design brief. Provision can be made on a roof to cater for other potential activities given that the space allowed. However, having a roof to cater for multiple activities such as passive social activities in conjunction with a green roof is possible. Also possible is roof greening with PV panels and/or other plant superimposed over it. In fact, studies have shown that green roofs have the potential to increase the performance of equipment due to the lowering of the ambient temperature around the same equipment.

Most designers acknowledge the importance of insulating buildings to reduce energy costs and reduce the carbon footprint of buildings. It transpired that most designers consider their office building as being inefficient when it comes to energy efficiency. They also acknowledge that the use of air conditioners to render the office more comfortable is unsustainable and contributes to climate change and the increase in the carbon footprint of buildings. They also are aware of the benefits of green infrastructure especially in urban areas. However, less than half of the subjects interviewed would consider installing a green roof if they have PV panels or solar water heaters installed. Similarly, less than 34% of the designers stated that would install a green roof if they had thermal insulation on the roof. This can be said to be somewhat of a controversy given that benefits by green roofs greatly outweigh the limited benefits of installing insulation.

Conclusion

The need to increase awareness and inform stakeholders on the benefits of green roof is evident. Designers are influential and crucial to the successful dissemination of green roof technology due to their role in the construction industry. However, unless architects, engineers and interior designers are confident of this relatively new technology, green roofs will never be adopted as a trusted green technology. Following the first questionnaire, it became clear the design industry needed to be approached as part of the dissemination of information about green roofs. It would be of benefit to organise seminars and public talks to encourage dialogue and the sharing of information. This was followed up with various public information sessions including one at the planning authority and other seminars.

The demonstration green roof at university plays an important role in demonstrating both the construction practises as well as insulation and flood mitigation performance of green roofs the local context. For this reason, the project has been involved in a number of lectures given to architecture students at both undergraduate and post graduate levels.

The cost of green roof construction is a real issue which has to be dealt with seriously if roof greening is to be adopted on a national scale and by all levels of society and not by the elite few. Green roofs are mostly effective if the technology is adopted on a wider scale. The more green roofs are constructed, the more the benefits are felt. This is a matter to be taken up at a later stage by the LifeMedGreenRoof project where a document is to be drafted as guidelines to policy makers to identify possible ways of increasing and encouraging the dissemination of this technology.

Some may argue that other systems such as insulation at roof level with much lower capital costs would make more sense than investing in green roof technology which might seem complicated and a time bomb for problems such as water leaks. However, unlike other infrastructure, green roofs can convey more benefits over and above that which can be enjoyed by the host building.

Analysing the effects of the green roof on employees of the Faculty for the built Environment

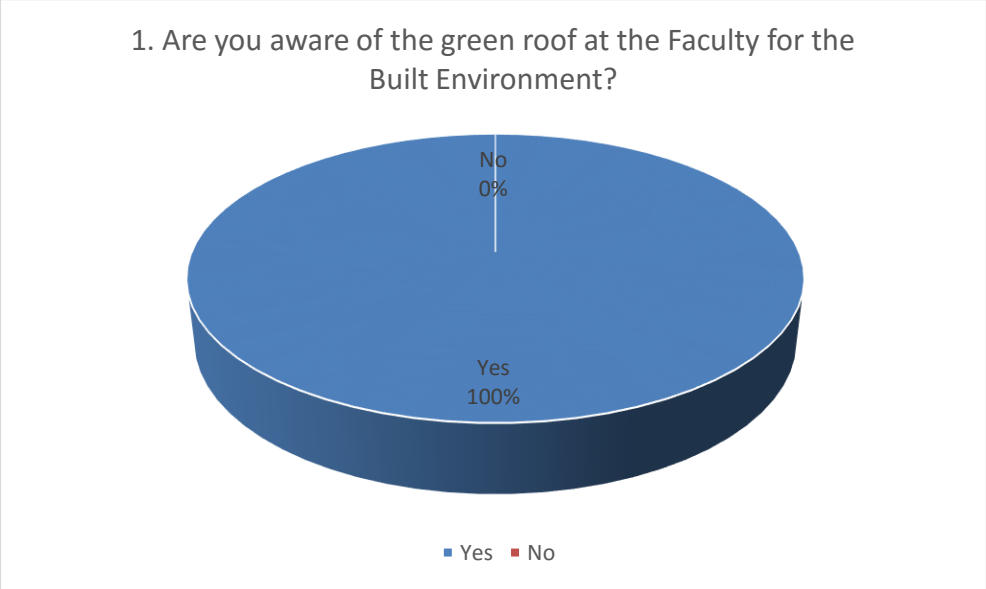
The demonstration green roof is located on a roof of the Faculty for the Built Environment and is overlooked by a number of offices. The administrative staff of the faculty and a number of the academic members occupy the offices. Other members of staff do not have windows overlooking the green roof.

On two occasions (May 2016 & April 2017), a questionnaire was sent to all academic and non-academic members of staff to assess their perception of the green roof and to confirm whether they are aware of the green roof. On each occasion, a short questionnaire was sent by e-mail to 51 individual member of staff. Of the total e-mails sent, 13 replied in 2016 and 2017. Two questionnaires were sent roughly 12 months apart so as to be able to compare any change in perception about the green roof. A period of around a year was allocated between the sending of the two questionnaires so as to allow time for the demonstration green roof to establish and mature. 2016 was the year the green roof construction was completed. A copy of the questionnaire is included in the appendix.

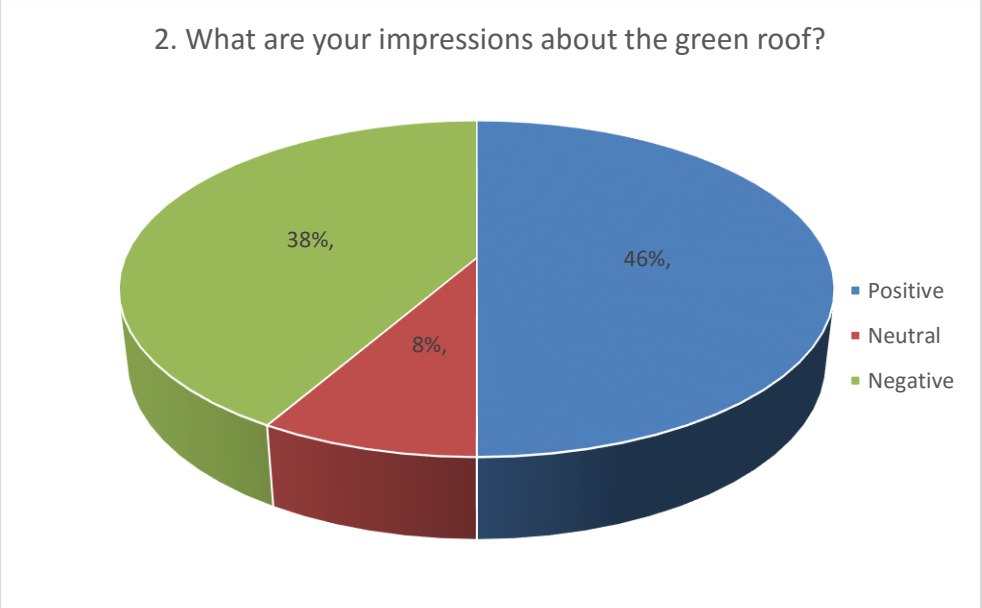
Figure 1 Office windows overlooking east wing of the green roof

Figure 2Office windows overlooking west wing of the green roof

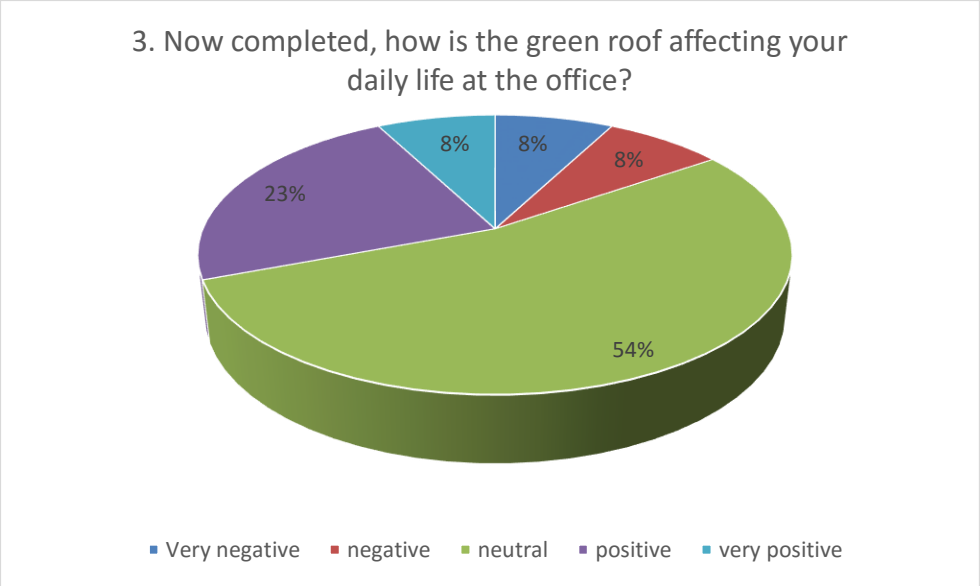
Initial perception questionnaire (no. 1)



From the above it resulted that all the respondents were aware of the newly constructed green roof at the Faculty for the Built Environment.

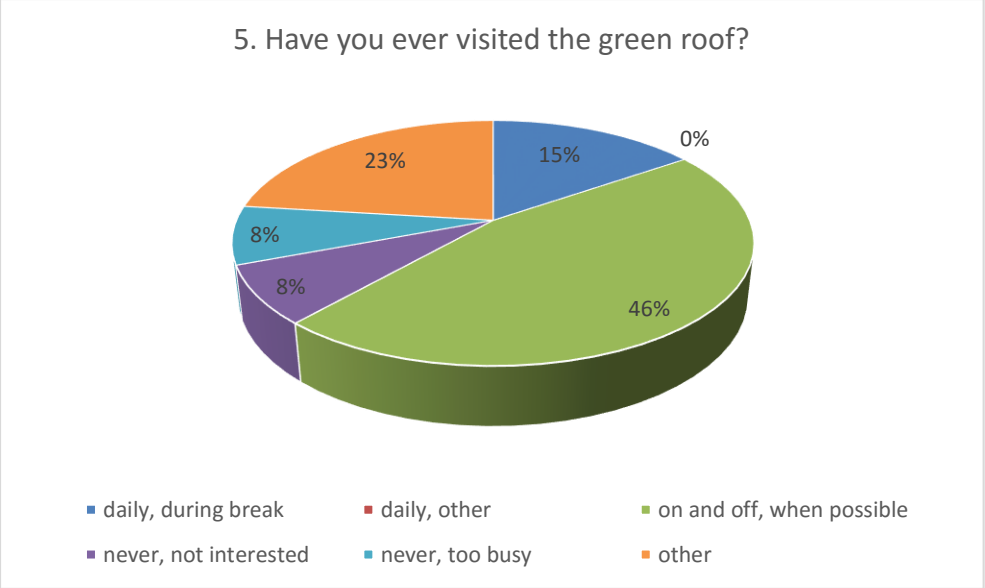


On querying on the impression about the green roof, 46% (6 individuals) reacted positively towards green roof, while 38% (5 individuals) reacted negatively. 8% (a single individual gave a neutral response whereas another individual abstained from giving a reply.

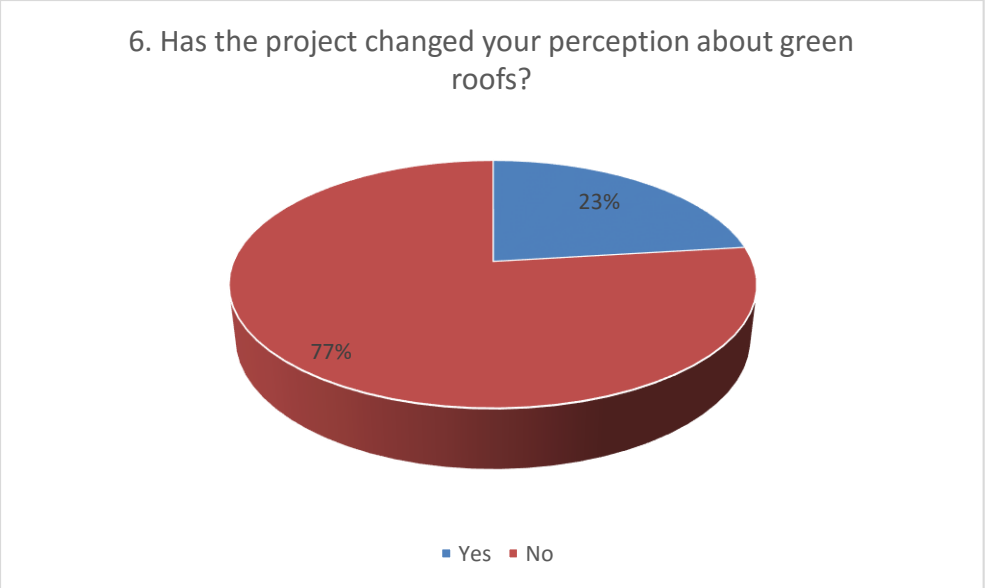


The respondents were then asked whether the green roof had an effect on their daily life at the office. Just over half (54% - seven individuals) the participants responded that the green roof had 'no effect', 23% responded 'positively', whereas 8% 'very positively'. 8% of respondents experienced 'very negative' and 'negative' effect by the green roof. All in all 31% of respondents were affected positively where as 16% negatively.

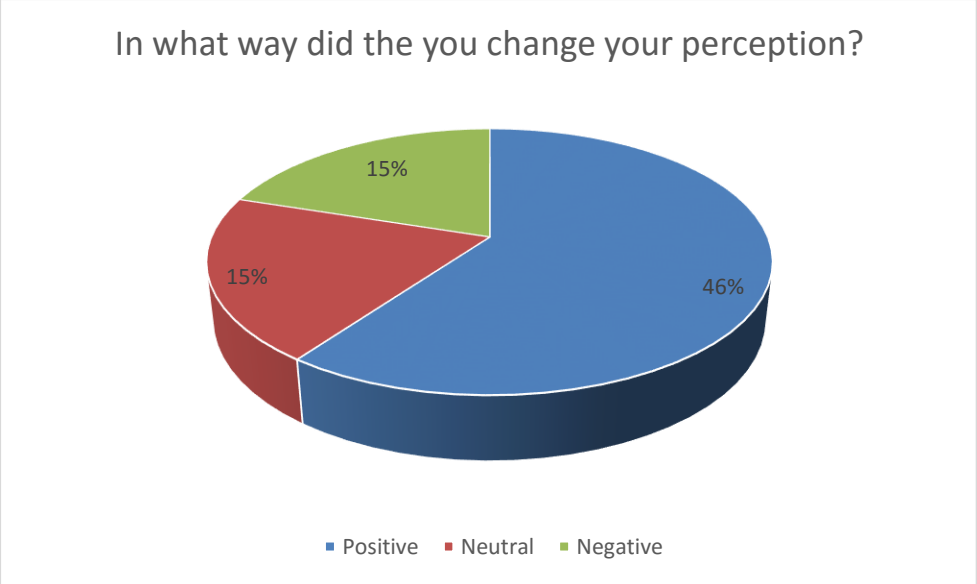
The positive effects generally related to better views out of the window. The neutral replies related to individuals whose office did not overlook the green roof. There were those who commented that the green roof did not affect them at all. Negative reactions included concerns of loss of privacy once people visit the green roof and the noise levels related to the former,



The members of the faculty were then asked whether they had ever visited the green roof. 46% claimed they visit the roof on and off when possible, 15% said they visit the garden on a daily basis during breaks. Those who never visited the green roof because they were either not interested or too busy made up 16% of the replies. 23% did not know that the green roof was accessible.



77% of the respondents claim that the demonstration garden did not change their perception about green roofs whereas 23% confirm that it has. The way the perception changed was mainly positive (46%) whereas 15% were neutral and negative. 23% of respondents did not answer the question.



Positive rating mainly related to individuals who had a positive approach towards green roofs. Negative ratings related to the work and expense needed to construct the green roof. One individual thought that the exercise was futile.

Discussion

It has been confirmed that all participants were aware o the green roof at the Faculty. Most had a positive impression of the green roof although negative impressions were also very high at 23%.

When analysing the effects of the green roof on the daily life at the office most of the respondents indicated a positive or very positive response, however over half of the total respondents gave a neutral reaction. This is understandable given that the plants on the green roof have not yet established themselves. It also illustrates the effect green infrastructure has on individuals.

The fact that 61% of participants claim to have visited the green roof, illustrates the interest the garden has instilled as well as the importance of such infrastructure in providing much needed amenity space and in the contribution of increased well-being.

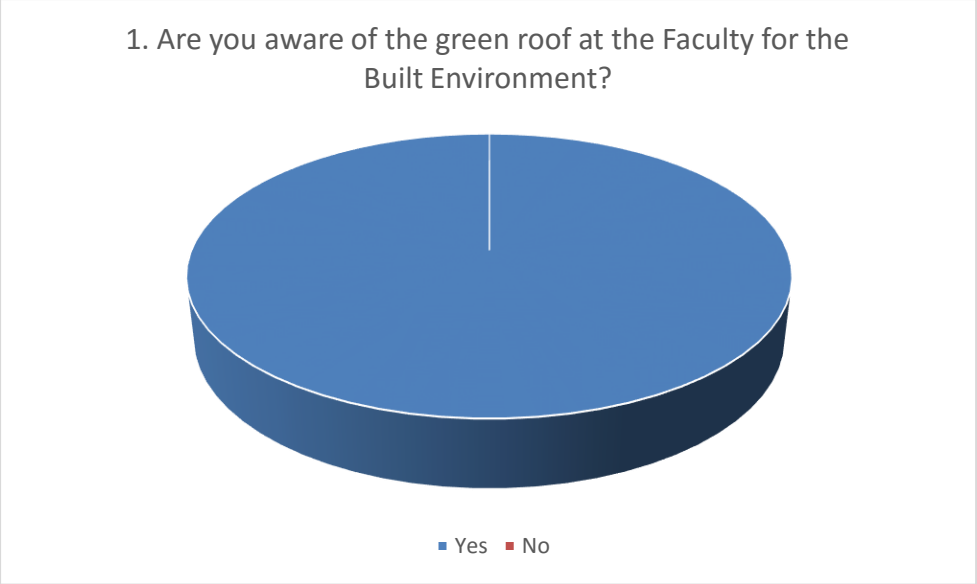
In conclusion, people's perception of a green roof was positive with very few negative impressions. These negative comments were generally plausible and related to issues of initial capital cost and water use for irrigation. Others, such as maintenance, might not be so understandable.

Initial perception follow-up questionnaire (no. 2)

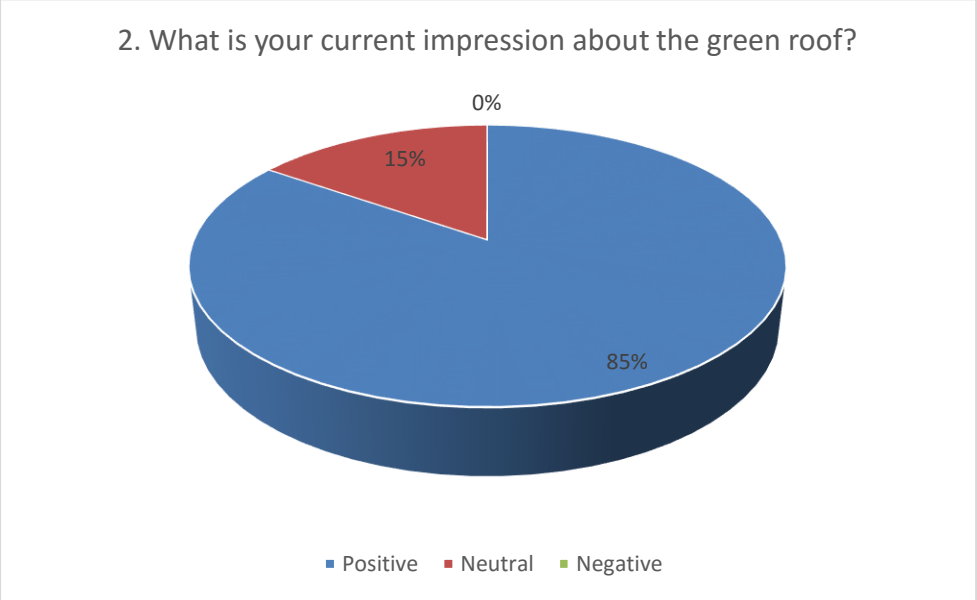
A second questionnaire was issued to employees of the Faculty for the Built Environment. 13 questionnaires were completed over a period of a few days. The individuals responding to the questionnaire were anonymous and not necessarily the same as the ones who responding to the first. As indicated above this questionnaire was issued around a year after the first giving the plants time to develop and establish. After a year the demonstration green roof looked much different as can be seen in the following images.

Figure 3 General view of the east wing of the green roof in May 2016

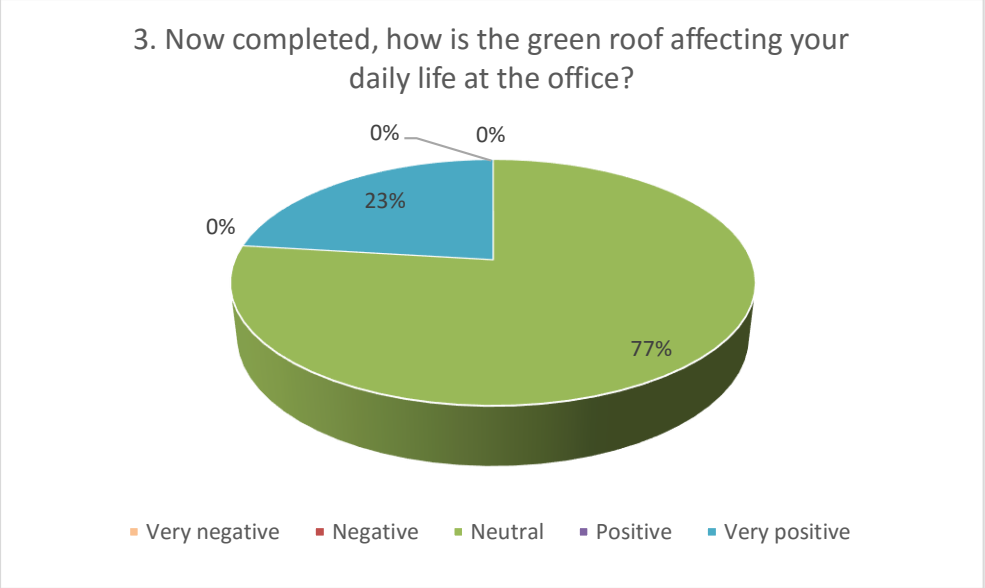
Figure 4 General view of the east wing of the green roof by December 2016



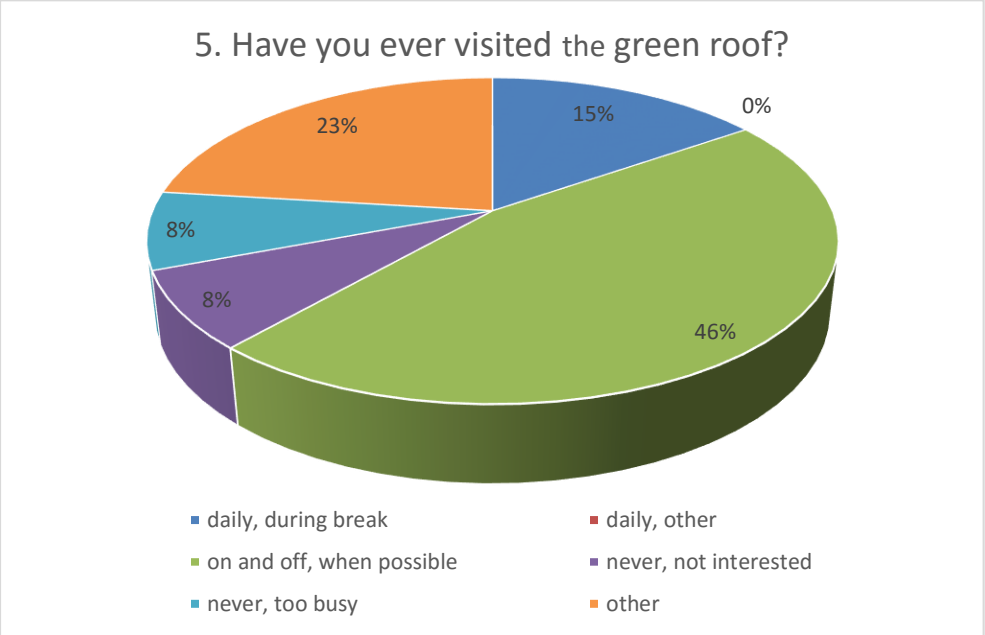
All the individuals responding to the questionnaire were aware of the green roof at the Faculty for the Built Environment.



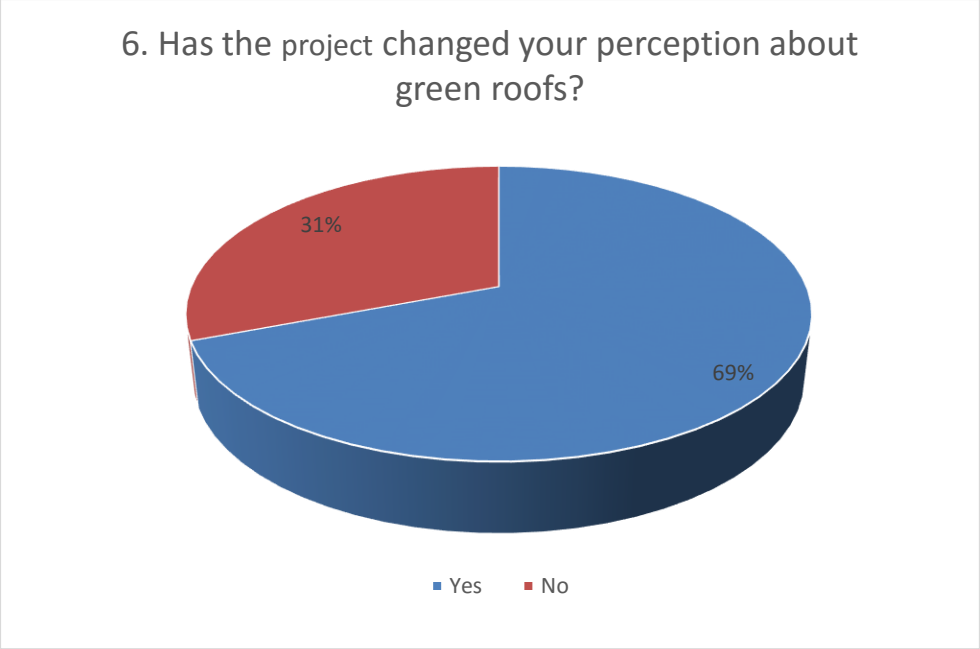
The majority of the participants (85%) had a positive outlook of the green roof. No negative responses were had however 15% (2 responses) of the responses were neutral.



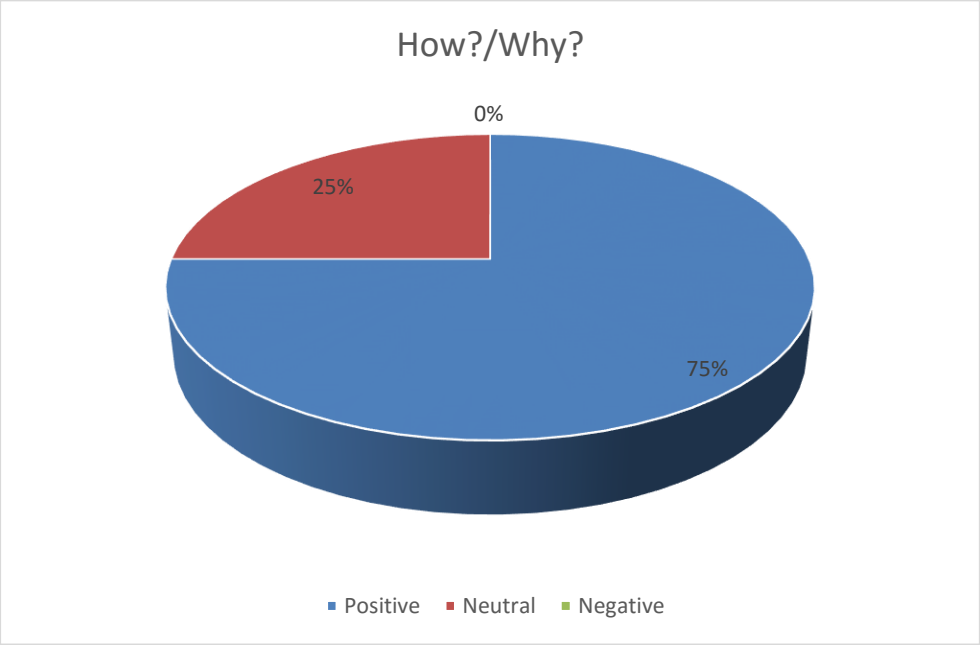
When asked about how the green roof affects daily life at the office, 77% pointed out that the green roof did not affect them in a positive way neither did it affect them negatively. 23% of the responses however gave very positive feedback.



Most (46%) of the respondents said that they visit the green roof 'on and off, when possible' and 15% said they do so on a daily basis during break. 16% were not interested at visiting the green roof and were too busy to do so. The 23% labelled as 'other' either never visited the green roof for one reason or another or only visited once.



Most of the faculty employees who responded to the questionnaire said that the green roof has indeed change their perception whereas the remaining 31% said that it had not.



When asked whether there was a change in perception, 75% claimed that they were already convinced about the benefits of green roofs. Others were previously sceptic about the possibility of growing vegetation on a roof in the local environment and were now convinced that green roof could possibly work. Some also commented that the green roofs provide a more pleasing environment visually compared to the bland conventional roofs. The 25% neutral responses related to one comment and two failed to comment.

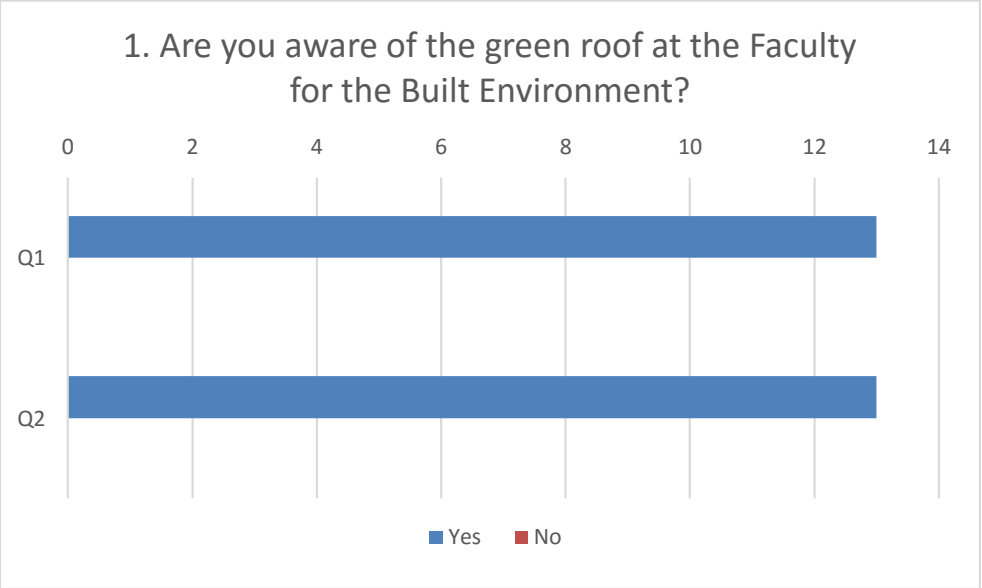
Discussion

It so happens that just like the first questionnaire, all of the respondents were aware of the demonstration green roof. As attested by studies on green roofs, the demonstration green roof at the faculty portrayed a positive feeling to those who experience it. The main comment shared by most respondents related to the aesthetic value of the green roof, especially considering that previously the roof was composed of black damp proof membrane. One individual also noted the increase in biodiversity, "Nice to have birds and flowers around", whereas another commented that the green roof is stimulating. The green roof seems to convey an atmosphere of serenity and was even suggested that such a scheme should be replicated throughout the university campus.

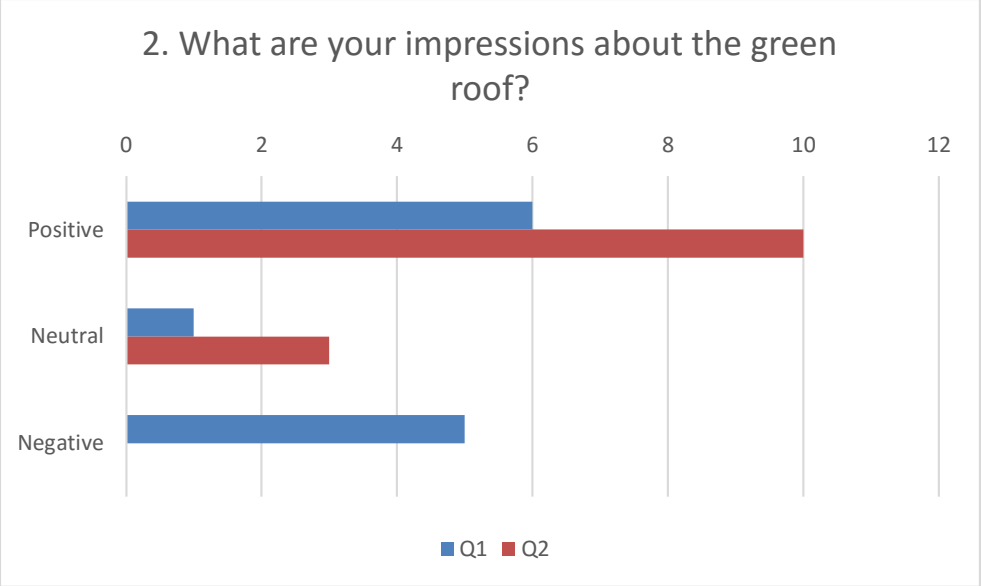
How the green roof effects the daily life of members of staff is very dependent on a number of issues. Most gave a neutral feedback. Some individuals noted that they did not have windows overlooking the garden, others stated that they are not affected by the green roof. However generally the feedback was positive feedback and related to the creation of better views out of the office window. An individual also mentioned the purification of air.

In general, the outcome of the second questionnaire was a positive one with issues such as amenity, biodiversity and aesthetic value being brought up by the participants. Negative comments were few.

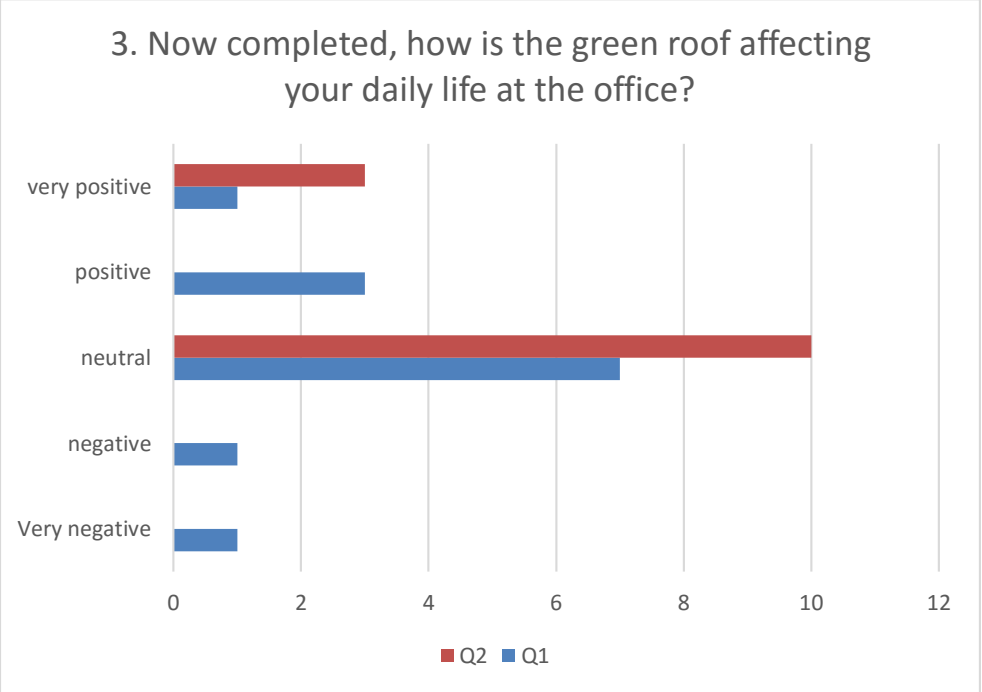
Change in perception between both questionnaires



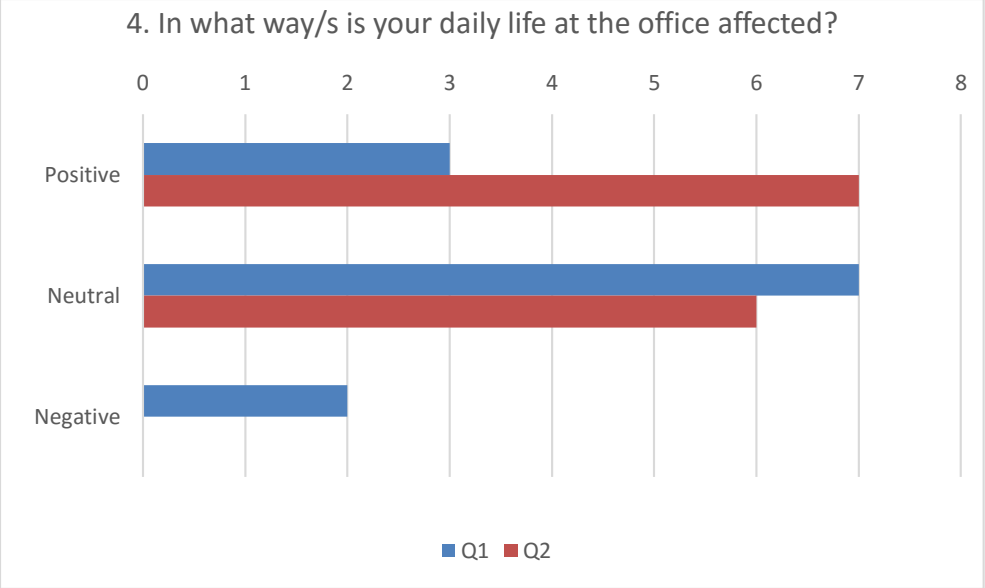
Comparing both questionnaires together it results that all participants were aware of the demonstration green roof.



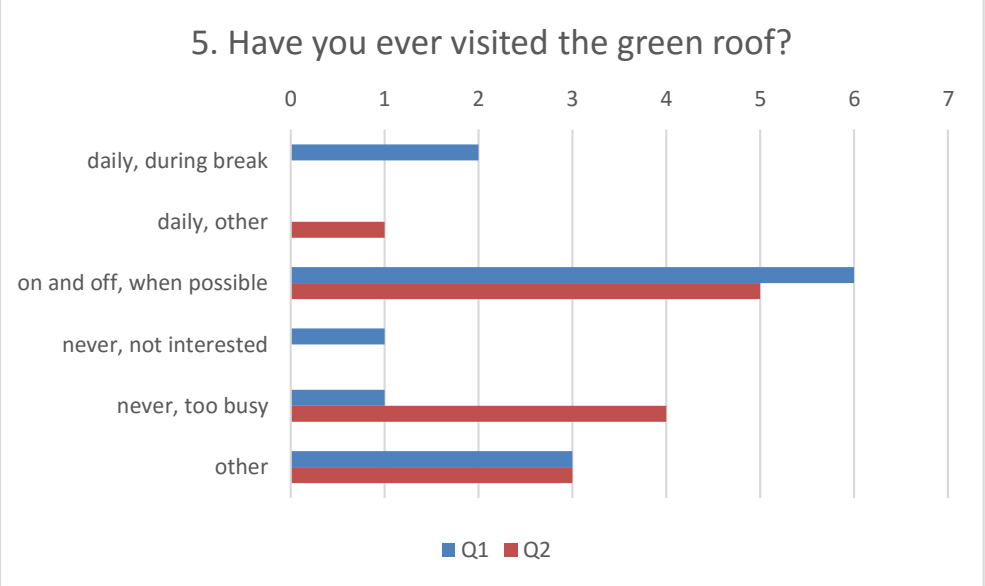
In the second questionnaire there was a more positive response to the green roof. There were also more neutral responses but no negative feedback as opposed the first questionnaire.



When asked about how the green roof affected the daily life at the office, most participants in both questionnaires gave a neutral response although in the second the number of such respondents was greater. In the first questionnaire, there were two negative comments which did not result in the second questionnaire. With regards to positive replies, the former study had 4 positive and very positive responses whereas in the last questionnaire there was only very positive feedback.



When asked about how the daily life was affected, most of the responses in the second questionnaire were positive closely followed by neutral responses. In the first questionnaire neutral responses were the most abundant. There were three positive replies and two negative ones.



In total, more individuals visited the green roof prior to the first questionnaire. The number of participants who never visited the green roof were higher in the second questionnaire than they were in the first.

Discussion

Comparing both questionnaire results shows that green roofs do have a positive effect on the stakeholders. In fact, the general perception of the demonstration green roof at the faculty staff can be said to have increased. Two factors seem to be the main cause, firstly the fact that with the establishment of the plants the green roof became more aesthetically pleasing. Following the completion of the construction of the green roof, the plants were still relatively small in size and looked frail. This could have given the impression that they could succumb to the harsh summer season. However, a year after the plants have since established themselves and even multiplied filling

in all the exposed vegetation. This gives a lusher and pleasing view and atmosphere. In addition, such a habitat tends to attract wildlife especially those regarded attractive by people. This adds to the appeal of the green roof.

Secondly, the green roof has changed the perception which some people had of green roofs. Many are of the opinion that the semi-arid climate makes plant cultivation impossible on roofs given that the island experiences long dry summers and almost constant winds. Generally, the roof space on a building lacks specific activity. Very few people grow plants on roofs due to high solar and wind exposure; those that do generally grow very hardy plants such as cacti and succulents. There are also those who grow other plants (always in pots) but these generally require a lot of effort and resources to keep alive. The transformation of the plants on the green roof would have had a positive influence on the stake holders considering the outcome after a year.

Although many appreciated the green roof and commented positively on its development and establishment, this did not reflect in the number of visits to the green roof. One could have assumed that visits to the green roof by faculty personnel would have increased. The reality of it is that either the respondents are part-time staff (thus they only visit the faculty intermittently and generally to give lectures and to attend meeting), or they could be full-time members of staff with a hectic schedule. However there still are those participants who visit the green roof at regularly.

Conclusion

This action set out to analyse the perception of members of staff of the Faculty for the Built Environment in terms of the demonstration green roof. The study was organised into two questionnaires, the first was distributed following the construction of the green roof and the second around a year later. The questionnaires were distributed electronically to all members of staff, be them part-time or full-time, academics, technical and administrative. The evidence from the study suggests that the green roof enhanced the view out of the office windows and that it contributes to a degree to ameliorating the quality of life at the office. This confirms previous findings on the perception of green roofs in urban areas (Syumi Rafida, Hamidah, Sapura, & Muhamad Solehin, 2015). The increase in wildlife on the green roof has also contributed to the increase in the appreciation of the green roof.

The study also confirms the need for further demonstration green roofs to increase awareness about the need of such technology. This action had confirmed the importance of demonstration projects in increasing awareness and appreciation. A number of respondents have in fact changed their perception in favour of green roofs after witnessing that plants were able to be successfully cultivated on a roof without issues of plant failure and water ingress.

General Conclusion

During the course of the LifeMedGreenRoof Project and as part of Action C3, five questionnaires were circulated to establish how the stake holders' perception of green roofs have changed. The project conducted various activities to inform stake holders about the need to introduce green roofs into the urban fabric. Stake holders mainly included the general public, education sector, the design industry and the policy makers. The general questionnaire was circulated towards the first half of the project whereas the second general questionnaires was circulated towards the latter half. Two other studies were carried out to assess the perception of faculty staff members following the construction of the demonstration green roof.

The main findings of these studies can be summarised into the following:

Through the media activities conducted by the project, it can be concluded that the perception of stake holders towards green roofs has increased. More people are aware of what green roofs are and what their purpose is. Green roofs contribute towards a more pleasant environment increasing a

sense of well-being. The value of green roof increases if stakeholders experience an increase in attractive wildlife such as birds and butterflies.
The way that information is distributed is also important. Internet proved very effective. The use of a website and better still social media widens the catchment area. Publication of articles and press releases exposed stake holders to the concept of green roofs. However, the most effective way of altering the perception of stake holders is through the demonstration green roofs. Many are those who perceive green roofs as being difficult to establish locally. Through the demonstration green roof, stake holders could see that green roofs can be a reality in Malta and that issues such as water leaks can be curbed with the proper workmanship and the right construction methods.
For the project to be truly successful, it is imperative that information dissemination is not terminated at the end of the project. Information dissemination especially amongst policy makers should persist. Demonstration project should be encouraged on a national scale to further reinforce the idea that green roofs play an important role in rendering urban areas more sustainable.

Limitations

The aim of this study was to understand better people's perception on green roofs. The design of the first questionnaire spanned further from the issue of green roofs by including aspects of green infrastructure and energy efficiency in buildings. This was done to better appreciate people's understanding of the benefits of green infrastructure, (of which green roofs is one) and the why and what is understood by alternative energy. The questionnaire also attempted to gather information about the prevalent media sources to concentrate efforts in information dissemination.

The questionnaires were published on line following the consideration of other possible methods. This has resulted in the targeting of a selection of the population, mainly the middle class. Targeting the middle class was important as it constitutes the largest sector of the population. Understanding their limitations, would help the LifeMedGreenRoof project in producing a media strategy which would be most useful for achieving the aims of the project.