

**ENERGY EFFICIENCY DIRECTIVE:
ARTICLE 4 – BUILDING RENOVATION**

**Malta's Long-Term Strategy for Mobilising
Investment in the Renovation of the National
Stock of Residential and Commercial
Buildings**

FIRST VERSION

MALTA

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Contents

1.0	INTRODUCTION	4
1.1	Directive Wording.....	4
1.2	Scope of Report.....	4
1.3	Building Categories Targeted by the Report.....	5
2.0	OVERVIEW OF NATIONAL BUILDING STOCK	7
2.1	Construction Methods, Trends and Buildings' Lifespan.....	9
2.2	Buildings' Energy Use & Legislation	10
3.0	COST-EFFECTIVE APPROACHES TO RENOVATION.....	14
3.1	Building Stock Characterisation - Residential	14
3.2	Appraisal of Renovation Potential & Identification of Strengths, Weaknesses and Threats - Residential	16
3.3	Building Stock Characterisation - Offices	20
3.4	Appraisal of Renovation Potential & Identification of Strengths, Weaknesses and Threats - Offices	21
4.0	POLICIES AND MEASURES TO STIMULATE COST-EFFECTIVE DEEP RENOVATIONS	23
4.1	Past and Present Policies and Measures	23
4.2	Proposed New or Extended Polices and Measures	23
4.2.1	List of proposed policies and measures for residential buildings.....	23
4.2.2	List of implemented and proposed policies and measures for commercial and public buildings	25
4.2.3	List of proposed policies and measures common for both residential and commercial buildings	26
5.0	FORWARD-LOOKING PERSPECTIVE TO GUIDE INVESTMENT DECISIONS.....	29
5.1	Guide to Investment in the Residential Sector	29
5.2	Guide to Investment in the Commercial (Office) Sector	30
5.3	Financing of energy efficiency measures in buildings.....	30
5.3.1	Government support schemes	30
5.3.2	Selected domestic bank products on the market	31
5.3.3	Other measures.....	32

6.0	EXPECTED BENEFITS FROM RENOVATION OF BUILDINGS.....	33
6.1	Energy Savings	33
6.2	Reduction in CO ₂ Emissions & Pollution	33
6.3	Energy System Benefits	34
7.0	CONCLUSIONS.....	35

1.0 INTRODUCTION

In line with the requirements of Article 4 of Directive 2012/27/EU of the Council of 25 October 2012 on Energy Efficiency, as stated in Section 1.1, Malta has prepared a first strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private.

1.1 Directive Wording

Article 4 of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, states that:

Article 4

Building renovation

Member States shall establish a long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private. This strategy shall encompass:

- (a) An overview of the national building stock based, as appropriate, on statistical sampling;*
- (b) Identification of cost-effective approaches to renovations relevant to the building type and climatic zone;*
- (c) Policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations;*
- (d) A forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions; and*
- (e) An evidence-based estimate of expected energy savings and wider benefits.*

A first version of the strategy shall be published by 30 April 2014 and updated every three years thereafter and submitted to the Commission as part of the National Energy Efficiency Action Plans.

1.2 Scope of Report

As required by Article 4 of the Directive the scope of this report is primarily to present a first strategy towards long-term building renovation of the existing building stock, however, in order to encompass a holistic strategy towards the energy performance of buildings in Malta, the report was structured in such a way as to represent an ongoing working document which, in line with the requirements set by the Directive, shall be reviewed every three years and submitted to the Commission as part of the National Energy Efficiency Action Plans (NEEAP).

This strategy encompasses an overview of the national building stock, it identifies cost-effective approaches to renovations, policies and measures to stimulate such renovations and provides a forward-looking perspective to guide investment decisions in the sector. Furthermore the report gives an evidence-based estimate of expected energy savings and wider benefits.

1.3 Building Categories Targeted by the Report

The building categories which are expected to be covered through this strategy is wide ranging and includes all those listed in Annex I (5) to Directive 2010/31/EU, as follows:

- Single-family houses of different types;
- Apartment blocks;
- Offices;
- Educational buildings;
- Hospitals;
- Hotels and restaurants;
- Sports facilities;
- Wholesale and retail trade services buildings; and
- Other types of energy-consuming buildings

Given the number and the extent of the wide ranging building categories, only the residential sector (single-family buildings and apartment blocks/multi-family buildings) and the commercial (office) sector are going to be addressed in detail in this first version of the strategy.

This is not to say that there is no ongoing work towards improving the energy efficiency of the other sectors, but rather that, at this point in time there is a tangible lack of information on what is current state of affairs in remaining sectors. This renders the creation of a coherent and holistic strategy for all these building categories quite difficult. Creation of a long-term strategy, including specific building category based targets requires further time, specifically aimed at collecting data and performing analysis related to the building performance of the existing building stock, age, ownership and energy characterisation of the different building categories, calculating and setting up (cost-optimal) building performance requirements, *etc.*

Nonetheless, especially as shown in Section 4 of this Strategy, policies which address building typologies other than the residential and commercial (offices) sector are being

presented as well (*e.g.* the pilot project at the Siggiewi Primary School, Energy Efficiency Measures for the Hospitality Sector, *etc.*).

Furthermore, specific work aimed at addressing information gaps in certain sectors has already started or is in the process of being initiated. This work includes:

- A survey to have a better understanding of the energy consumption in educational buildings. The survey will be targeted to have a register of all local schools and their corresponding electricity consumption in the past three years. A similar exercise will be carried out in the hospitality and health sector. This will enable detailed policies and measures to be set up to target the decrease of energy consumption in schools, hospitals, hotels and restaurants.
- A study commissioned by the Ministry for Energy and Health (MEH) to identify cost effective energy efficiency technologies aimed for the retrofitting of a hospital residence for old people. The results of this study will enable their application in similar hospitals within Malta and Gozo.

Given this context, the fact that a considerable amount of data has already been gathered for the residential and commercial (office) building sector together with the notion that these two building categories include the largest share of buildings renders their selection as recipients of the first strategy, only natural. This first version of Malta's building renovation strategy therefore focuses specifically on the following buildings:

- Single-family houses of different types;
- Apartment blocks/multi-family buildings; and
- Office buildings.

Other building categories (*incl.* educational institutions, hospitals, hotels and restaurants) will be tackled in further detail in the next report of the long term building strategy required in 2017, when more information is available¹ and specific² minimum performance requirements are established for the different building categories.

¹ As explained a plan is being devised to address aspects related to obtaining missing information for the non-residential and non-office building categories, including the building performance of the existing building stock, building stock characterisation, *etc.*

² Currently the only existing minimum requirements are those specified by the 'Technical Guidance Part F – Conservation of Fuel, Energy and Natural Resources', which is a generic list of minimum requirements for all buildings in Malta.

2.0 OVERVIEW OF NATIONAL BUILDING STOCK

As discussed the scope of this report is to mainly analyse single-family, multi-family buildings (mainly consisting of maisonettes and apartment blocks) and office buildings.

Analysis by Building Type

Based on the 2011 Malta Census carried out by the National Statistics Office, Malta had 223,848 residential buildings (dwellings), of which just 68.2% were occupied. Of the vacant properties almost one-fifth were holiday dwellings³. Terraced houses constitute the most common type of dwelling, representing 34.4% of all occupied dwellings.

Information regarding commercial office buildings is limited to recent years only. Until the last two decades, commercial office buildings deployed the same construction methods as the residential sector, with a substantial amount of companies and firms making use of existing converted buildings, originally designed as dwellings. Only recently has this trend changed, with new commercial blocks being built according to modern office space construction methods, and specifically to fulfil this purpose.

Analysis by Building Age

Generally speaking Malta's buildings stock can be considered as a very old. In fact round 34.9% of all residential buildings in Malta are over 50 years old, that is, they are beyond the average life span of buildings in Europe. A third of these buildings have actually been built before the First World War (1918), almost a century ago. Table 1 shows distribution of buildings by type (single or multi-family buildings) and age band.

Building Type	Age Band					
	Pre-1918	1919-1960	1961-1980	1981-2000	2001-2005	2006-2011
Single-family building	10,220	16,080	16,190	23,450	* ⁴	* ⁴
Multi-family building	5,340	16,050	20,170	24,490	10,882	8,603
Offices ⁵	N/A	N/A	N/A	N/A	N/A	N/A

Table 1: Distribution of buildings by type and age band⁶

³ National Statistics Office, 2010

⁴ Current industry trends show that new buildings are predominantly of the multi-residential type. Number of new single family houses is comparatively very small.

⁵ Full analysis of information regarding offices is still in the process of being collected.

Analysis by Building Ownership

In 2008, 64.6% of the households owned their main dwelling, while 18.7% rented their dwelling. A factor that may be attributed to rent laws (the latter being only recently reformed and which for many years deterred landlords from renting out their vacant property) is that 53.5% of occupied residential buildings which are rented were constructed prior to 1956 compared to the 8.7% of the rented stock which were constructed after 1990⁷. Table 2 and Table 3 show the distribution of buildings by type of ownership and by type of tenure respectively.

Building Type	Type of Ownership		
	Privately Owned	Publicly Owned	Mixed
Single-family building	67,020	N/A	N/A
Multi-family building	62,847	9,853	N/A
Offices	N/A	N/A	N/A

Table 2: Distribution of buildings by type of ownership

Building Type	Type of Tenure			
	Owner Occupied	Rented from Public	Rented from Private	Mixed
Single-family building	57,520	N/A	9,500	N/A
Multi-family building	50,900	9,853	11,947	N/A
Offices	N/A	N/A	N/A	N/A

Table 3: Distribution of buildings by type of tenure⁸

⁶ National Statistics Office, 2007

⁷ National Statistics Office, 2007

⁸ National Statistics Office, 2007

2.1 Construction Methods, Trends and Buildings' Lifespan

Buildings in Malta are massive constructions, predominantly built with limestone (sourced in local Maltese quarries, hence requiring a low energy intensive process, especially for transport) and other durable materials, which are designed to stand for as long as possible. Limestone, the only natural resource available on the island was utilised since the very first structures erected in Malta, dating back to three centuries BC and until the introduction of concrete in post war constructions, local constructions mainly consisted of thick masonry walls (approx. 600mm), high ceilings and small openings roofed over with stone slabs. Traditional Maltese residential buildings⁹ such as houses of character, town houses and farmhouses are in fact characterised as buildings having thick stone walls (creating an appreciable thermal mass which prevents large indoor temperature fluctuations), high ceilings and an internal courtyard (to promote indoor ventilation). This renders such buildings particularly prone in creating comfortable indoor temperatures for Malta's specific climate.

The British presence in Malta introduced structural steel to local construction in the 1840s. The British still largely used Limestone in many buildings and until past the Second World War, Maltese houses were roofed with thin stone slabs supported on steel joists. Post war, reinforced concrete roofs became the norm. This, coupled with the opening of the first plant to produce prefabricated pre-stressed concrete roofing elements in 1956, changed the typical method of building construction in Malta.

Construction Trends

Up to and including the Second World War, Malta's buildings were limited to localities and areas close to the core of villages and towns. Sporadic constructions were also present in rural settings, but this was not the norm.

The 1960s construction boom involved the urbanisation of large areas of land. A sector of the Maltese population was in need of affordable housing which led for an extensive programme of social housing. By the late 1970s almost all towns and villages had newly-built housing estates on their peripheries¹⁰.

The 1980's saw the Maltese construction industry boom again. Costly and scarce supply of land coupled by a drive to reduce construction costs however led buildings to be built

⁹ Such buildings are currently in great demand and owners go through great expenses and effort to retain much of their original features.

¹⁰ MEPA, 2002. *Malta Structure Plan - Housing Topic Paper*

using thinner walls and lower ceilings, compromising the thermal comfort inside buildings.

Driven by the relaxation of new height limitations in most localities in Malta, another brief housing boom lasted from 2002 to 2005. Financially the boom was set off by low interest rates and a tax amnesty for Maltese residents with overseas assets which shot up property prices again.

Similarly to what happened anywhere else, the financial crisis slowed down the building industry in the latter part of the first decade of the 2000s, though possibly not as much as in other countries. Nonetheless the number of new constructions has seen a considerable reduction. In 2010, the Malta Environment and Planning Authority (MEPA) approved 4,444 new residential dwellings down from the 9,081 new units which were given the green light in 2005.

Life Span of Buildings and Refurbishment Trends

As shown by the abundance of historical buildings in Malta, Maltese buildings were historically built to last, sometimes not only decades but also centuries. In fact for most Maltese, purchasing or building a property is seen as a life-long investment, which will require little if no modification over a person's lifetime. Such a consideration has led to a low refurbishment (or indeed demolition) rate throughout the private residential sector with only few property owners significantly refurbishing their property over the years. In this context, 'Deep' renovation is mainly undertaken when there is a change of ownership and may not happen again for another 30 or 40 years since the size of the islands does not necessitate living close to the workplace (the general trend is that one stays in the same dwelling throughout his adulthood). On the other hand, the long life span of our dwellings means that existing units, even those with low energy performance, shall continue to be used for a long time, probably without any 'Deep' renovation.

In the public sector a considerable amount of central government bodies are housed in scheduled buildings, however in some instances a number of such buildings are being refurbished or have been earmarked for refurbishment, particularly through the granting of EU funds.

2.2 Buildings' Energy Use & Legislation

Malta's climate is described as a warm climate with wet cool winters and dry hot summers. This type of climate has resulted in Maltese buildings being low energy

consumers compared to buildings in other European Countries¹¹.

In the residential sector Maltese dwellings have around 16% share of the total final energy consumption, while tertiary buildings consume 15% share for total of around 31%¹².

Energy Usage in the Residential Sector

In terms of electrical energy, NSO reported that in 2010 the residential sector consumed 571,246MWh or 27% of the total electricity consumed in the Maltese islands¹³. The figures refer to the electrical energy generated and not consumed. Including only the amount of electricity actually delivered at end-user (therefore excluding for example the electricity used in the power stations), the residential sector accounts for 33.5% of the final end use electricity.

If one had to consider the overall energy consumption in the household sector in 2009, it was reported¹⁴ that the average Maltese household consumed 0.63 tons of oil equivalent (*toe*). This is less than half the EU 27 average, which stood at 1.48 *toe* per dwelling. The bulk of the energy used in European homes, approximately 70%, is utilised in space heating, something of an unknown technology in Malta (National Census 2011 reported that only 2% of the residential building stock have a central heating system installed). In this context, the lack of central heating systems coupled with Malta's favourable climate conditions and the fact that Maltese enjoy a predominantly outdoor lifestyle compared to their European counterparts, has resulted in Malta's low residential energy consumption compared to other countries in Europe.

In lieu of central heating systems, most Maltese households tend to heat buildings during the very short heating periods either using portable LPG gas heaters or reversible heat pumps (in the form of split-unit air conditioner [AC] units)¹⁵. The latter have effectively become very popular as heating devices especially in consideration of the fact that

¹¹ Enerdata. 2012. *Energy Efficiency Trends in Buildings in the EU, Lessons from the ODYSSEE/MURE Project*. D.Bosseboeuf. Paris, France.

¹² Enerdata. 2012. *Energy Efficiency Trends in Buildings in the EU, Lessons from the ODYSSEE/MURE Project*. D.Bosseboeuf. Paris, France.

¹³ National Statistics Office News Release 195/2012, 2012

¹⁴ Enerdata. 2012. *Energy Efficiency Trends in Buildings in the EU, Lessons from the ODYSSEE/MURE Project*. D.Bosseboeuf. Paris, France.

¹⁵ Enerdata. 2012. *Energy Efficiency Trends in Buildings in the EU, Lessons from the ODYSSEE/MURE Project*. D.Bosseboeuf. Paris, France.

efficient reversible heat pumps split-units have become readily available for the cooling market. A favourable aspect in this regard is that, apart from the high EER (Energy Efficiency Rating) which can be obtained when using heat pumps, heating can be provided in a decentralised manner permitting better individual space control, hence heating can be provided specifically where required.

In terms of cooling requirements the share of total energy consumed by air-conditioning system in the residential sector in Malta, is around 10%. In 2005, the average Maltese dwelling consumed 550kWh per annum for cooling for air conditioning. As demonstrated by the increased sales of heat pumps (45% of the local households in 2005 had air conditioners whilst in 2011 this increased to over 50%), this type of energy consumption is on the increase. Notwithstanding this fact, good educational campaigns and a very energy conscious population (vis-a-vis energy consumption in buildings) have prompted a considerable number of households to use (high efficiency) inverter heat pumps having high EER ratings, so already partially offsetting the increase energy consumption due to the increased market penetration of the heat pumps.

Domestic hot water heating is still predominately based on electric water storage, with only 10% of existing dwellings¹⁶ making use of solar water heater to heat domestic hot water.

Other renewable sources of energy typically used in Maltese dwelling include mainly electricity produced from photovoltaic panels. Successive grant schemes and the establishment of Feed-in Tariff (FIT) have greatly facilitated this technology. In 2012 photovoltaics generated 0.6% of the electricity generation.

Energy Usage in the Commercial (Office) Sector

In terms of electricity usage, in 2010 the commercial sector consumed 625,554MWh, a share of 29% of the total electricity consumed. Heating and cooling energy consumption for office buildings is harder to establish, given the multitude of existing building typologies in this sector. It is however reasonable to assume that air conditioners, both split-units and centralised systems making use of chillers and air/water delivery systems, are the predominant technologies used for the purpose of space heating and cooling. Similarly to what happened in the residential sector, energy and cost conscious commercial building owners have already realised the importance of energy conservation and efficiency and as such tend to go for good energy-efficient technologies such as

¹⁶ National Statistics Office, 2011, National Census of Maltese Households 2011.

VRFs, inverter type and heat recovery technologies. Lighting in office buildings, though a substantial load, is already mainly of the energy-efficient type.

Energy Performance of Buildings Related Legislation

Given the mild climate of the Maltese islands, energy performance of buildings was never a major parameter in the design of buildings in Malta. The '*Technical Guidance Part F – Conservation of Fuel, Energy and Natural Resources*' which sets the minimum energy requirements on the energy of buildings performance represents the construction industry's current requirements for all new and (major) renovated buildings since January 2007¹⁷.

Although the *Technical Guidance Part F* was considered a significant step in the right direction in as far as energy performance of buildings is concerned, in accordance with Article 4 of Directive 2010/31/EU on the Energy Performance of Buildings (Recast EPBD) Malta through the Building Regulations Office (BRO), towards the end of 2013, issued a tender for two studies meant to develop the cost optimal energy performance levels for residential and offices buildings in Malta respectively. The studies will also serve as a platform towards future revisions of the said *Technical Guidance Part F*.

¹⁷ Originally issued within the scope of LN 1002 of 2006 transposing the first EPBD, Directive 2002/91/EC, now they fall within the scope of LN 376 of 2012 – Energy Performance of Building Regulations which transposes the Recast EPBD Directive, Directive 2010/31/EU.

3.0 COST-EFFECTIVE APPROACHES TO RENOVATION

In order to make an informed appraisal of the best approaches towards creating a building renovation strategy in Malta, it is important to set a specific starting point towards understanding the current situation of the existing building stock. In this regard, the studies '*Cost-optimal energy performance levels in new and existing residential buildings in Malta*' and '*Cost-optimal energy performance levels in new and existing office buildings in Malta*' are being used as the baseline for this report. In particular, the reference buildings selected in these studies are being used as the base characterisation of existing buildings in Malta. The calculations of the cost-optimal energy performance levels¹⁸ in new and existing buildings in Malta have been carried out as per Guidance Document 244/2012. The calculations have been performed as per methodologies established in Malta for energy performance rating/certification of buildings. These are the **Energy Performance Rating of Dwellings in Malta** (EPRDM) methodology for dwellings and the **Simplified Building Energy Model for Malta** (SBEMmt) for offices.

The report here presented makes extensive use of the above mentioned studies for two main reasons. Primarily, as discussed they are the most recent documents (issued in 2014) relating with building energy performance in Malta. Secondly, these studies will be used to underpin other major national policies, *e.g.* nearly zero-energy buildings targets for 2020. Use of these two studies therefore enables consistency in the different results obtained and strategies being proposed.

3.1 Building Stock Characterisation - Residential

Section 2.2 of the '*Cost-optimal energy performance levels in new and existing residential buildings in Malta*' gives specific details as to the assumptions made in calculating the energy performance of existing residential buildings. In general however, the study focuses on 14 residential building typologies dating both pre and post war¹⁹.

As explained in the study:

"In most cases the reference buildings have been modelled with two different wall constructions, namely double skin limestone walls with an uninsulated air cavity, and single skin hollow concrete block wall., representing the common construction types in

¹⁸ '*Cost-optimal energy performance level*' means the energy performance level which leads to the lowest cost during the estimated economic lifecycle.

¹⁹ The reference to pre and post war buildings does not refer specifically to the historical years, but rather to the difference in floor space dictated by the two construction periods, as explained in Section 2 of this report.

Malta which would be expected to have significantly different baseline performances, significant potential for energy efficiency upgrade, and different options available for retrofit.”

The 14 residential building typologies have been categorized based on this classification as shown in **Table 4: Characterisation of existing residential buildings**. Also shown in Table 4 are the *reference primary energy for existing buildings* and the *reference primary energy value for new buildings* built according to *Technical Guidance Part F* which sets the minimum energy requirements on the energy of buildings performance.

		Primary Energy (kWh/m ² yr)	
Building Type (Residential)	Area (m ²)	Reference Existing Building	Reference New Building
Detached villa	176	196	94
Owner Developed Semi Detached Villa	235	177	84
Speculatively Developed Semi Detached Villa	235	189	84
Post war Terraced House	219	163	82
Pre-war Urban Terraced House	219	159	82
Pre-war Rural Terraced House	201	139	82
Post war top floor Maisonette	89	246	97
Post war ground floor Maisonette	89	231	127
Pre-war top floor Maisonette	129	202	97
Pre-war ground floor Maisonette	105	201	127
Post war top floor Flat	74	274	125
Post war mid floor Flat	74	205	117
Pre-war top floor Flat	105	240	125
Pre-war mid floor Flat	105	170	117

Table 4: Characterisation of existing residential buildings

Based on the data developed in the cost-optimal analysis studies it can be seen that the average primary energy value of the existing residential building stock built before 2006, that is, before the entry into force of the minimum energy efficiency building requirements set by the *Technical Guidance Part F*, is about 199kWh/m²yr, whilst the value for new buildings built according to *Technical Guidance Part F* is about 96kWh/m²yr. Hence it is clear that the introduction of the *Technical Guidance Part F* was already a major improvement as regards to energy efficiency in buildings.

3.2 Appraisal of Renovation Potential & Identification of Strengths, Weaknesses and Threats - Residential

Apart from characterizing the ‘as-is’ energy performance of existing residential buildings the ‘*Cost-optimal energy performance levels in new and existing residential buildings in Malta*’ also sets a cost-optimal level of minimum energy performance for the different typologies of existing residential buildings. For each building typology a number of energy-efficiency intervention measures were grouped together in different packages (each containing aspects relating to building envelope, type of water heating technology, heating and cooling system technologies and presence of renewables, primarily solar water heaters and photovoltaics) and modelled to establish the primary energy consumption of the building with that particular package. Also, for each package a corresponding global cost in €/m², which takes into consideration costs related to investment, maintenance, energy and emissions, discounted over a lifetime period of 30 years was calculated. The table below, Table 5, shows the cost-optimal level for each building typology. A negative primary energy value refers to the fact that the dwelling is considered a net exporter due to the presence of photovoltaics.

Building Type (Residential)	Area	Cost-Optimal Level
	m ²	Primary Energy (kWh/m ² yr)
Detached villa	176	10
Owner Developed Semi Detached Villa	235	8
Speculatively Developed Semi Detached Villa	235	10
Post war Terraced House	219	4
Pre-war Urban Terraced House	219	5
Pre-war Rural Terraced House	201	4
Post war top floor Maisonette	89	0
Post war ground floor Maisonette	89	5
Pre-war top floor Maisonette	129	0
Pre-war ground floor Maisonette	105	10
Post war top floor Flat	74	-50
Post war mid floor Flat	74	40
Pre-war top floor Flat	105	-32
Pre-war mid floor Flat	105	-38

Table 5: Cost-optimal levels of existing residential buildings

As can be seen by comparing Table 4 and Table 5, if cost-optimal levels are taken into consideration, existing residential buildings have the potential of becoming very energy

efficient buildings, possibly also energy-neutral buildings or even net energy exporters.

It is important to stress the fact that however such cost-optimal levels can only be reached if the right conditions exist. Specifically, such low cost-optimal values are tied with the possibility of buildings making use of renewable sources of energy (mainly solar water heaters and photovoltaics).

This as will be explained, may not always be the case given Malta's land limitations and specific context. Therefore other elemental solutions (*e.g.* improving the building envelope, energy efficient heating and cooling technologies would have to be deployed). This would of course alter the possible attainable primary energy target.

In accordance with the proposed plans for new nearly zero energy buildings, it is therefore being proposed that the 'Deep' renovation of an existing residential building should be aimed at achieving an average primary energy value of:

- **80kWh/m²yr** for buildings improving their energy performance without making use of renewable sources of energy (*i.e.* through improvements in the building envelope and buildings systems only); and
- **40kWh/m²yr** for buildings which in addition to improvements in the building envelope and buildings systems have the capability of making use of renewable sources of energy to further improve their energy performance.

Detailed Analysis of RES Potential in Buildings' Refurbishment

Currently the RES potential in the building sector, especially the residential one, is attributable to the fact that there has been a considerable amount of photovoltaic and solar water heater installations installed on the flat roof tops of buildings. For a number of reasons which are explained in detail below, such a potential is however finite and given the present/past generous grants and FITs, it is thought that a large number of those buildings which could afford to install such systems have already done so.

Limited land space and conflicting roof use

Malta is a country with very limited open spaces, and flat roofs apart from providing much needed outdoor spaces also have to accommodate services such as water tanks, telecommunication apparatus such as TV antennas and other building services such as air conditioners outdoor units. Historically roofs of residential buildings have also been used to dry clothes. This is in itself an energy-efficient practice, since it reduces the use of

energy intensive tumble dryers.

This trend in multi-family (storey) buildings is however changing since such new buildings either do not have access to the roof or no space is available for additional services. Before 2006, when building policies in Malta were changed to allow an additional livable space on top of existing buildings (penthouses), the roof space on top of a residential block of apartments was shared equally between the apartments' owners. When permits for penthouses started being granted, these were granted on condition that no washrooms would be permitted on the roof of the penthouse; and where permanent means of access (stairwell to the roof of the penthouse is provided), the highest part of the stairwell structure above the penthouse roof shall not exceed 1.5m from the finished roof level. Access to the roof was to be used for the purpose of maintenance only.

The addition of a penthouse on top of an existing building reduces the roof area available for services since regulations permit that penthouses can take a substantial part of the roof area. The airspace on top of the penthouse is either sold with the penthouse or retained by the original owner/developer for further development should permits for an additional floor become possible. The units in the block are granted permission to place a water tank and a shared/individual antennae/aerial and can access it only for maintenance. The installation of other services including systems making use of renewable energy sources may therefore not be allowed, even in the case when there is enough space.

Similar situation applies to maisonette developments, with a ground floor and a first floor maisonette. The ground floor unit is usually allocated the back yard while the first floor enjoys the full roof, meaning that the ground floor maisonette is only allowed to install a water tank and antennae/aerial on the roof. This means that half of the existing maisonettes, 18,115 units or 13.2% of all dwellings (14,305 post-war and 3,810 pre-war) do not have access or permission to install photovoltaic panels.

Other policy regulations on available roof space

The average area of new apartments is 74m². Recent residential blocks within development zones, where apartments are normally permitted, is made up of an average of 4 units (including penthouse) on top of each other. This means that in the case where each unit is granted permission to use the roof, each unit may have a maximum of 18.5m² (not taking into consideration the required setback of 2m from the front and back

edges²⁰), including space for water tanks, antennae/aerials and possible solar water heater. In certain areas, MEPA allows up to 9 floors, meaning that 9 units would have to share the roof, leaving only 8.2m² available for each unit. Therefore in multi-family building units which constitute a predominant percentage of the existing residential building stock, the space available for installation of RES is very limited.

Solar rights

Terraced houses constitute 34% of all existing residential buildings. They have their own private roof and an average area of over 200m². This leaves enough space to cater for the required setback, space for the standard services (water tanks and TV antennas), and a reasonable area where to dry clothes whilst still leaving space for the installation of photovoltaic panels. The hurdle faced in this instance is the lack of solar rights. Terraced houses are located within development zones, where semi-basement, 3 floors plus penthouse are permitted. Since terraced houses are normally two floors which abut each other, in a predominant side by side narrow rectangular plot matrix, the adjacent house may be demolished to make way for a residential block. This often creates a situation whereby a block of 4 units, 14m high (as allowed by MEPA) is constructed instead of a terraced house, touching another terraced house with a considerably lower elevation (6.4m high of liveable space spread on two floors, reaching with a washroom 3.4m on top). In the absence of any solar rights regulations (or regulated compensation), it is becoming more common for terraced houses owners (which although having the required space) to encounter problems when installing a photovoltaic installation, due to the limiting orientation of the terraced house and over shading due a adjacent buildings. Such problems may be so acute as to render the installation of such a system unfeasible.

Plot size, shape and orientation

It is a very rare occurrence that local architects are afforded the possibility of designing dwellings of different orientation than that dictated by the size and shape of the building plot. Plots in Malta are characteristically narrow and long, with a front and back façade of just 6m wide. This oblong configuration leaves little scope for manipulation in the orientation to promote certain passive technologies in building design or indeed to maximise RES output. The orientation is thus determined by the plot shape and is aligned with the road. Factoring in planning restrictions, it is sometimes very difficult to allocate

²⁰ All services are placed at least 2 metres from the front and back edge of the roof of the penthouse, stair-hood and washroom. All such services shall not exceed a height of 1.5m above roof of penthouse except for the solar water heater which should not exceed an overall height (including any storage tank) of 1.9m from the roof of the penthouse, stair-hood and washroom.

the right ‘sunny’ south-facing space for photovoltaic installations.

3.3 Building Stock Characterisation - Offices

A similar exercise conducted for the residential building sector was conducted, this time for the commercial (offices) building sector.

Section 2.2 of the ‘*Cost-optimal energy performance levels in new and existing office buildings in Malta*’ gives specific details as to the assumptions made in calculating the energy performance of existing office buildings. In the case of office buildings, 3 buildings typologies were chosen: Detached, Terraced and Mixed Use – the assumed floor configuration being open plan/cellular office layouts sized on the basis of 3 floor area sizes: less than 250m², larger than 250m² but smaller than 1,500m² and offices with a total floor area higher than 1,500 m². Using a similar methodology to the one used for residential buildings, **Table 4: Characterisation of existing residential buildings** was prepared showing the *reference primary energy for existing office buildings* and the *reference primary energy value for new office buildings* built according to *Technical Guidance Part F* which sets the minimum energy requirements on the energy of buildings performance.

Building Type (Offices)	No. of Floors	Total Area (m ²)	Primary Energy (kWh/m ² yr)	
			Reference Existing Building	Reference New Building
Detached – Open Plan/Cellular Offices	2	225	539	373
Detached – Cellular Offices	2	900	560	280
Detached – Cellular Offices	2	1,642	582	339
Terraced – Open Plan/Cellular Offices	2	235	557	420
Terraced – Cellular Offices	3	501	804	378
Terraced – Cellular Offices	4	1,972	589	352
Mixed Use – Open Plan/Cellular Offices	1	186	467	382
Mixed Use – Cellular Offices	1	836	1,287	367
Mixed Use – Cellular Offices	1	2,558	532	318

Table 6: Characterisation of existing office buildings

In the case of office buildings the difference between the reference new buildings and existing buildings lies not only in the type and quality of the building envelope but also in the different heating and cooling technologies. ‘On/Off Split Units ACs’, ‘Packaged Ducted’ and ‘Chiller Systems with Water Delivery Systems’ (fan coils) for existing

buildings having a seasonal coefficient of performance of 3 for both heating and cooling; ‘Energy Efficient Inverter Split Units ACs’ and ‘VRF’ technologies for new buildings having a seasonal coefficient of performance of 3.8 for cooling and 3.4 for heating.

Based on this data it can be seen that similarly to the residential sector the introduction of the *Technical Guidance Part F* was already a major improvement as regards to energy efficiency in buildings. In fact, whereas the average primary energy value of the existing building office stock built before 2006, that is, before the entry into force of the minimum energy efficiency building requirements set by the *Technical Guidance Part F*, is about 657kWh/m²yr, the value for new office buildings built according to *Technical Guidance Part F* is about 357kWh/m²yr.

3.4 Appraisal of Renovation Potential & Identification of Strengths, Weaknesses and Threats - Offices

Similarly to the residential case, the ‘*Cost-optimal energy performance levels in new and existing office buildings in Malta*’ sets a cost-optimal level of minimum energy performance for the different typologies of existing office buildings. The table below, Table 7, shows the cost-optimal level for each building typology.

Building Type (Offices)	Cost-Optimal Level	
	Area m ²	Primary Energy (kWh/m ² yr)
Detached – Open Plan/Cellular Offices	225	119
Detached – Cellular Offices	900	89
Detached – Cellular Offices	1,642	120
Terraced – Open Plan/Cellular Offices	235	131
Terraced – Cellular Offices	501	154
Terraced – Cellular Offices	1,972	170
Mixed Use – Open Plan/Cellular Offices	186	158
Mixed Use – Cellular Offices	836	189
Mixed Use – Cellular Offices	2,558	140

Table 7: Cost-optimal levels of existing office buildings

For each building typology a number of intervention measures were grouped together in different packages (each containing aspects relating to building envelope, type of water heating technology, heating and cooling system technologies and presence of renewables) and modelled to establish the primary energy consumption of the building with that particular package. Also, for each package a corresponding global cost in €/m², which

takes into consideration costs related to investment, maintenance, energy and emissions, discounted over a lifetime period of 30 years was calculated.

As can be seen by comparing Table 6 and Table 7, if cost-optimal levels are taken into consideration, existing office buildings have the potential of becoming energy efficient buildings. **However, similarly to the case of residential buildings, existing office buildings can reach such cost-optimal levels if the right conditions exist. Specifically, again such low cost-optimal values are tied with the possibility of buildings making use of renewables sources of energy although to a lesser degree than residential buildings, but also and especially to the fact that only appropriately sized offices can make use of large energy-efficient HVAC systems (e.g. heat recovery ventilation for office spaces above 250m²). In this regard it is important also to point out that the achievable cost-optimal level of each building typology is sensitive and highly susceptible to the type of building layout, orientation, extent of glazed façade, floor space, etc. as different buildings can make use of different cost-optimal solutions.**

For this purpose, and in consideration of the sensitivity analysis carried out in the aforementioned ‘*Cost-optimal energy performance levels in new and existing office buildings in Malta*’ study for the different existing office building typologies, it is being proposed that the ‘Deep’ renovation of an existing office building should be aimed at achieving an average primary energy value which fits the target range for that particular office building typology as shown in Table 8.

Building Type (Offices)	Area	‘Deep’ Retro-fit target range
	m ²	Primary Energy (kWh/m ² yr)
Detached – Open Plan/Cellular Offices	225	119 - 308
Detached – Cellular Offices	900	89 - 246
Detached – Cellular Offices	1,642	120 - 246
Terraced – Open Plan/Cellular Offices	235	131 - 291
Terraced – Cellular Offices	501	154 - 251
Terraced – Cellular Offices	1,972	170 - 253
Mixed Use – Open Plan/Cellular Offices	186	158 - 306
Mixed Use – Cellular Offices	836	189 - 263
Mixed Use – Cellular Offices	2,558	140 - 253

Table 8: Target for ‘Deep’ retro-fitting of existing office buildings based on sensitivity of cost-optimal solutions

4.0 POLICIES AND MEASURES TO STIMULATE COST-EFFECTIVE DEEP RENOVATIONS

4.1 Past and Present Policies and Measures

To promote energy efficiency in residential buildings, in 2007 the Maltese Government launched a once-only grant for the purchase of energy-efficient appliances. This was followed in 2009 by a scheme for the replacement of incandescent light bulbs with compact fluorescent lamps. These two schemes have proved to be successful in improving energy efficiency but also as a learning tool towards the public's appreciation of the benefits of energy efficiency in buildings.

Aimed directly at improving the building envelope, since 2006 a scheme has been in place to promote the purchase and laying of thermal roof insulation materials for roofs of residential buildings. Since 2012 this grant was also extended to double glazing. These two schemes have however been less effective and the general uptake was low.

Starting 2009, concurrently with its Renewable Energy targets, the Maltese Government also devised two schemes for the greater uptake of photovoltaic panels and solar water heaters in residential buildings. Similar schemes were re-launched in 2013 and extended into 2014. Based on the electrical throughput exported to the grid a guaranteed Feed-in Tariff per unit of electricity, is also in place.

In terms of commercial buildings, a number of grant schemes, administered by Malta Enterprise have been targeted specifically at improving the energy efficiency in industrial buildings. Such schemes have mainly included Energy Grant Schemes offered to be used either in *Energy Saving Measures* or *Renewable Energy Sources*. The energy saving measures grants investments in the implementation of energy saving solutions and lighting such as intelligent lighting systems, solar heating, thermal insulation, building management systems and energy-saving lighting. Renewable energy solutions targeted efforts towards the installation of energy generating solutions based on the use of solar and wind energy resources.

4.2 Proposed New or Extended Policies and Measures

4.2.1 List of proposed policies and measures for residential buildings

The Maltese government has been promoting energy efficiency and green energy for the last decade. With Malta's accession in the EU, a number of obligations have increased Malta's efforts to reduce energy consumption and to reduce pollution. Two of the most

successful campaigns in this regard where:

1. The energy rating of household appliances; and
2. The replacement of incandescent light bulbs with compact fluorescent lamps.

As discussed the impact of these two measures, was not only on the actual energy savings, but in the general culture change of the public's positive discrimination towards energy saving technologies.

Efforts to improve the building envelope have been to date less effective. To improve on this, the new proposed measures will be specifically targeted and set on measures highlighted by the cost-optimal studies. This shall be done primarily by implementing the following measures:

- Financial incentives and grants;
- Progressive electricity tariffs;
- Soft loans.

Financial Incentives & Grants

Policy measure	Brief Description
Thermal roof insulation materials for roofs and double glazing	Malta Resources Authority (MRA) offers a reimbursement of 15.25% of the purchase price capped at € 1,000. Similar schemes have been available since 2006 (more details in Section 5.3.1).
Photovoltaic panels scheme	50% of the cost of the panels up to € 2,500 per application plus feed-in tariff of 22c per unit for the first 6 years. MRA has offered similar schemes since 2008 (more details in Section 5.3.1).
Solar water heaters scheme	€400 rebate or 40% of the capital cost. MRA has offered similar schemes since 2008 (more details in Section 5.3.1).

Progressive Electricity Tariffs

Reduction in electricity tariffs to favour households who consume less	The electricity tariff imposed by Enemalta for the first 2,000 units will be reduced by 35%. The tariff on usage of between 2,000 and 6,000 units will be reduced by 25% and the tariff on consumption of between 6,000 and 10,000 units will be reduced by 15%. Such a measure should promote energy conservation.
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Soft Loans

Strengthen provision of interest rate subsidies on commercial loans that target investment in energy efficiency	Soft loans targeted specifically for green or energy efficiency investments are available from all leading local banks. These consist of unsecured loans with low interest rates. The aim is to mobilize as much capital into the sector as possible. Such a strategy ensures that appropriate financing is available at affordable rates (more details in Section 5.3.2).
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4.2.2 List of implemented and proposed policies and measures for commercial and public buildings

Schemes Administered by Malta Enterprise

As shown below in recent years, Malta Enterprise activated a number of schemes directly aimed at mobilising investment in existing commercial buildings including hotels, restaurants *etc.* Schemes have now been closed.

European Regional Development Funds (ERDF) Innovation Actions Grant Scheme	Competitive grant scheme supporting innovation in small and medium sized enterprises through investments in environmentally friendly technologies.
Energy Efficiency Measures for the Hospitality Sector	Specific grants schemes were established to promote renovation in buildings in the hospitality sector.
Refurbishment of Hotels, Accommodation facilities & Restaurants	Interest rate subsidy scheme to support upgrading operations and product offering so as to provide new and improved services.

Public Buildings - Schools

As part of a pilot project towards improving the energy efficiency in schools a pilot project will be undertaken at the Siggiewi Primary School.

Pilot project at Siggiewi Primary School	This initiative is a pilot project, proposed to take place at the Siggiewi Primary School where the current equipment will be replaced with a more modern, energy efficient one. This will include amongst others insulation, double glazing and smart lighting.
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Public Buildings - Central government buildings

In terms of public buildings, Malta has compiled an inventory of central government buildings as required by Article 5 of Directive 2012/27/EU of the European Parliament

and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

The data was collected through energy audit reports that were performed between 2010 and 2013 and through on-site visits specifically carried out to obtain useful floor areas and energy performance of the buildings occupied by central government buildings. The most energy consuming buildings were selected by identifying a threshold for energy consumption in offices. These offices will be retrofitted to achieve the best energy consumption. **This measure will be extended to other public buildings to include retrofitting aimed at obtaining energy efficient buildings.**

In 2013, the Buildings Regulations Office set up a meeting with the organisations occupying Public Buildings. During this meeting all occupants were informed that an Energy Performance Certificate (EPC) of the building they occupy is required to be displayed in each building. As a result the Buildings Regulations Office has been providing advice on a case by case basis as regards refurbishments and/or certification.

4.2.3 List of proposed policies and measures common for both residential and commercial buildings

A national educational campaign aimed at making the public aware of the benefits, both at individual and national level that can result from energy efficient buildings will boost investment in the renovation of both residential and commercial buildings.

The education campaign has to be coupled with intensive training to ensure correct installation of energy efficient measures. It is essential to deliver quality and the promised benefits that only a highly skilled labour force can provide.

Educational Campaign

Set up a Design Review Panel	On a voluntary basis, architects may submit their projects for review. The aspect of sustainability and energy efficiency would play an important role in the review comments. High quality projects can then be promoted and used as case studies to encourage the public to take up new measures in their own homes.
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Centre for the Built Environment	The creation of a Centre for the Built Environment acts as a platform to showcase successful projects. The creation of a Centre for the Built Environment can complement the prototype project or even be housed in one of the retrofitted dwellings open to the public. It can further promote sustainable and energy efficient retrofitted dwellings by displaying the innovative solutions and resulting benefits. Such solutions may also be applied in the prototype units along with other information on grants, regulations, insulation installation techniques and material data.
Advertisement campaign	An intensive campaign promoting the advantages of energy efficiency in buildings, with emphasis on the increase in property market price.
One stop shop for information, promotion and support schemes	Currently, there is no single agency responsible for administering support schemes pertaining to renewable energy and energy efficiency. Although the MRA is currently in the lead for consumer products, commercial support schemes are currently being administered by Malta Enterprise. Support schemes are also sporadic, limited in terms of time, and in some cases rapidly and heavily oversubscribed – due to the fact that these are primarily financed through various EU funds. This provides little comfort to investors whose decision-making cycle may be slightly longer due the high upfront investment and the relatively long payback period involved. Centralising and streamlining the application processes for support schemes, information resources and support, is likely to facilitate a higher take-up rate.
Creation of green building label (Building Classification)	In order to facilitate the recognisable impact of energy efficient buildings a Maltese residential and office buildings energy classification of buildings (A, B, C, D, etc.) will be created. This will facilitate public understanding of the performance of each building possibly creating additional competition in the building market. It is being proposed that such a rating is to be displayed in adverts for sale and rent of properties in line with what required already by the Recast EPBD.
Public sector to take leading role in the renovation revolution	In fulfillment of Article 5 of Directive 2012/27/EU Malta will be retrofitting existing central government buildings to achieve better energy efficiency. Similar refurbishment will be encouraged in other public buildings.
Training of skills in the construction industry	i. The BICC and Malta's main educational centre for vocational courses MCAST (Malta College of Art, Science & Technology) are participating in Build-Up Skills. The aim is to create a National Education Platform that will develop a detailed National Qualifications Roadmap for the local construction industry. A national system of certification of both suppliers and installers pledges good quality thermal retrofits.

	<p>ii. A number of entities offer training and exams for Energy Performance Assessors who in turn draw up Energy Performance Certificates. After following a common syllabus prospective assessors are examined by the Building Regulations Office through a common exam.</p> <p>iii. The Faculty for the Built Environment at the University of Malta formerly the Faculty for Architecture and Civil Engineering has over the recent years seen a transition aimed at holistically addressing all those features related with the built environment. These include not only areas which strictly are pertinent with environmental aspects but also other areas of interest towards a sustainable building industry.</p>
Get Qualified	Programme covers course of studies leading to a certification, degree or post-graduate degree course. Supports the personal development of individuals for the achievement of qualifications and certifications required by energy efficiency measures industry. Subjects related with sustainable development in the built environment are included as part of the eligible subjects.
Certification of Photovoltaic systems and Solar Thermal systems Installers	In line with the requirements stated in Directive 2009/28/EC, as from 31 st December 2012 installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems <i>etc.</i> are being certified. Approved courses are being organised by the University of Malta and MCAST in specific technologies as required under the Directive. The Certification of Installers will have an expiry date of 5 years. Continuous training is envisaged.

Technical Measures

Revise National Building Regulations	Revision of <i>Technical Guide Part F</i> to reflect findings of the cost-optimal report of residential and office buildings.
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Other Measures

Revise MEPA's Policy and Design Guidelines	Revision and provision of good practice guidelines that permits and takes into consideration the installation of energy efficient technologies in the new and existing residential buildings that will enable improvement of energy performance in residential/commercial building sector.
Setting up of national scheme to give access to solar potential where it is not physically possible	The cost-optimal studies indicate that the most significant factor in increasing energy efficiency in buildings is the use of renewables. Due to the very high level of building density in Malta and issues with 3 rd party access to roofs, good solar potential cannot always be available or guaranteed. The case of a contractually linked off-site investment in photovoltaics is being investigated.

5.0 FORWARD-LOOKING PERSPECTIVE TO GUIDE INVESTMENT DECISIONS

5.1 Guide to Investment in the Residential Sector

As described in the ‘*Cost-optimal energy performance levels in new and existing residential buildings in Malta*’ the existing residential building stock has great potential savings which could be attained, both with respect to existing energy performance building standards, but also, and especially considering potential cost-optimal levels. The report however also emphasises the fact that for such savings to be realistic and achievable the right conditions for exploitation of renewable energy have to exist, particularly in relation to the use of photovoltaic installations on roof space, *etc.*

Apart from the use of renewables the cost-optimal study for residential buildings also highlights two other aspects which require specific attention:

- a) The refurbishment of the building envelope whenever possible to include high efficiency building elements (walls, windows, and ground) having lower U-values; and
- b) The promotion of alternatives to electric storage water heating (*e.g.* gas water heating or instantaneous electrical heaters) where solar water heating is not possible.

In this context, apart from renewable sources of energy the predominant cost-optimal solutions for refurbishing existing residential buildings include:

- A general improvement to the building envelope, particularly in terms of glazing U-values; and
- Providing efficient air-to-air inverter heat pumps for heating and cooling, which given Malta’s commitment to improve the conversion efficiency at national grid level will result in a lower primary energy consumption compared towards other types of heating and cooling.

It is important to highlight that during the last few years, the Government has been already actively pursuing these measures as will be discussed in Section 5.3.1. It is therefore of paramount importance that measures aimed particularly at the cost-optimal solutions listed above are continued to be addressed, whilst still considering the

limitations addressed previously.

5.2 Guide to Investment in the Commercial (Office) Sector

For the commercial sector the principal areas recommended for specific attention are the following:

- a) The refurbishment of the building envelope whenever possible to include high efficiency building elements (walls, windows, and ground) having lower U-values;
- b) The solar heat transmission of glazed areas (g-value of windows is to be low as to protect from incoming solar heat gains);
- c) High efficiency air conditioning systems;
- d) Use of efficient lighting fixtures;
- e) Integration of renewable energy sources; and
- f) Solar water heating.

5.3 Financing of energy efficiency measures in buildings

Throughout the past years a series of financial support actions were already taken by Government and local private banks to support residential buildings and small and medium enterprises.

5.3.1 Government support schemes

Government has these past years made use of national funds and European Regional Development Funds (ERDF) to promote a wider use of renewable technologies, most notably photovoltaic panels and solar thermal units, and energy efficient technologies, such as double glazing apertures and roof insulation. Several were the households who made use of these schemes.

For the schemes promoting photovoltaic panels in residences, ERDF funds were allocated. The first call was carried out in 2010 and 2011 and by the end of 2011, MRA has reimbursed 4,680 households for photovoltaic installations and 569 households for solar water heating installations. The second scheme run by the MRA commenced in 2013. To date, 3,900 households have been reimbursed for their photovoltaic

installations. However, a total of 8,837 households have been awarded a grant and therefore this leads to the national Managing Authority, the Planning and Priorities Co-ordination Division at the Ministry for European Affairs and the Implementation of the Electoral Manifesto, expecting another 4,937 households to claim the reimbursement after installation of photovoltaic system takes place.

Energy efficiency support schemes *e.g.* the introduction of double glazing and roof insulation were supported by national funds. The schemes have been running since 2009, and 433 households have been made use of such fund

5.3.2 Selected domestic bank products on the market

A number of local banking operators in Malta offer loan facilities and banking products to facilitate the purchase and installation of energy efficiency products. These include:

- *ECO Personal Loan* a product of Bank of Valletta finances the purchase of environmentally-friendly equipment such as solar water heaters, solar lamps, solar collectors, photovoltaic systems and products/systems/services which save on electricity consumption including Class 'A' white goods, double glazing, energy audits, residential energy management systems and thermal insulation products.
- *APlus* is a product of APS Bank that combines home loan with current, overdraft, deposit accounts and debit cards - all in one single account. These features effectively lower the amount of borrowing on which you are charged daily debit interest, enabling you to maximise your savings.
- *Green Loans* a product of APS Bank supports domestic home owners and businesses in financing their investment in solar water heaters, PV panels.
- *The Banif Green Energy Loan* of Banif Bank is a fast and simple financial solution aimed at clients who wish to buy environment friendly products such as solar water heaters, roof thermal insulation, double or triple glazing, external shading, photovoltaic systems, and energy efficient appliances.
- *Green loan* of HSBC Bank used to finance a range of environmentally friendly initiatives and energy saving products: solar water heaters, photovoltaic installations, double glazing, solar film/room darkening, PIR (Passive Infra Red) sensors, solar lights – photo sensors, thermal insulation, external shading, and energy efficient

appliances with a minimum rating of A++.

5.3.3 Other measures

Plans are also being established to set up various financing schemes (which will include financing from EU Structural and Cohesion Funds and schemes from domestic banks leveraging market finance through public funds) for energy efficiency developments in buildings which could include:

- Schemes for photovoltaic installations (Domestic and Industrial). This project will help supporting the shift of the Maltese economy towards a low-carbon economy supported RES production.
- Design and introduce a scheme that will incentivise the use of passive cooling and heating in buildings as an alternative to energy based space conditioning.
- Introduce an interest-free loan for low income households and a low interest loan for higher income households and businesses to invest in RES and/or carrying out energy saving measures in their property.
- To implement recommendations of energy audits in the residential sector carried out with the help of the Government

Other measures that will be analysed are the financial instruments mentioned in the document Energy Efficiency – the first fuel for the EU Economy²¹ published by the Energy Efficiency Financial Institutions Group established by Directorate General for Energy and United Nations Environment Programme Finance Initiative..

²¹ ec.europa.eu/energy/.../2014_fig_how_drive_finance_for_economy.pdf

6.0 EXPECTED BENEFITS FROM RENOVATION OF BUILDINGS

Proper government incentives may not only induce environmental benefits by reducing CO₂ emissions, but can also create new jobs in the construction industry. Retrofitting also has the potential of creating healthier indoor living conditions for Maltese families with a subsequent reduction of public health spending. Encouraging people to invest in the thermal upgrading of their homes also helps reducing the burden of high energy bills and thus help vulnerable section of society such as low income households.

6.1 Energy Savings

The National Energy Efficiency Action Plan (NEEAP) estimates that the average annual energy consumption of Malta is 4,195 GWh. Malta's residential buildings are exclusively dependent on electricity and bottled LPG. The latter is used primarily for cooking and space heating. In 2010 the residential sector consumed 571,246MWh of electricity and 186,080MWh (equivalent to 16,000 toe) LPG. The overall energy consumption in the household sector is less than half the EU 28 average because Maltese households heat/cool their dwellings only sparingly. Thus energy savings from local residential buildings cannot be compared to what is normally achieved by Northern European countries. An over-riding benefit, which can be experienced immediately after the renovation process, is thermal comfort. Instead of having just one or two rooms, which are kept at comfortable temperature, the whole dwelling will be more pleasant to live in.

Energy savings from renovation of offices and other buildings may result in more substantial energy saving. However at this stage of the strategy and being a first strategy, more information regarding this sector needs to be gathered so as to fully quantify the potential savings on national scale.

6.2 Reduction in CO₂ Emissions & Pollution

Electricity generation accounts for about 64% of all of Malta's greenhouse gas emissions in terms of CO₂ equivalent. The current Enemalta's Delimara and Marsa power stations result in a factor of 0.89 kgCO₂ emitted for every kWh generated. This will be slashed once gas-fuelled electricity generation will commence at Delimara, and the remaining parts of the Marsa power plant retire. An emissions factor of 0.34kg CO₂/kWh may be assumed for the modern ElectroGas plant as well as the gas-converted Delimara extension.

This has to be taken into account when quantifying and revising future strategies for the ‘Deep’ renovation of buildings.

6.3 Energy System Benefits

Renovating buildings also contributes towards achieving a number of goals, mainly:

Lower cost of energy by:

- Reducing the total capital expenditure required for new electrical generating capacity;
- Reduce capital expenditure on new supply infrastructure; and
- Reduce traditional peaks in energy use which are the most expensive to supply.

Further benefits derived from Energy Efficiency are:

- Higher Property Value;
- Increased Employment;
 - In the manufacturing, installation and throughout the extensive supply chain of products and services
 - Increase State tax receipts
 - Stimulate local economic growth through increased disposable income
- Reduce energy poverty; and
- Health and Thermal Comfort Improvement, which in turn reduce:
 - Lost working days due to ill health
 - Burden on State’s health services

7.0 CONCLUSIONS

This first version of Malta's long-term strategy for mobilising investment in the renovation of buildings gives a clear picture of the particular attributes of the Maltese buildings. It describes the method of construction, energy consumption patterns and limitations of the local building sector.

The development of the strategy has identified several issues that need to be assessed and their impact statistically evaluated. These issues include:-

- The effect of changes in electricity consumption behaviour due to the reduced tariffs (effective from the end March 2014);
- Impact of more efficient electricity generation;
- Rate of 'Deep' renovations vs. rate of re-development of different type of dwellings and buildings;
- Detailed analysis of RES potential in buildings considering:
 - The limited land space and conflicting roof use;
 - Other policy regulations on the available roof space;
 - Solar rights; and
 - Plot size, shape and orientation.

The estimate of the potential improvement is based on the findings of cost-optimal studies in residential and office buildings. It has to be pointed out that the cost-optimal studies include certain assumptions that could change from time to time (*e.g.* energy prices and primary energy conversion factors, *etc.*). Cost-optimal studies are based on a factor of 3.45 to translate final electricity savings into primary energy. These need to be revised to take into account the new investments in generation of electricity, which substantially changed the cost base for electricity. Factor will be close to 2.0 by 2016.

Given that electricity generation in Malta is undergoing large investment, a revision of the cost-optimal studies, and subsequently of the long-term strategy for buildings renovation may be required. This strategy shall be updated every three years and submitted to the Commission as part of the National Energy Efficiency Action Plans.