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**SURVEY INTO THE AGE OF MAJOR HOUSEHOLD APPLIANCES IN MALTA AND
INVESTIGATION INTO THE SCOPE FOR ENERGY REDUCTION RECOMMENDATIONS**

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ABSTRACT: Despite the focus put on renewable energy sources the largest reduction in carbon emissions over the past 25 years has come from energy savings due to more efficient household appliances. The latest refrigerators use a half of the energy of those from 25 years ago and washing machines use 75% less. The stock of appliances in Maltese households will include 25-year-old low efficiency devices and very latest high efficiency models. This paper establishes the age distribution of appliances in Malta and the amount of energy they use. This will provide a basis for evaluating policies designed to promote energy efficiency.

Keywords: Household Appliances, Energy Efficiency.

1 INTRODUCTION

The purpose of this research paper is to evaluate the potential for energy savings in Malta through the replacement of major household appliances by more energy efficient models. In the USA the Appliance Standards Awareness project reports improvements in efficiency of refrigerators by 50% from 1987 to 2010, and improvements for washing machines of 75% [1].

The appliances targeted in this study are refrigerators, washers, dryers and hot-water heaters. Lighting was also included as this represents a significant portion of household energy consumption and one where replacement options are available. Heating and air conditioning were not included in the study.

2 SURVEYS

The methodology was to collect data on the age of appliances in Malta. This was done through an on-line survey and a phone survey. The same question set was used for both surveys. The questions were kept short so as to encourage completion of the survey. The questions asked for the age of washing machines, tumble dryers, and refrigerators, what is the energy source for hot water and how many lights use energy efficient bulbs.

It was anticipated that the survey population, and therefore the responses, could be significantly different. The online survey would be self selective. Survey takers may already be predisposed to a favorable view on energy efficiency. The survey population demographic would be more computer literate, probably younger and possibly richer than average. The phone survey captures a different demographic. Names were randomly selected from the phone book and were contacted through their land line and not by mobile phone. They were contacted at home during the day or early evening.

A total of 445 people completed some or all of the online survey. For the phone survey a total of 378 calls were made. Out of those calls 158 went unanswered, 134 declined to answer and a total of 86 participated in the survey.

Figures 1-3 show the correlation between the online survey and phone survey was very high. This ruled out the possibility that the people who volunteered to participate in the online may have a greater concern for the environment and this would have an impact on their ownership pattern for appliances. The on-line participants of the survey can be regarded as representative of typical Maltese households.

The survey asked for the age of appliances for washing machines, tumble dryers and refrigerators, the type of water heater and how many energy efficient lights they had in their homes.

3 RESULTS

3.1 Washing Machines

Nearly all households in Malta have washing machines. Over half of washing machines were less than 5 years old and nearly 90% were less than 10 years old. This is a more frequent turnover than for other appliances, however it is in line with other European countries [1]. A small number (3%) of washing machines are over 20 years old which may be because these appliances have seen little use or have not needed to be replaced because they continued to work effectively.

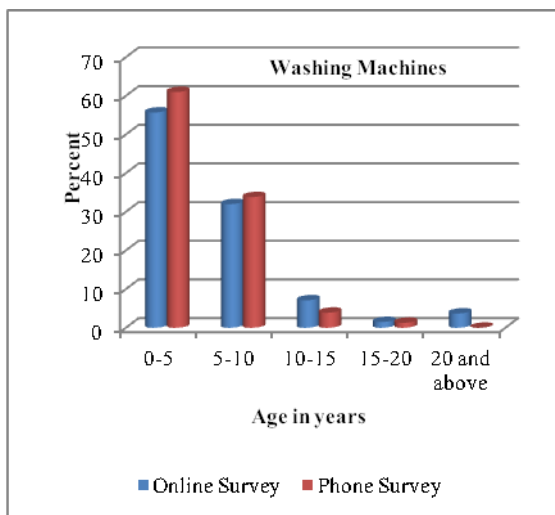


Figure 1: Age of washing machines from online and phone surveys.

3.2 Tumble Dryers

Tumble dryers are owned by less than a third of Maltese households, similar to other European countries [3]. There are more tumble dryers 5-10 years old (37%) compared to newer appliances in the 0-5 year range (27%). This drop in the purchase of tumble dryers may be due to economic conditions. Tumble dryers in Malta appear to have long lifetimes, compared to European averages, with 30% being between 10 – 20 years old and almost 5% older than 20 years [4]. This long lifetime could be because they are not the primary or sole means of drying clothes. Natural air drying may also be used given Malta's favorable climatic conditions.

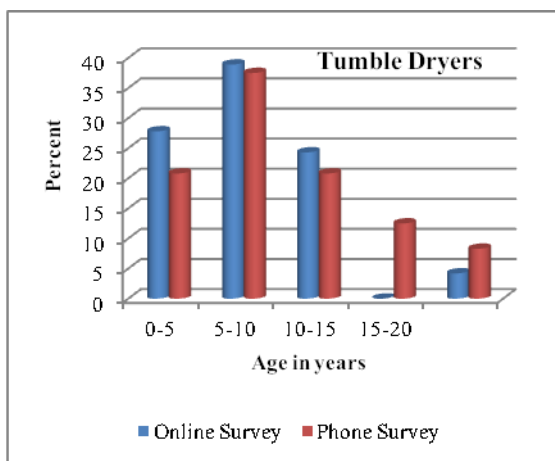


Figure 2: Age of tumble dryers from online and phone surveys.

3.3 Refrigerators

Two thirds of refrigerators are under 10 years old, however there are substantial numbers of refrigerators exceed that age; as many as eight percent of refrigerators are 20 years old or over [5]. The long life expectancy of refrigerators is consistent with other European countries and suggests refrigerators are only replaced when they fail.

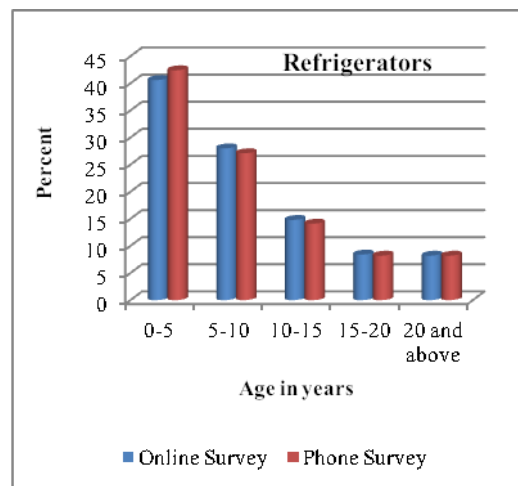


Figure 3: Age of refrigerators from online and phone surveys.

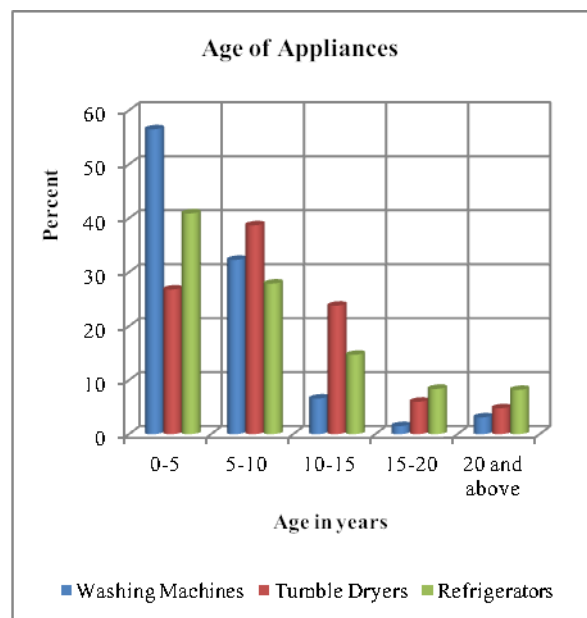


Figure 4: Age of washing machines, tumble dryers and refrigerators.

3.4 Lighting

The survey shows good take up of energy efficiency lights in Maltese households. Three out of 4 respondents reported that most of the lights in their home were energy efficient bulbs.

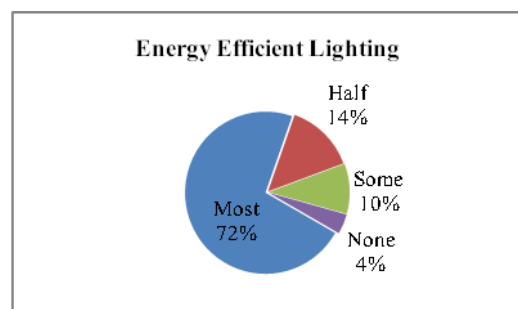


Figure 5: Energy Efficient lighting

3.5 Water Heaters

The survey asked what energy source was used for domestic hot water. Two thirds of households use electric water heaters while 18% use solar water heaters and 9% use gas. 5% reported owning both solar and electric water heaters.

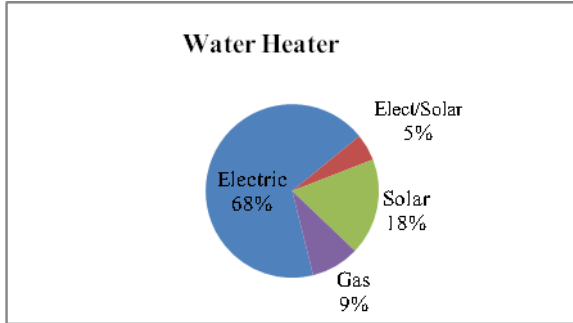


Figure 6: Type of Water Heater

4 ENERGY CONSUMPTION

A survey on the electricity consumption of Maltese households was conducted by the National Statistics Office in 2011 (Figure 7) [6]. Average energy consumption was 22% for refrigeration, 24% for water heating but just 2% for washing machines, and less than 1% for tumble dryers. Refrigeration and water heating were the largest consumption categories other than a broad category of lighting and others that consumed 32% of electricity.

Assuming a typical household energy consumption of 4,000 kWh per year then the average appliance consumptions would be refrigeration - 866 kWh, water heating - 955 kWh, washing machines - 94 kWh and tumble dryers -9kWh. The greatest potential for energy conservation initiatives are for refrigeration, water heating and lighting.

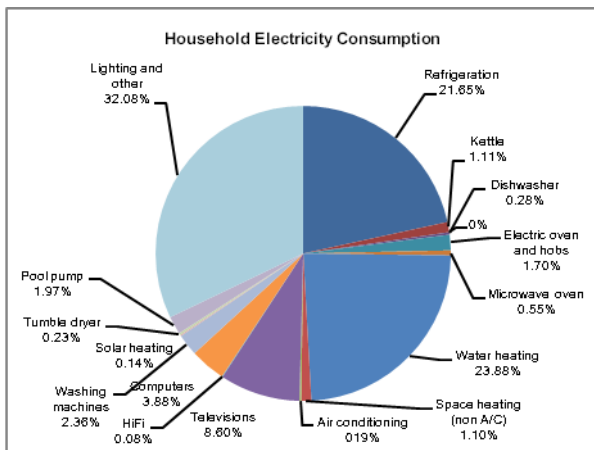


Figure 7: NSO Household Electricity consumption for Malta.

5 EU ENERGY EFFICIENCY INITIATIVES

5.1 General

A key initiative to drive household energy conservation is the European appliance labeling programme (Figure 8). In the USA the EnergyStar programme serves a similar purpose [7]. Manufacturers and distributors are required to test their products to these standards and provide a summary of the information to the customer. This summary is displayed on the EU Energy Labels, which were established under EU Directive 92/75/EC [8]. These include information important to the customer to compare products and make an informed decision. An overall energy grade is assigned and an annual energy consumption figure provided.

The Energy label is prominently displayed on the appliance and uses a grading letter to indicate efficiency from G to A. The success in persuading manufactures to develop more energy efficient products has resulted in raising the efficiency of some products to a point where only products meeting the top grades C, B and A are in the market. This has led to revising the labels to introduce new efficiency levels of A+, A++ and A+++ for washing machines and refrigerators.

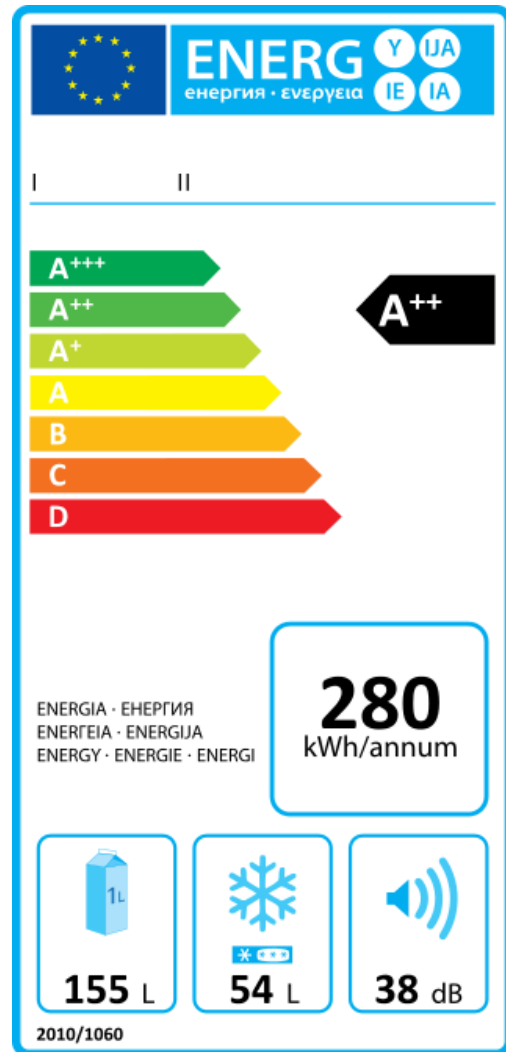


Figure 8: EU energy label for refrigerators

5.2 Washing Machines

The current version of the EU Energy label for washing machines was introduced in 2011 and consists of energy efficiency classes from G to A+++ . The pre 2011 label had classes from G to A but improvements in efficiency required the addition of classes A+, A++ and A+++ to differentiate the top performing appliances. Virtually all new washing machines meet or exceed class A.

The formula for calculating efficiency is based on 220 washing cycles per year, averaging cycles at 40°C and 60°C for full and partial loads. Figure 9 shows the energy consumption for various efficiency classes of the EU energy label for washing machines.

| <i>Energy Efficiency Class</i> | <i>Energy Consumption kWh/year</i> | <i>Annual cost @ €0.20 per kWh</i> |
|--------------------------------|------------------------------------|------------------------------------|
| A+++ | 77 | 15.4 |
| A++ | 88 | 17.6 |
| A+ | 100 | 20.0 |
| C | 110 | 22.0 |

Figure 9: Energy consumption by efficiency class for washing machines.

5.3 Refrigerators

Like washing machines the latest EU Energy label for refrigerators has energy efficiency classes from G to A+++ up from the previous label that had a range of G to A. Only class A and above refrigerators have been permitted since 2010 and this was raised to A+ in 2014. The average refrigerator on sale in 2013 is twice as efficient as that available in 2000 [9]. Figure 10 shows the energy consumption for various efficiency classes of the EU energy label for refrigerators.

| <i>Energy Efficiency Class</i> | <i>Energy Consumption kWh/year</i> | <i>Electricity cost @ €0.20 per kWh</i> |
|--------------------------------|------------------------------------|---|
| A+++ | 72 | 14.4 |
| A++ | 90 | 18.0 |
| A+ | 122 | 24.4 |
| C | 232 | 46.4 |

Figure 10: Energy consumption by efficiency class for refrigerators

5.4 Tumble Dryer

There are three types of EU labels for clothes dryers. They are for condensing dryers, air-vented dryers and gas-fired dryers. Air-venting uses less energy than condensing dryers, because they vent the moisture laden air so it can be exhausted outside the building while condensing dryers have the extra function of removing the moisture from the waste air. The energy classes are from D to A+++ however no A+++ dryers are on the market and most sales are of B and C class dryers. The energy efficiency indexes are calculated on 160 drying cycles at full and partial load per year. Typical energy usages are 212 kWh per year for A++ class to 560 kWh for a class C dryer.

5.5 Water Heaters

There is an EU energy label for electric water heaters but it is not a major factor in customer choice. A new label will be introduced in two stages starting in 2015. It will have separate labels for conventional, solar and heat pump water heaters, storage tanks and packaged systems combining solar and conventional heaters. Efficiency classes of A+, A++ and A+++ will be reserved for systems using heat pumps or renewable energy sources.

6. CONCLUSIONS

There is potential to reduce energy consumption in Maltese households by encouraging the replacement of older, but still functional, major appliances. The most potential for energy savings in Maltese households is for refrigeration, water heating and lighting. Additional studies are needed to determine the scope of incentive programmes.

6.1 Refrigeration

Refrigerators consume 22% of household energy. A third of all refrigerators in Maltese households are over 10 years old and 8% are over 20 years old. They usually only get replaced when they fail. Replacing a 15-year old refrigerator consuming 400 kWh per year with a new one could save 200 kWh per year.

6.2 Laundry

Washing Machines are newer on average in Malta with 90% being less than 10 years old. More will be higher efficiency models so there will be less opportunity to save energy through scrapping older appliances. Replacing an EU energy label C rated washing machine with an A+ rated appliance would only save 10% or 10 kWh per year. The latest washing machines also provide substantial saving in water consumption and have a number of energy savings features such as load sensors, cold water cycles and high spin speeds that reduce subsequent drying operations.

Tumble dryers are high energy users, with even the most efficient using three times more energy than a washing machine handling the same laundry load. They are found in only a third of Maltese households. Natural air drying should be encouraged as the preferred drying method whenever feasible.

6.3 Water Heating

Water heating uses a quarter of household electricity consumption and offers significant scope for energy savings. Electric resistance heaters were the principal means of heating water followed by solar heating in 24% of households and gas in 10%. Electric resistance heater converts energy at close to 100% efficiency, so only through the use of better insulation is it possible to reduce energy losses.

Solar water heating provides the possibility of meeting a household's hot water requirements at near zero energy costs. Despite having the best solar conditions in Europe, Malta lags behind several other countries in solar thermal installation. Cyprus has an installed capacity of 680 kW_{th} per 1000 inhabitants compared to 42 kW_{th} for Malta [10]. The key issues that limit more installations are the available rooftop space, and the capital cost to purchase and install solar thermal systems.

Heat pump water heaters are another technology which will meet the EU labelling requirements for higher efficiency appliances (A, A+, A++). Although they have higher purchase prices they can be two and a half times more efficient than electrical resistance water heaters.

6.4 Lighting

The adoption of energy efficient lighting has made good progress in Malta. EU regulations are phasing out incandescent bulbs in favour of halogen, compact fluorescent and LED bulbs. Costs are coming down for LED bulbs which offer the greatest energy savings with very long lifetimes; however incentives could help encourage their use.

6.5. Potential savings

Increasing the number of households with solar water heaters from 20% to 50% would reduce domestic electrical energy consumption by 10% or, on average, 410 kWh/yr per household.

Replacing the third of refrigerators which are more than 10 years old with new 45% more efficient models, would reduce domestic electrical energy consumption by 3% or, on average, 120 kWh/yr per household.

7. RECOMMENDATIONS

For new appliances the EU Labeling requirements provide an excellent path to drive up energy efficiency. Since 2012 all refrigerators for sale in the European Union must be rated A+ or above and the sale of incandescent light bulbs has been banned.

Suggestions for promoting energy efficiency in household appliances include:

- Educate public on the use of the EU Energy Labelling programme to calculate lifetime energy cost
- Encourage greater use of solar water heaters and investigate feasibility of a subsidy programme
- Promote heat pump water heaters as a more efficient option than electric resistance heaters when solar water heaters are not feasible
- Encourage line drying of laundry as eco-friendly option over tumble dryers
- Investigate a scrapping scheme for refrigerators over 10 years old
- Promote Washing machines with energy saving features such as load sensors, cold wash programmes, high spin speeds and hot water fill options

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