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SUSTAINABLE ENERGY BEHAVIOUR IN MALTA: AN EMPIRICAL STUDY

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ABSTRACT: This empirical study investigates the sustainable energy behaviour of the Maltese and Gozitan residents. Using a behavioural framework, a self-administered questionnaire containing eight internally consistent and uni-dimensional constructs (awareness of issues, subjective norms, personal norms, motivating factors, attitudes/inconveniences, intentions to act, satisfaction with local authorities' initiatives, and opinion on future initiative proposals) was purposely designed for the present study. A quantitative analysis on the responses of an online sample of 783 respondents revealed, among other things, that the Maltese people are quite knowledgeable of sustainable energy issues and are aware of economic and environmental consequences for not adopting sustainable energy behaviour. They also reported (on average) personal norms, attitudes and intentions that match the requirements for sustainable energy behaviour. The study also shows that the Maltese population is neither satisfied nor dissatisfied with the local authorities' initiatives in helping residents engaging in and sustaining sustainable energy behaviour. In addition, responses varied as a function of demographic characteristics such as gender, locality, and income. The findings are discussed and the study goes on to provide various suggestions that could better guide policy makers in the quest of educating, informing, and convincing the Maltese general public that engaging in sustainable energy behaviour pays.

Keywords: Sustainable Energy, Human Behaviour, Energy Policy, Malta

1 AIM & OBJECTIVES

In the light of the fact that there is practically no such locally commissioned and published study, the main aim of this study was to shed some light on the human behaviour and related components of the Maltese population vis-à-vis sustainable energy.

The main objectives of this study were to examine whether the Maltese and Gozitan residents: (a) are aware of sustainable energy issues; (b) are influenced by others (e.g. family or friends) in adopting sustainable energy behaviour; (c) have personal norms that match the requirements for sustainable energy behaviour; (d) intend to act to save energy at present and in the future; (e) are being hindered from engaging in sustainable energy behaviour due to inconveniences; (f) are motivated by factors (e.g. fiscal incentives) for engaging in energy efficient practices and investing in renewable energy systems; (g) are satisfied with the local authorities' initiatives; and (h) are in favour of future initiative proposals (e.g. the compulsory installation of double glazed apertures in new buildings).

The study also attempts to investigate whether the response of the general public varies as a function of demographic variables. The empirical findings are discussed and the study goes on to provide significant recommendations for policy makers and presents interesting avenues for further research.

2 LITERATURE REVIEW

2.1 Introduction

The Ernst & Young European (Business) Attractiveness Survey 2010 [1] quotes Mr. Philippe Carli (President of Siemens France) saying that the opportunities for European business in clean energy are real, and enormous, and that they already estimate that €23 billion of Siemens' turnover, a quarter of the total, comes from 'green' solutions.

The above is just an example of the importance of the field of sustainable energy for Europe's economy and the quality of life of the European citizens. This study is however intended to focus on what is happening in the Republic of Malta.

2.2 Legislation and the Political Scenario

Europe's popular 20-20-20 objectives are to achieve a 20% reduction in carbon dioxide (CO₂) emissions and 20% of final energy consumption from renewables by 2020. On the other hand, what follows are the sustainable energy targets set for Malta by the relevant European Union (EU) directives [2]:

- Energy Efficiency in Buildings: 9% energy savings from increased efficiency by 2016 (2006/32/EC)
- Renewable Energy Resources: 10% of final electricity consumption by 2020 (2009/28/EC)
- Bio-fuel contribution in the fuel mix: 10% of final energy consumption of fuels by 2020 (2009/28/EC)
- Reduction in greenhouse gas (GHG) emissions under effort sharing decision: +5% over 2005 levels by 2020 (2009/406/EC)

The above requirements and other obligations set by the relevant EU directives are transposed into the National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP).

Most probably, the renewable energy target mentioned above can only be achieved if the planned 100MW off-shore wind farm at *is-Sikka l-Bajda* site materialises. One of the main purposes of the first 200MW submarine electrical interconnection between Ragusa in Sicily and *Magħtab* (Malta), which is planned to be commissioned by the end of 2013, is for the off-shore wind farm to be synchronised with the European grid as necessary. In addition, the interconnector should make it possible for Enemalta to import low carbon energy in order to work towards the reduction in GHG emissions target. However, the interconnection is not necessary for Malta to purchase 'green' energy from EU states as a contribution towards reaching the national renewable energy target.

In Malta, the central government is the sole policy maker and hence energy planning only occurs at the national level. The Malta Resources Authority (MRA) was established in 2001 and is currently under the portfolio of the Ministry for Resources and Rural Affairs (MRRA). MRA's role is that of regulating, implementing, and monitoring the energy, water, and mineral resources policies. [2]

Malta has progressed relatively fast in its plans for the development and implementation of energy efficiency and renewable energy policies and initiatives. In addition, as part of a longer term plan the government allocated €25 million from the structural funds of the EU for the period between 2008 and 2013 in order to encourage the adoption of end use energy efficient apparatus and small-scale electricity generating equipment from renewable sources such as solar and wind energy.

2.3 Human Behaviour

According to Icek Ajzen [3], explaining human behaviour with all its complexity is a rather complicated task. Such a task can be approached at an array of levels, from focusing on physiological processes at one end to dealing with social institutions at the other. Social attitudes and personality traits are concepts referring to behavioural dispositions which have played an important role at attempts to predict and explain human behaviour. Ajzen [3] adds that cognitive self-regulation in the context of a dispositional predictive approach is an important aspect of human behaviour.

2.4 Ajzen's Theory of Planned Behaviour

Human behaviour is difficult to predict when the number of persons investigated is larger in quantity and more anonymous in its identity. Familiarity and acquaintance do help to strengthen our ability to predict human behaviour in a specific situation although even in this context the level of prediction cannot be considered as infallible.

In a nutshell, one can describe Ajzen's model as a theory that traces how persons regulate what they will think about an issue and their likely reaction toward that issue. Through this theory, it is possible to measure the disposition or intention of someone to behave in a certain way, and if he or she intends to undertake an action, he or she is likely to do so. This is known as Icek Ajzen's Theory of Planned Behaviour (TPB) and has attracted the attention of a number of researchers who tried to apply it in order to predict and understand people's intentions to engage in various activities [4]. Figure 1 below illustrates the latest model of Ajzen's TPB.

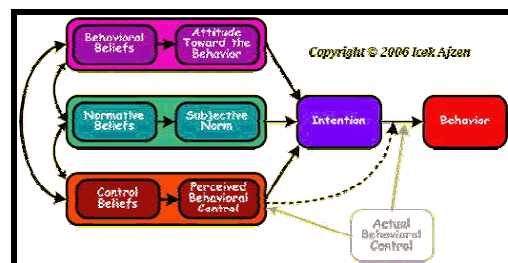


Figure 1: Ajzen's TPB Model (Source: Ajzen [4])

According to Ajzen's TPB [3], 'intention' has three conceptually independent sets of beliefs which determine it, namely:

- Behavioural beliefs - produce a favourable or unfavourable attitude toward a particular behaviour;
- Normative beliefs - are related to the probability that individuals or groups who are important to the person concerned approve or disapprove the performance of a given behaviour; and

- Control beliefs - deal with the presence or absence of the required resources and opportunities for the person concerned to perform a particular behaviour.

These sets of beliefs are supposed to be found in each person and they influence whether a person will have a positive or negative reaction to a situation and thus they will predict his/her intention to behave in a particular way. Since it is still quite inconceivable to simply measure beliefs, there are underlying determinants which are used to measure each set of beliefs. In this way, the theory articulates that intention and ultimately behaviour is a function of salient information, or beliefs, and it is these salient beliefs that are considered to be the prevailing determinants of a person's intentions and actions. Ajzen's TPB attempts to shed light on the concepts which exist within human social behaviour by applying these concepts to the understanding and prediction of specific behaviours within specific contexts.

On a general level, the model does predict behaviour in an accurate manner and it has helped to demonstrate a definite link between behavioural beliefs and attitude toward the behaviour, between normative beliefs and subjective norm, and between control beliefs and perceived behavioural control. Nonetheless, the exact nature of the links between these sets remains uncertain and thus the TPB has deficiencies that still need to be ironed out through more research. [3]

2.5 Schwartz's Model of Altruistic Behaviour

In his cause-and-effect model, Schwartz [5] deals with the impact of social norms and personal norms on the decision making process of every individual prior to committing or omitting a particular behaviour. Social norms refer to the pressure by society to behave in a certain way while personal norms refer to the individual's moral obligation to behave in the right way.

However, as illustrated in Figure 2 below, social norms are not a direct influencer of the actual behaviour. Social norms are transformed into personal norms while 'awareness of consequences' and the 'ascription to responsibility' moderate the direct effect between personal norms and behaviour.

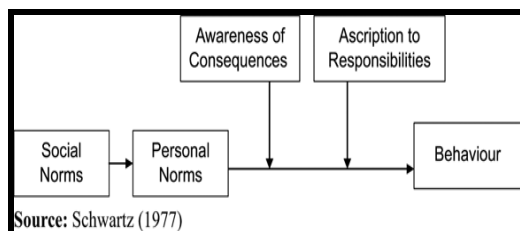


Figure 2: Schwartz's Model of Altruistic Behaviour (Adapted from Bezzina & Dimech [6])

2.6 Definition of Sustainable Energy

The 'two pillars' of a sustainable energy policy are energy (or resource) efficiency and renewable energy. Public policies on both pillars must be worked upon in parallel in order to stabilise and reduce the carbon dioxide emissions of our age. The efficient use of energy is essential to slow down the energy demand growth and in turn the rising clean energy supplies can make deep cuts in fossil fuel utilisation. If the demand for energy grows too fast, the renewable energy development will be outweighed and we will be chasing a receding target. Likewise, unless clean energy supplies come online rapidly, reducing the growth rate of energy demand will only begin to shrink the total emissions. On this merit, reducing the carbon content of energy sources is also required.

Thus, any serious vision of a sustainable energy economy requires major commitment (from all stakeholders, especially the central government) to both energy efficiency measures and the diffusion of renewables. [7]

2.6.1 Definition of Energy Efficiency

End use energy efficiency can result in large and highly cost-effective energy savings and emissions reductions. However, energy efficiency often lacks the 'sex appeal' that renewable energy enjoys among the general public and many policy makers. [7]

Enhancing energy efficiency refers to the reduction in the energy consumed by a given service such as lighting and heating or the lessening of the level of such activities. Reducing energy consumption is usually associated with technological changes. However, this is not always true since it can be the outcome of better management or the improved economic conditions of the sector. The latter are referred to as the 'non-technical factors'.

Consumption drops due to financial constraints imposed by high energy prices do not necessarily result in the increased overall energy efficiency of the economy, and are easily reversible. Such drops may be the result of bearing with uncomfortable room temperatures due to higher electricity tariffs or the lesser employment of private motor vehicles due to higher fuel prices. Such fluctuations should not be associated with energy efficiency.

For many, particularly economists, energy efficiency has a broader meaning. It should encompass all changes that result in decreasing the amount of energy employed to produce one unit of economic activity, such as the energy used per unit of the gross domestic product (GDP) or economic value added. Energy efficiency is associated with economic efficiency and includes technological, behavioural and economic changes.

Energy efficiency is first of all a matter of individual behaviour and reflects the rationale of energy consumers. Avoiding unnecessary consumption of energy or choosing the most appropriate equipment to reduce the cost of energy helps to decrease individual energy consumption without decreasing individual welfare.

Avoiding unnecessary consumption is certainly a matter of individual behaviour, but it is also, often, a matter of employing the appropriate equipment; thermal regulation of room temperature and the automatic de-activation of lighting in unoccupied hotel rooms are good examples of how equipment can reduce the influence of individual behaviour. [8]

2.6.2 Definition of Renewable Energy Sources

In contrast with energy efficiency, renewable energy often needs to address challenges regarding the capital investment involved as well as the estimated future savings [7]. On a more intrinsically technical approach, Godfrey Boyle [9] refers to Twidell and Weir (1986) who define renewable energy as the 'energy obtained from the continuous or repetitive currents of energy recurring in the natural environment'. Boyle [9] also refers to Sorensen (2000), who defines renewable energy as 'energy flows which are replenished at the same rate as they are used'.

All renewable energy sources are principally derived from the mammoth power of the sun's radiation. The renewable sources of energy are at once the most ancient and the most modern forms of energy used by humanity.

Early human societies were based on solar power, both in the form of direct solar radiation and in indirect forms such as water, wind or bio energy. The solar-driven process by which plants are created from water and atmospheric carbon dioxide, namely the power of photosynthesis, was first used by our ancestors when they managed to light fire.

The next step of the early civilisations was to develop ways of exploiting the movements of water and wind. Such movements were caused by the solar heating of the oceans and the atmosphere and were engaged in order to grind corn, irrigate crops, and propel ships.

It was not until the advent of the environmental movement and the oil crisis with its steep oil price increases of the 1970s that the world's politicians began to seriously consider the effects of fossil fuel use on planet Earth's natural ecosystems and global climate. The oil crisis of the last three-four years has likewise had the effect on the world's industrialised countries (including Malta) to focus more on better harnessing of the renewable sources of energy.

On-going concerns about the sustainability of both fossil and nuclear fuels use have been a major catalyst of the renewed interest in renewable energy sources in recent decades. Ideally, a sustainable energy source is one that is not substantially depleted by its continued use, does not entail significant pollutant emissions or other environmental problems.

2.7 Local Sustainable Energy Measures

This subsection recounts the most significant of the local sustainable energy measures taken by the national government and other entities as from the year 2001 to date. These measures were extracted from a year by year catalogue of measures kindly compiled and referred by the Ministry for Resources and Rural Affairs (MRRRA) [10]:

- a. The registration tax on battery-operated vehicles was reduced to 15% from the normal rate of between 50% and 70%. The registration tax on battery-operated motorcycles was reduced to 6.5% from the normal rate of between 28% and 42%. The government also committed itself to review such rates every two years (2001)
- b. Import duties on a number of environment friendly products were reduced as follows:
 - Recycled paper - 0%
 - Degradable refuse bags - from 8.4% to 6.5%
 - Shopping bags made of recycled paper and carton - from 6% to 3.7% (2003)
- c. Eco-contribution was introduced on a number of products (2004)
- d. As from the beginning of 2005 the government also started refunding an amount equivalent to 15.25% of the purchasing value of electric vehicles up to a maximum of Lm500 (2005)
- e. The eco-contribution was extended to include plastic bags, plastic containers and other objects that leave a negative impact on the volume of waste generated in our country (2005)
- f. The government enhanced the rebate limit to 25% of the retail price of solar energy products and equipment subject to a maximum of Lm100. This same measure also became applicable to wind energy operated equipment as well as roof insulation materials and installation at private homes (2006)
- g. Considering the high capital expenditure involved in the adoption of photovoltaic technology, in 2006 the government has finally decided to offer a refund of 25% of the purchase price of photovoltaic systems up to a maximum of Lm500 (2006)
- h. As from November 2007 the government introduced a 20% rebate, capped at Lm50, on the purchase price of certified energy efficient domestic appliances such as washing machines, tumble dryers, refrigerators, freezers, and air-conditioning equipment for domestic use (2007)

- i. As from the beginning of 2008 the government further augmented the refund on the purchase price of electric vehicles to 20%, up to a maximum of €2,329 (Lm1000) (2008)
- j. The controversial electoral promise of the energy saving light fittings of the year before materialised with the distribution of security vouchers to all Water Services Corporation (WSC) registered households across Malta and Gozo. The total cost of this measure was estimated in the range of €4 million (2009)
- k. Another important measure was the offering of 50% refund on photovoltaic systems up to a maximum of €3,000. The budget allocated for this measure was €0.5 million and around 200 families were expected to take advantage (2009)
- l. The motor vehicle tax reform brought into effect as from this year meant that small-to-medium- sized vehicles had lower registration tax than larger vehicles (2009)
- m. Road license fees were also proportionally tied to CO₂ emissions and the former would increase annually after the first five years of a vehicle's lifetime (2009)
- n. In an endeavour to further diffuse the adoption of solar water heaters, in 2010 the relevant grant was raised to 40% of the capital expenditure required, capped at €560 (2010)
- o. Through an innovative scrapping scheme, an old vehicle could be scrapped upon the purchase of a brand new motor vehicle with low exhaust emissions (2011)
- p. In May 2011 ARMS Ltd announced that those who have installed grid-connected photovoltaic systems will receive their accumulated credit in their first utility bill issued after October 1st of the current year. The applicable feed-in (the grid) tariffs were classified as follows:
 - Residential premises in Malta: 25c per kWh, guaranteed for 8 years
 - Residential premises in Gozo: 28c per kWh, guaranteed for 8 years
 - Non-residential premises in Malta and Gozo: 20c per kWh, guaranteed for 7 years (2011)
- q. Measure (k) above was repeated for the third consecutive year but this time the allocated budget was in the range of €6.0m and some 2000 families were expected to benefit (2011)

2.8 Take-up Figures

The request to MRRA for take-up figures relevant to the comprehensive local sustainable energy measures elicited in the previous subsection was turned down on the basis that such information was not readily available. A similar request was then made to MRA, and Table 1 and Table 2 below are the result of what was obtained [11]:

Grant Applications by equipment type and receiving year						
Equipment / Year	2006	2007	2008	2009	2010	2011
Air-Conditioner		2,974	3,652	59		
Dishwasher	6	809	938	61		
Double Glazing				64	21	
Photovoltaic System			2	160	1,105	
Refrigeration	73	5,429	5,681	271		
Roof Insulation			145	194	28	
Solar Water Collector (EN12975)					27	5
Solar Water Heater (EN12976)			1,603	3,439	763	162
Tumble Dryer		13	16	1		
Washing Machine	208	10,651	9,600	129		

Table 1: Take-up Applications (Source: MRA [11])

Grant Payments (€) by equipment type and payment year						
Equipment / Year	2006	2007	2008	2009	2010	2011
Air-Conditioner		173,123	212,408	3,425		
Dishwasher	349	47,078	54,588	3,552		
Double Glazing				12,980	4,834	
Photovoltaic System			5,462	471,493	3,265,884	
Refrigeration	5,650	506,705	575,212	29,678		
Roof Insulation			15,953	54,446	7,973	
Solar Water Collector (EN12975)					14,754	2,760
Solar Water Heater (EN12976)			367,597	1,367,217	376,198	81,582
Tumble Dryer		757	932	58		
Washing Machine	12,113	619,741	557,573	7,509		

Table 2: Take-up Payments (Source: MRA [11])

3 METHODOLOGY

3.1 The Questionnaire

The Sustainable Energy Behaviour Questionnaire was purposely designed for the present study. Adopting a behavioural theoretical framework, this study used the Theory of Planned Behaviour (Ajzen [3,4]), the Model of Altruistic Behaviour (Schwartz [5]) as well as other sources such as Bezzina & Dimech [6] in identifying the questionnaire components. The chosen determinants, which were considered as essential for understanding the sustainable energy behaviour of local residents, are the following: awareness of issues, subjective norms, personal norms, attitudes/inconveniences, intentions to act, motivating factors, satisfaction with local authorities' initiatives, and opinion on future initiative proposals.

The statements for every construct were worded in a way so as to also represent the other aspects of the literature and as many diverse technical issues as possible. Suggestions and ideas for innovative and practical measures were also included.

The questionnaire consisted of two different sections. Section A - Individual Determinants - consisted of a number of statements for which the respondent was requested to indicate his/her level of agreement with each statement on a standard five-point Likert scale ranging from strongly disagree to strongly agree. On the other hand, Section B requested the Demographic Characteristics of every respondent.

Section A of the questionnaire consisted of five items related to *Awareness of Issues* (e.g. 'I am aware that power plants running on fossil fuels are becoming more expensive and less sustainable'), four items related to *Subjective Norms* (e.g. 'My friends encourage me to adopt an energy efficient behaviour'), three items related to *Personal Norms* (e.g. 'I feel that it is important to consume energy as efficiently as possible'), four items related to *Intentions to Act* (e.g. 'I switch off the lights upon my exit from a room and electronic equipment when not in use' or 'I intend to take up the current government grant on solar water heaters and/or photovoltaic panels'), three items related to *Attitudes or Inconveniences* (e.g. 'Holding an energy efficient behaviour requires too much effort'), three items related to *Motivating Factors* (e.g. 'If the government offers fiscal incentives on retro-fitting initiatives such as aperture double-glazing and roof insulation, I would go for them'), three items related to *Satisfaction with Local Authorities' Initiatives* (e.g. 'The local authorities are putting a sufficient amount of effort and investment in order to encourage Maltese residents in adopting an energy efficient behaviour'), and four items related to *Opinion on Future Initiative Proposals* (e.g. 'I would agree with the enforcement of the mandatory inclusion of a domestic well wherever possible'). Section B provided a comprehensive picture of the characteristics of the individual without revealing personal information and/or infringing data protection matters.

3.2 The Population and Proposed Sample

In Malta, the population consists of 412,970 persons, of whom 205,419 are male and 207,551 female. Since this study was concerned with persons aged between 18 and 65, the sampling frame was reduced to 275,975 persons. [12]

A random sample of 800 persons stratified by gender, age, and locality of residence was ordered from the National Statistics Office (NSO) and the corresponding telephone numbers of the sampled persons were retrieved through the local service providers' websites and other sources.

3.3 The Survey

Sampled individuals were kindly invited to participate in the survey by either responding over the phone (either straight away or following an

agreed appointment) or online through a web link sent via e-mail. After half of the sampled respondents were either actually contacted or tried to be contacted, it became evident that in order to reach the targeted hundreds of responses there had to be a diversification of the survey administration strategy.

Instead, an online survey questionnaire web link was distributed through various organisations (e.g. University of Malta, Enemalta Corporation, Local Councils, etc.), social networking websites (e.g. Facebook), and the e-mail addresses of friends and friends of friends. Half way through the survey an extra effort was made in order to match the proportions of the online sample with the national demographic statistics. The survey was conducted between the 20th July and the 7th August 2011 and a total of 783 valid responses were gathered.

Chi-Square Goodness of Fit tests revealed that the sample of respondents was representative by gender ($\chi^2 = 0.8$, $df = 1$, $p = 0.37$) and district of residence ($\chi^2 = 7.43$, $df = 5$, $p = 0.19$) but differed significantly by age group ($\chi^2 = 212.20$, $df = 4$, $p < 0.01$) since the older age groups were under-represented, most probably due to the general characteristics of internet users [13].

3.4 Data Analysis

The preliminary analysis of responses consisted of the internal consistency reliability and construct validity tests (see Appendix). Principle component analysis revealed eight distinct factors and the oblique factor rotation method in factor analysis (Direct Oblimin) confirmed that all the items loaded on their respective factor. No items produced an unstable factor structure and all items loaded highly on a single factor. The Cronbach Alpha coefficients for the various constructs ranged from satisfactory to exemplary. This confirmed the internal consistency and uni-dimensionality of the eight construct measures used in this study.

Data analysis continued by calculating descriptive statistics for every construct and its individual items. On the other hand, in order to determine whether the construct measures varied as a function of the demographic characteristics, the analysis of variance (ANOVA) test together with the Duncan post-hoc test (where applicable) were carried out.

4 MAIN FINDINGS

A summary of the factor scores revealed that the Maltese and Gozitan residents:

- a. strongly agree that they are aware of the sustainable energy issues and of the economical and environmental consequences for not adopting sustainable energy behaviour ($\bar{x} = 4.50$, $SD = 0.50$);

- b. neither agree nor disagree that other people around them influence their sustainable energy behaviour ($\bar{x} = 3.04$, $SD = 0.74$);
- c. strongly agree that sustainable energy behaviour is the 'right thing to do' and that they encourage others to adopt such behaviour ($\bar{x} = 4.30$, $SD = 0.56$);
- d. agree that they intend to act by saving energy wherever and whenever possible ($\bar{x} = 4.05$, $SD = 0.57$);
- e. disagree that sustaining an energy efficient behaviour constitutes an inconvenience ($\bar{x} = 2.39$, $SD = 0.67$);
- f. agree that incentives by the government to encourage the adoption of sustainable energy systems are motivating ($\bar{x} = 4.05$, $SD = 0.55$);
- g. neither agree nor disagree that they are satisfied with the local authorities' initiatives ($\bar{x} = 3.07$, $SD = 0.90$);
- h. agree with the implementation of a number of future initiatives aimed at enforcing sustainable energy behaviour among the Maltese residents ($\bar{x} = 4.09$, $SD = 0.65$).

The study also showed that some of the factor scores varied across the demographic characteristics of the respondents. In fact,

- a. females reported a significantly higher mean score than males that adopting sustainable energy behaviour is the 'right thing to do' ($F[1,772] = 3.86$, $p = 0.05$) and a significantly lower mean score that sustainable energy behaviour is an inconvenience ($F[1,772] = 8.36$, $p < 0.01$);
- b. persons residing in the northern localities of Malta and all over Gozo reported, on average, that (i) they are more highly motivated by government initiatives to invest in sustainable energy systems ($F[1,772] = 4.28$, $p = 0.04$), and (ii) that adopting sustainable energy behaviour is less of an inconvenience ($F[1,772] = 6.15$, $p = 0.01$), than those residing in the southern region of mainland Malta;
- c. income had a direct impact on intentions to act ($F[2,772] = 4.55$, $p = 0.01$). Further analysis via the Duncan post-hoc test revealed that this significant effect was mainly due to the difference in means between two groups: the respondents with a gross annual salary of up to €25,000 reported greater intentions to act and engage in sustainable energy behaviour than those earning over €25,000 ($p = 0.03$).

5 DISCUSSION

The large number of responses gathered for this study confirms that the topic of sustainable energy is one of interest across the Maltese islands. Thus,

the registered awareness of the relevant issues is not so surprising.

The upward fluctuations of the electricity and water tariffs over the past fifteen years may be one significant reason for this result. In effect, a survey carried out by TNS Europe in Malta for Eurobarometer and reported in *The Times of Malta Online* [14] revealed that following the latest excursions in the utility tariffs the Maltese people were transformed into the EU's biggest energy savers with 87% saying that they have tried to cut down on the use of lighting and electrical appliances in their homes through 2010.

In support to this finding, Enemalta has during the last few years reported a slow down if not a decline in the power load demand, especially during peak seasons. In fact, the highest summer peak of 434MW reached in 2007 was not met again yet. On the contrary, the constant downward trend reached 400MW in 2010. The winter peak demand, which before the diffusion of air-conditioning units constituted the annual peak demand, shows the same trend and dropped from a highest of 402MW in 2005 to the 318MW recorded in 2010. These trends are confirmed by the monthly units generated. [15]

Subjective norms refer to the influence by others for a person to behave in a certain way and in general the response for this construct was a predominantly doubtful one, with an almost perfect normal distribution of responses. An interpretation of this result would be that the Maltese residents' sustainable energy behaviour is in fact influenced by important others but up to a certain extent. Individual item frequencies suggest that immediate family members and experts in the field are the most likely influencers of the relevant behaviour.

Personal norms are the way in which a person is accustomed to behave towards a particular issue or in a specific situation. The main descriptive statistics convey a positive and optimistic message for the relevant personal norms of our fellow nationals. In fact, a mean score of 4.30 ranks within the 'strongly agree' range and this verifies a very favourable personal approach to sustainable energy matters.

Items relevant to the intentions to act construct reflected engaging in energy efficiency measures (e.g. making every drop of water count and investing in top-rated efficiency appliances) and the adoption of renewable energy systems (e.g. the take-up of grants on solar water heaters and/or photovoltaic panels). The overall response for intentions was a favourable one. However, the latter category was not applicable to all respondents since the installation of such systems also depends on factors which may be out of control of the individual, such as the residence ownership, adequate roof space and the availability of a water reservoir. Moreover, in contrast with energy

efficiency practises, renewable energy systems require a substantial capital outlay.

Almost 64% of the respondents disagreed or strongly disagreed with the statement that holding an energy efficient behaviour takes too much effort while only 22% agreed or strongly agreed with it.

Similar results were obtained on whether an energy efficient behaviour means living a less comfortable life. This confirms that the Maltese population does not see it difficult to assume an energy efficient behaviour. This positive and committed response was partly counter-balanced by the doubtful response towards renewable energy technology. The latter outcome does not necessarily mean that such systems are seen as unworthy. It only reflects the current perception of the Maltese residents that renewable energy systems may not be financially feasible. All-in-all, it can be stated that the Maltese general public holds a just-above-average attitude towards sustainable energy behaviour.

The popular response vis-à-vis motivating factors such as advantageous feed-in tariffs on photovoltaic systems, subsidies on the commissioning of household energy audits and fiscal incentives on retro-fitting initiatives (such as the repair and use of domestic wells, the installation of roof insulation or the re-fitting of double-glazed apertures) was very positive indeed. These motivators reflect that the topic of sustainable energy is not all about safeguarding the environment and sustainability but is also becoming a matter of domestic financial management. This outcome offers quite a lot of input and food for thought in establishing upcoming sustainable energy measures that would guarantee successful participation.

From the analysis of responses, it is crystal clear that in general the Maltese population is neither satisfied nor dissatisfied with the local authorities' initiatives relevant to sustainable energy matters such as educating the general public and putting sufficient effort and investment in encouraging the adoption of energy efficiency measures and renewable energy systems. This finding may be interpreted in a way that the local people are acknowledging the latest efforts but at the same time are convinced that more can be done.

The national public opinion seems to be willing to undergo a number of legislative measures in order to encourage and enforce sustainable energy behaviour. These measures refer to the mandatory inclusion of double-glazed apertures, roof insulation and a water reservoir (whenever possible) in new buildings, fiscal incentives in the form of VAT refund for investing in sustainable energy systems, and that the local authorities enforce the adoption of the EU directive (2002/91/EC) stating that all new buildings and property for sale or rent must have an energy

performance certificate (EPC); similar to the energy efficiency certification of domestic appliances.

Although the latter might have a negative effect on the pockets of first-home buyers (or renters) and property developers (or landlords), the fact that respondents agree with the future initiative proposals suggests that those living on the Maltese islands are eager for new and innovative initiatives aimed towards a more sustainable lifestyle.

Descriptive statistics by demographic variables revealed that gender, district of residence and income group produced a significant effect on some of the factor scores.

The results suggest that females are more concerned about the subject of sustainable energy than males. Female participants regard sustainable energy measures as less of an inconvenience than males, and this confirms a better attitude towards the concept of sustainable energy behaviour. This result corroborates the finding by Paco and Varejao [16] that women's behaviour is keener towards saving energy resources than men's.

On the other hand, the Maltese and Gozitan residents occupying the northern region registered a more positive predisposition towards sustainable energy measures with respect to Maltese inhabitants residing across the southern region. One of the main findings of Catenazzo *et al.* [17] is that their comprehensive literature review acknowledged that education plays a crucial role in influencing individuals' attitudes and behaviours to meet sustainable development requirements. These two independent findings are linked by the local north-south educational divide confirmed by the latest published Malta Census of Population & Housing (2005) and reported on the MaltaTodayOnSunday Online in August 2007 [18]. A similar result was obtained by the northern population vis-à-vis sustainable energy initiatives as motivators for sustainable energy behaviour.

The relevant behavioural intentions of high income earners proved to be less sensitive than that of individuals on a lower salary. This finding may be explained by the simple logical reasoning that those who earn above a certain amount are not that much concerned about their utility bills, and this makes them less energy conscious than others. However, this warrants further investigation before any strong conclusions can be drawn.

6 LIMITATIONS OF THE STUDY

As with any other paper, this study suffered from a number of limitations which could in some way bias results. The main limitations are elicited hereunder:

- With an online survey, certain categories of individuals (e.g. those aged 66+) could not be

reached and hence were excluded from the study;

- With an online sample, respondents were representative of the population with respect to gender and district of residence, but not representative by age group, especially because the older age groups (46-55, 56-65) were under-represented;
- With a self-administered questionnaire, it is impossible to make sure that the message contained in all questionnaire items is conveyed, especially when the survey deals with a technical subject, like the one delved into in this paper;
- With a five-point Likert scale, it could be that not all respondents were able to associate with any of the possible options;
- Moreover, it could be that not all respondents were capable of an adequate degree of rating (a five-point Likert scale) with precision and objectivity.

7 RECOMMENDATIONS

Notwithstanding that the study revealed that the Maltese population considers itself as highly aware of sustainable energy related issues, this may be a matter of perception and hence policy makers are hereby advised to continue educating and informing. Grants, subsidies, and incentives do have an immediate effect but education is an investment that will last a lifetime. Especially through the last few years the local authorities have augmented their efforts and investment towards a sustainable energy society. However, as the results of this study expose, there is much more that can be and should be done. So keep it up, we are heading towards the right direction!

One of the findings reports that the Maltese have a neutral intention towards the adoption of renewable energy systems. However, this must be acknowledged as a positive result when considering that such investments require a substantial amount of money. In this context, policy makers are encouraged to keep working at it and make the balance get unbalanced in favour of sustainability. It is interesting to note that the outcomes of the 'intentions' and 'satisfaction' constructs partly corroborate each other. More specifically, higher incentives will lead to higher intentions, and we've seen this happen with regards to PV panels.

Policy makers are advised to commission feasibility studies on the four future sustainable energy initiatives proposed by this research paper. The response received vis-à-vis these proposals is very encouraging.

From the results obtained it is rather clear that high income earners are less likely to engage in sustainable energy behaviour. In line with this finding it is hereby recommended that utility tariffs

are set on the principle that who consumes out of proportion pays proportionally to that consumption.

This measure shall help to make high income earners more energy conscious. Probably, the recent stratified tariffs according to consumption level were not as effective and more needs to be done in this regard. Utility tariffs may also be tied to the level of income but many may sustain that this would be a discriminatory measure, apart from inducing tax evasion.

'Attitudes/inconveniences' and 'personal norms' both registered a significant relationship with 'gender'. In fact, females proved to be more pro sustainable energy behaviour than males. Policy makers may find these results useful when devising and marketing a relevant promotional or educational campaign.

The authorities are also advised to dedicate informational campaigns targeted to the south region of mainland Malta since both 'attitudes' and 'motivating factors' registered a significant difference between north and south respondents.

The area of sustainable energy (especially in Malta) is still rather unexplored. Policy makers are to commission studies and monitor already operating renewable energy systems in order to be able to scientifically quantify the payback period and the effective savings in case of energy efficiency initiatives. Until this day sustainable energy systems are promoted as cost savers but almost no one is able to quantify such savings with respect to time. The development of scientific models for quantifying the benefits would earn a major milestone in promoting sustainable energy behaviour.

8 SUGGESTIONS FOR FURTHER RESEARCH

Research regarding the last item of the above section may be carried out as public-private partnerships between government entities and business operators. Such practical information would make it easier for energy consumers (being domestic, commercial, or industrial) to decide whether to invest and adopt sustainable energy systems and which strategy best suits their needs and circumstances. Along the course of this study it was decided to focus on the domestic sector but two interesting ideas relevant to the industrial sector which popped up down the process and that may merit a dedicated study are the following:

- a. To investigate the industrial interest in the investment on recycling waste water by hoteliers. In this regard it was learnt that the central government would consider supporting such initiatives;
- b. To investigate the industrial awareness, interest and way forward in the study of motor drives' efficiency in industrial applications such as in the manufacturing sector.

It would also be interesting to hold a study on the household characteristics of the Maltese residents and the sustainable energy measures that were already adopted. Such a study shall also investigate items like the ownership and type of dwelling, the number of permanent residents and the ownership and type of roof space.

This study was based on quantitative research techniques. A similar research project with a qualitative approach may lead to a complementary image of the topic of sustainable energy behaviour in Malta.

A qualitative research method may be applied to the relevant policy makers, authorities, product/service providers, businesses, non-governmental organisations (NGOs), and consumers.

9 CONCLUDING NOTE

In this study, the main objectives set have been achieved, even though certain decisions had to be taken along the process in order to mitigate practical problems and to follow a more logical direction. This unexplored area of research in the local context proved to be very interesting and there is still much more to delve into.

By and large the Maltese residents proved to be well oriented towards sustainable energy behaviour. Although it much depends on the political and economic forces of our country, the results obtained in this study augur well for the relevant targets to be achieved within the established timeframes.

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APPENDIX

FACTOR ANALYSIS RESULTS

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.809
Bartlett's Test of Sphericity	Approx. Chi-Square	6351.713
	df	406
	Sig.	.000

Table 2: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings ^a
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
	1	4.839	16.688	16.688	4.839	16.688	16.688
2	2.955	10.190	26.877	2.955	10.190	26.877	2.665
3	2.342	8.074	34.951	2.342	8.074	34.951	2.858
4	1.819	6.273	41.224	1.819	6.273	41.224	2.765
5	1.585	5.464	46.688	1.585	5.464	46.688	2.699
6	1.453	5.011	51.700	1.453	5.011	51.700	1.807
7	1.197	4.129	55.829	1.197	4.129	55.829	2.355
8	1.111	3.831	59.660	1.111	3.831	59.660	2.069

Extraction Method: Principal Component Analysis

Note: Only components with Eigenvalues greater than one (1) are shown

Table 3: Pattern Matrix^a

	Component							
	1	2	3	4	5	6	7	8
A1	.578	.055	-.001	.007	.034	.010	.136	-.033
A2	.728	.015	.104	-.013	-.009	.038	-.141	-.074
A3	.650	-.065	.024	-.056	.116	-.035	.129	.094
A4	.678	-.003	-.061	.006	.083	-.039	.151	.056
A5	.703	-.021	-.034	-.016	-.019	-.079	-.004	-.037
S1	.026	.878	.027	-.029	.022	-.032	-.026	.028
S2	.000	.911	.034	-.014	.007	-.030	.005	.001
S3	-.044	.899	.001	-.008	.045	-.014	.009	.009
IA1	.064	.029	.767	-.045	-.046	.007	-.052	-.088
IA2	.002	.038	.774	-.014	-.129	-.133	.058	-.105
IA3	.041	.005	.774	.023	.022	-.011	-.035	.019
IA4	-.092	.002	.683	.007	.184	.185	.143	.057
SN1	.135	-.003	.003	-.708	-.098	-.026	-.025	-.073
SN2	-.063	-.067	.000	-.839	-.025	-.008	.047	.047
SN3	-.129	.072	-.097	-.741	.140	.033	.032	-.015
SN4	.115	.087	.103	-.724	-.008	.014	-.054	.012
O1	-.012	.101	.013	.041	.741	-.021	.069	-.009
O2	-.026	.011	.016	-.063	.803	-.029	-.070	-.026
O3	.049	-.001	-.104	.019	.519	-.033	.149	-.189
O4	.208	-.062	.091	-.017	.645	.065	-.090	.047
I1	-.066	-.017	.055	.037	.107	.715	-.072	-.038
I2	.086	.014	-.070	.011	-.034	.689	-.218	.060
I3	-.071	-.055	.021	-.031	-.076	.654	.167	-.029
M1	.020	.157	-.063	-.025	-.120	.239	.105	-.646
M2	.028	-.081	.139	-.024	.060	-.117	-.090	-.746
M3	.028	-.109	.088	-.011	.249	-.071	.005	-.687
PN1	.277	-.010	-.067	.034	.004	.030	.679	-.086
PN2	.171	.060	.056	.045	-.043	-.017	.731	-.020
PN3	-.115	-.060	.148	-.187	.118	-.136	.658	.057

Extraction Method: Principal Component Analysis

Rotation Method: Oblimin with Kaiser Normalization

a - Rotation converged in seven (7) iterations

Legend: A = Awareness of issues; PN = Personal Norms; SN = Subjective Norms; IA = Intentions to Act; M = Motivating factors; I = Inconveniences; S = Satisfaction with local authorities' initiatives; O = Opinion on future initiative proposals.