

**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**

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EXECUTIVE SUMMARY

In line with the requirements of Article 4 of Directive 2012/27/EU of the Council of 25 October 2012 on Energy Efficiency, Malta has prepared a report presenting a strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private. This is the second report of its kind, the first one having being prepared in 2014.

The report hereby being presented, builds on the previous strategy and provides an update to the work carried out in the previous report. In this context, this updated report first builds on the previous work which was carried out on three specific building categories:

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

In addition, this report also presents the initial results of the data obtained for a number of building categories other than the three mentioned above, that is:

- Educational buildings;
- Hotels;
- Hospitals (*incl.* retirement homes); and
- Sports facilities.

The report first gives an overview of the existing build stock of the above mentioned building categories, listing number of existing units, age and typology, detailed estimated energy consumption by type of use, construction and refurbishment trends.

For dwellings the average electrical energy consumption per dwelling was calculated at around 3,890 kWh/annum with an average total final energy consumption of 0.45 toe/dwelling per annum, considerably lower than the equivalent average total final energy consumption of dwellings in other European countries. The main energy consumer for dwellings is domestic hot water. In the non-residential sector the primary energy is space cooling in the case of offices, and domestic hot water for all the other building categories investigated.

The report also addresses current residential construction and refurbishment trends, currently estimated at 0.3%, increasing to 0.5% in 2020 and then to 0.7% in 2025, and lists down major non-residential building projects, such as the building of new schools,

construction and planning of new mixed-use office buildings, hotel refurbishments, *etc.* which have been carried out over the last 3 years.

A detailed analysis of energy performance of buildings related legislation is also provided, highlighting the 2015 updating of the minimum energy performance requirements of buildings regulations, and a newly published plan for nearly zero energy buildings.

A cost-effective approach to renovation for both the residential and the non-residential building sector highlighting, renovation potential, new energy targets for renovated buildings (reflecting the recent changes in the minimum energy performance requirements of buildings regulations), and an analysis of the strengths, weaknesses, opportunities and threats to renovation, is also discussed. Access to the use of renewable sources of energy due to limited land space and conflicting roof use, the lack of solar rights and other policy regulations on available roof space, is being seen as a major threat.

In terms of renovation potential it is estimated, assuming the current renovation trend, that around 11,600 dwellings will be refurbished by 2030, resulting in an overall energy saving of 4,591 toe (53.4 GWh) over the 2017-2030 period. For the non-residential sector, the report highlights the potential savings attainable in a number of public buildings (based on a number of Energy Audits which have been carried out in 2016), the results of a deep renovation study carried out on the St. Vincent de Paul Residence, a hybrid between a nursing home and a hospital with a total population of over 1,100 residents, the preliminary results from the initial work carried out on the cost-optimal studies for other building categories, and an overview of the potential use of CHP and district heating for certain building categories.

Section 4 of the report highlights policies and measures aimed at stimulating cost-effective renovations, both existing and planned. Existing policies and measures specifically targeting the residential building sector category include financial incentives and grants aimed at improving the building fabric of dwellings, financial incentives and grants designed to facilitate the purchase of technologies and systems making use of renewable sources of energy, financial incentives and grants aimed at the restoration of cisterns for rainwater collection, and specially dedicated energy incentives to assist vulnerable households. Existing policies and measures specifically targeting the non-residential sector include, financial incentives and grants administered by Malta Enterprise for the carrying out of an Energy Audit, and the purchase of co-generation

equipment, ERDF grants and educational campaigns on energy efficiency. Existing policies and measures targeting the quality of the building industry are also addressed.

Finally, the report gives a forward looking perspective to guide investment decisions, both in the residential and non-residential building categories, listing existing and planned financing mechanisms, both government and privately driven, and the expected benefits from the renovation of buildings, both in terms of primary energy savings, reduction in CO₂ emissions, and additional benefits resulting from building renovation.

To conclude, it should be pointed out that this report is being considered as an interim report which will form the basis for a complete report due 2020, which should include most if not all building categories and a full holistic strategy for the long-term mobilisation of investment in the renovation of the national stock of residential and commercial buildings, both public and private.

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1 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 report presenting a strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private.

This report follows on the 1st version of the strategy presented in April 2014.

1.1 Directive Wording

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 strategy towards long-term building renovation of the existing building stock reviewed every three years and submitted to the Commission as part of the National Energy Efficiency Action Plan (NEEAP).

This strategy encompasses an overview of the national building stock, it identifies cost-effective approaches to renovation, policies and measures to stimulate such renovation and provides a forward-looking perspective to guide investment decisions in the sector.

Furthermore, the report provides preliminary evidence-based estimates of expected energy savings and wider benefits, driven by such renovation.

As will be discussed in the next section, the level of progress being reported for the different building categories and hence the creation of a long term strategy is varied for the different building categories. Such a premise is based not only on the limited information available for some sectors but also on the fact, that certain building categories have been more responsive than others with respect to the different initiatives being deployed to improve their energy efficiency.

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.

In the first report, two main types of building categories were covered, namely dwellings, comprising single-family houses and apartment blocks, and offices. Given the number and wide extent of all the building categories requested, only these two categories could be covered in detail mostly because of a tangible lack of information on what was the current state of affairs in the remaining sectors, and the fact that the aggregated energy consumption of these two building categories forms a significant chunk of the total energy consumption attributable to buildings.

As had been discussed in the first report, this is not to say that there was no work going on, or being planned in the other building categories, but rather that the initiatives being deployed to improve the energy efficiency in certain building categories were not of a holistic nature, but rather were individual projects and initiatives aimed at improving the energy efficiency of individual building projects.

Within the 3-year period time period since the 1st strategy, however, work on cost-optimal studies for categories other than dwellings and offices has begun, a number of studies on the energy consumption of specific building categories have been carried out, including a number of full scale energy audits, a study on heating and cooling demand in selected building categories has been carried out, and certain building categories have had individual show case energy efficiency improvements extended to other buildings in the same category, for example, hotels, sports facilities and educational buildings.

Furthermore, specific work aimed at addressing information gaps in certain sectors is still ongoing. This includes the continuous updating of the information on the existing building stock, improving the methodology used to quantify the energy savings obtained by specific energy efficiency measures (taking in consideration Malta's climate), and the testing out of new cross-themed policies such as the renovation of residential water cisterns for the storage of rain water, to combat water scarcity and reduce the pressure from the energy-intensive reverse osmosis plants.

In this context, and as had been done in the previous report, given 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, this report will mainly focus on providing an update of the strategy for the following three building categories, that is:

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

In addition, however this report will also present the initial results of the data obtained for a number of building categories other than the three mentioned above, together with an account of policy measures and specific projects which have been carried out. The additional building categories being addressed in this report are the following:

- Educational buildings;
- Hotels;
- Hospitals (*incl.* Retirement Homes); and
- Sports facilities.

As such this report is still being considered as an interim report which will form the basis for a complete report due 2020, which should include most if not all building categories and a full holistic strategy for the long-term mobilisation of investment in the renovation of the national stock of residential and commercial buildings, both public and private.

2 OVERVIEW OF NATIONAL BUILDING STOCK

2.1 Analysis by Building Category – Residential Sector

Based on the National Statistics Office Census carried out on population and housing in 2011¹, the dwelling stock in Malta totals 223,850 units, ranging from single-family houses such as terraced houses/townhouses, to apartment blocks comprising units such as flats, maisonettes and penthouses.

The total number of occupied dwellings totals 152,770 units, equivalent to 68.2% of the total dwelling units. A substantial portion (31.8%) of dwelling units is unoccupied property, that is either used as seasonal or secondary use, or else completely vacant. Whereas great potential (in terms of number of units) exists in terms of renovating such buildings, especially those which are completely vacant, the reasons why these are vacant are multiple, and most of the time due to motives other than just of a financial nature. Notwithstanding recent interest in renovating a number of these buildings (mostly in a historic areas) and a number of government schemes purposely created to incentivise their use, no comprehensive information that takes stock of the quality of these vacant dwellings and quantifiably describes the issues that prohibit them from being readily available on the market is available. For this reason, in this report only the portion of dwellings which is continuously occupied is being considered.

Considering only the continuously occupied dwellings, single-family buildings, comprising terraced houses, townhouses, semi and fully detached houses, farmhouses and other typologies correspond to 41.7% of the total number of occupied dwellings. The balance, 58.3%, makes up the share of dwellings being multi-family buildings, comprising flats, maisonettes and penthouses. Table 1 shows the distribution of residential buildings by building type.

<i>Type of Dwelling</i>	<i>Units</i>	<i>Percentage of Total (%)</i>
Terraced House/Townhouse	52,519	34.4
Semi-Detached House	5,812	3.8
Fully Detached House	3,383	2.2
Semi/Fully Detached Farmhouse	1,306	0.9
Other	686	0.4
<i>Single-Family Houses</i>	<i>63,706</i>	<i>41.7</i>
Maisonette Ground Floor Tenement	44,145	28.9
Flat/Apartment/Penthouse	44,919	29.4
<i>Multi-Family Houses</i>	<i>89,064</i>	<i>58.3</i>

Table 1: Distribution by type of residential building

¹Census of Population and Housing 2011: Final Report. - Valletta: National Statistics Office, 2014

In terms of age distribution, notwithstanding the recent increase in number of new multi-family houses, replacing single-family houses, the bulk of the national Maltese residential stock is generally quite old. This is especially true for buildings of the single-family typology, given that current industry trends show that new buildings are predominantly of the multi-family building type, whereas given cost implications and the limited space available the number of new single family houses is comparatively very small. Table 2 and Table 3 show the distribution of buildings by age band for single-family houses and multi-family buildings.

	<i>Terraced House Townhouse</i>	<i>Semi-Detached House</i>	<i>Fully Detached House</i>	<i>Semi/Fully Detached Farmhouse</i>	<i>Other</i>	<i>Total Single Family Houses</i>
<i>1918 or earlier</i>	9,142	615	376	520	219	10,872
<i>1919-1945</i>	6,503	131	114	179	74	7,001
<i>1946-1970</i>	8,978	888	835	240	111	11,052
<i>1971-1990</i>	20,736	2,682	1,387	286	158	25,249
<i>1991-2000</i>	5,618	1,015	463	75	92	7,263
<i>2001-2011</i>	1,542	481	208	6	32	2,269
Total	52,519	5,812	3,383	1,306	686	63,706

Table 2: Distribution of residential buildings by age band – Single-Family Buildings

	<i>Semi/Fully Detached Farmhouse</i>	<i>Other</i>	<i>Total Multi Family Houses</i>
<i>1918 or earlier</i>	3,912	971	4,883
<i>1919-1945</i>	4,928	1,401	6,329
<i>1946-1970</i>	9,879	8,574	18,453
<i>1971-1990</i>	12,659	13,463	26,122
<i>1991-2000</i>	7,680	8,443	16,123
<i>2001-2011</i>	5,087	12,067	17,154
Total	44,145	44,919	89,064

Table 3: Distribution of residential buildings by age band – Multi-Family Buildings

Full ownership of one's dwelling is quite high amongst Maltese residents. In fact, about 76% of the occupied residential dwellings are owned (with or without ground rent). Such a high percentage is primarily motivated by the fact that owning property is seen as a good investment given the limited land available, and secondly the short commuting distance across the territory, which enables the purchasing and owning of one's own dwelling to be considered as a once in a lifetime investment, with people seldomly requiring to move house more than a few number of times during their lifetime.

Renting, on the other hand, has seen a substantial increase only in recent years. In 2011, almost 20% of the occupied dwelling were being rented out. Though no official statistics exist it is believed that this number has over the recent years grown to a higher

percentage. Such an increase in renting residential property has mostly been driven by the increasing number of foreigners coming to work in Malta, which has created quite a lucrative residential renting market. Table 4 shows the total distribution of buildings owned and rented out.

<i>Tenure Status</i>	<i>Units</i>	<i>Percentage of Total (%)</i>
<i>Owned Freehold</i>	92,281	60.4
<i>Owned with ground rent</i>	24,513	16.0
<i>Rented unfurnished</i>	22,351	14.6
<i>Rented furnished</i>	7,994	5.2
<i>Held by emphyteusis</i>	1,438	0.9
<i>Used free-of charge</i>	4,193	2.7
<i>Total</i>	152,770	

Table 4: Distribution of residential buildings by type of ownership

As a final note in relation to the residential units' statistics presented, it has to be pointed out that 2017 falls just in the middle between two consecutive national censuses. As such, currently the National Census carried out in 2011 is the most definitive detailed data available. In terms of overall construction trends more data will be given in Section 2.7.2.

2.2 Analysis by Building Category – Offices

Specific data on this sector, in terms of number of units and available space is very limited.

Traditionally office space in Malta used to be catered for by converting and refurbishing former large residential units, such as an entire apartment block or a large house into working offices, possibly housing multiple entities. Only a limited number of buildings were specifically designed as offices. The advent of a number of international companies, and the increase in the services sector over the last 10-20 years, has however brought about a sharp increase in the demand for high quality dedicated office space. In order to attract foreign investment and possible tenants, some dedicated office projects such as Smart City Malta and Sky Parks Office Park have also sought to achieve voluntary energy performance certification in the form of LEED and BREEAM respectively.

Government buildings on the other hand, have other than some individual cases always relied on the use of government owned (mostly scheduled) buildings. In the public sector a considerable amount of central government bodies are housed in such buildings. In most instances some form of renovation is carried out, though admittedly more for the purpose of satisfying their change of use rather than to improve their energy efficiency. In

some cases, however a number of such buildings have been refurbished extensively and relatively speaking innovatively, particularly when EU funds were made available.

2.3 Analysis by Building Category – Educational Buildings

Malta’s educational system is primarily divided into two parts, compulsory schooling, where children are obliged to attend up till the age of 16 years, and higher education.

Compulsory Schooling Sector

The compulsory educational system is structured in three stages: *pre-primary* (ages 3-5), *primary* (ages 5-11) and *secondary* (ages 11-16). Buildings serving this part of the compulsory side of the education system are very diverse though typically follow the traditional layout, that is, a dedicated building having a number of classrooms, with an annexed outdoor yard or playing ground (depending on the school footprint), and possibly a number of dedicated rooms for non-academic activities such as arts, crafts, music, *etc.* Building footprint varies depending on the school’s location and number of floors, however typically average size varies between few 100m² to few 1,000m².

Education at this level has been traditionally provided by the State or the Church, with independent privately run schools becoming a viable alternative only recently (last 20 years). Table 5 shows the total number of schools sub-divided by level (pre-primary, primary or secondary), type² (State, Church or Independent school).

	<i>State</i>	<i>Church</i>	<i>Independent</i>	<i>Total</i>
<i>Pre-Primary</i>	61	32	24	117
<i>Primary</i>	72	25	16	113
<i>Secondary</i>	33	23	8	64
Total	166	80	48	

Table 5: Distribution of educational buildings by level and type

Educational buildings in this category are very diverse in terms of their age band. Some are very old, dating to around the second world war period or even in some cases scheduled historical buildings. Other are relatively new, having been built and inaugurated fairly recently.

Higher Education Sector

Higher Education (voluntary schooling) mainly comprises Post-Secondary and Tertiary Education and is offered by three main sectors as follows:

² Education Statistics: 2006/2007; 2007/2008. – Valletta: National Statistics Office, 2011

State Education

- Giovanni Curmi Higher Secondary School (Post-Secondary)
- Sir Michelangelo Refalo Sixth Form (Post-Secondary)
- Junior College (Post-Secondary)
- Malta College for Arts, Science and Technology (Post-Secondary & Tertiary)
- University of Malta (Tertiary)

Non-State Education

The Non-State Sector divides itself into two categories, those educational services offered by Church educational institutions and Independent institutions. Church institutions mainly offer Sixth Form (post-secondary) education through a number of Colleges manned by the Roman Catholic Congregations/Orders.

Independent/Private Institutions

This sector has developed widely these last years and ranges from post-secondary, tertiary education and vocational qualifications and include:

- Institutions offering Post-Secondary Education
- Institutions offering Tertiary Education through Foreign Qualifications
- Institutions offering Vocational Qualifications
- Institutions offering English as a Foreign Language

The total number of licensed institutions is 138³. The number and size of buildings utilised however does not reflect the number of licences. Buildings utilised for this sub-sector of the educational buildings category are very diverse. The vast majority are very small entities offering tuition in privately owned small buildings catering for not more than 1 or 2 classrooms. Some even don't have their own building and rent out space based on their tuition needs. Other like the University of Malta or the Malta College for Arts, Science and Technology are proper campuses in their own right, and include a number of faculty buildings, lecture theatres, auditoriums, sports facilities, administration buildings, cafeterias, libraries, laboratories, student's buildings and even accommodation.

This latter category is however very low in number, practically unique cases.

³ List of Licensed Institutions (updated 17.02.2017) (National Council for Higher Education)
[http://ncfhe.gov.mt/en/register/Documents/Register%20\(Licensed%20Institutions\)%2017.02.2017.xlsx](http://ncfhe.gov.mt/en/register/Documents/Register%20(Licensed%20Institutions)%2017.02.2017.xlsx)

In this context and for this purpose, this report will mainly focus on examples taken for the compulsory schooling category.

2.4 Analysis by Building Category – Hotels

Hotel buildings in Malta started purposely being built just after Malta’s Independence in 1964. Since then the sector has developed into a thriving sector, a pillar of the Maltese economy. As per international practice, hotel buildings vary depending on the quality and facilities offered, resulting in the Star rating system, that is, 5 Star, 4 Star, *etc.* Apart from hotels a number of guest houses and hostels also exist together with one dedicated tourist village. Table 6 shows the total number of units and beds, by hotel typology⁴. Data shown includes only serviced accommodation. Self-catering units are excluded from the analysis.

	<i>Units</i>	<i>Beds</i>
Hotels 5 Star	15	7,210
4 Star	44	16,253
3 Star	52	10,433
2 Star	21	1,460
<i>Total Hotels</i>	132	35,356
<i>Tourist Village</i>	1	612
<i>Guest Houses/Hostels</i>	70	3,236
<i>Total Serviced Accommodation</i>	203	39,204

Table 6: Distribution of total number of accommodation units by typology

It has to be pointed out that a recent trend in new licensed hotels is for old buildings in urban conservation areas or historical areas to be refurbished and renovated to enable their use as boutique hotels.

2.5 Analysis by Building Category – Hospitals (incl. Homes for the Elderly)

This category covers healthcare, specifically hospitals and homes for the elderly (retirement homes).

Hospitals

Hospital healthcare in Malta is dominated by the public sector with 95.5% (1,820 beds) of the beds being publicly owned and managed, whilst the remaining 85 beds are privately owned. Table 7 below shows the main hospitals⁵ in Malta divided by ownership, date opened and type of hospital.

⁴ MTA Licensing Administration Office (as at 31 December 2015)

⁵ Healthcare Delivery in Malta – PWC August 2012

<i>Ownership</i>	<i>Name</i>	<i>Number of Beds</i>	<i>% of Total</i>	<i>Type of Hospital</i>	<i>Year Opened</i>
	Mater Dei Hospital	825	43.3	Acute General Hospital	2007
	Gozo General Hospital	158	8.3	Acute General Hospital	-
Public Sector	Mount Carmel Hospital	512	26.9	Mental Health and Substance Abuse Hospital	-
	Sir Anthony Mamo Oncology Centre Rehabilitation Hospital/Karen Grech Hospital	113	5.9	Other Specialty Hospitals	2015
		212	11.1	Other Specialty Hospitals	1979
Public Sector Sub-Total		1,820	95.5		
Private Sector	St. James Capua Hospital, Sliema	79	4.1	Acute General Hospital	1996 ⁶
	St. James Hospital, Zabbar	6	0.3	Acute General Hospital	1984
Private Sector Sub-Total		85	4.5		
Total		1,905			

Table 7: Distribution of hospital beds by ownership, year opened and typology

Retirement Homes

Malta is like most countries experiencing a trend where the number of elderly people is on the increase, and as such retirement homes are on huge demand.

Government presence in this sector is mainly through the St Vincent De Paul Residence, a hybrid between a nursing home and a hospital with a total population of over 1,100 residents. St. Vincent de Paul hospital residence constitutes one of the largest complex of government buildings in Malta. It is sited over a 1 km² campus footprint and apart from the elderly patients or residents it provides work for 2,500 employees operating on a continuous basis. The whole complex consists of twelve blocks in two main buildings, namely, the St. Vincent complex and the Rużar Briffa hospital building. A special mention in regards to this residence is the fact that recently a study for ‘Deep’ Energy and Resource retro-fitting was conducted with the aim of assessing not only the energy efficiency potential but also the cost benefit analysis of these retrofits.

⁶ Hospital occupies part of the former ‘Capua Palace’ building (Palazzo Capua), built over 200 years ago.

The private sector and the Church run 28 of these homes between Malta and Gozo⁷.

In terms of this report the analysis is mainly concerned with characterising the energy consumption of two of these retirement homes.

2.6 Analysis by Building Category – Sports Facilities

Malta has quite a number of sports facilities, ranging from small open plan buildings (halls) housing only the training of individual sport activities to fully fledged national sports complexes with terraces, which would include one or more of the following facilities: multi-purpose hall, a full size football pitch or a swimming pool. Given the high premium associated with land purchase, most of these facilities are government owned, but rented out on a short or long term basis including on emphyteusis to national associations and, or private sports clubs. For the purpose of this report, only the 2 main ‘national/regional’ (indoor) sport complexes will be considered. Football stadia are being excluded, as these are outdoor facilities, with practically all, apart from the National Stadium in Ta’Qali providing only the basic showering and changing facilities in small annexed buildings.

The facilities being reviewed in detail are the:

- Cottonera Sports Complex; and
- Gozo Regional Sports Complex.

A short description of each sports complex follows:

Cottonera Sports Complex⁸

Situated in Cospicua, the Cottonera Sports Complex is the main sports complex in the south of Malta and the largest indoor sports facility in Malta. Built in 2003, the complex building is innovative and unique to Malta and its space frame roof covers one of the largest spans. The total footprint of the complex is *circa* 5,250m². This facility has two multi-purpose halls with 3 satellite areas. The main hall has a capacity of 1,200 spectators and a separate press area. The secondary multipurpose hall can accommodate over 300 spectators. The complex also has a number of meeting areas which are regularly utilised by sports organisations for committee meetings, annual general meetings, *etc.*

⁷ Annual Report of Department of Health Care Services Standards, 2007

⁸ Information available from: www.sportsmalta.com

Gozo Regional Sports Complex⁹

Built in 1993 and recently refurbished, the Gozo Regional Sports Complex is the main sports complex in Gozo. It occupies a footprint of almost 2,100m² and includes terraces with a total seating capacity of 1,750 spectators. Apart from the main hall, the complex also houses a squash court, gym, climbing facilities, shower and changing facilities.

Whereas the focus in the section has been on the two largest national sports complexes, it should be pointed out that a number of smaller sports facilities have been recently undergoing renovation, including the installation of photovoltaics or the use of combined heat and power to heat outdoor swimming pools.

2.7 Construction Methods, Trends and Buildings' Lifespan

2.7.1 Construction Methods & Styles

This part of the report is a historic description of the construction methods and styles which have been used for the construction of buildings in Malta. Given this premise the account and description being presented here is similar to that utilised in the first strategy. At the end of this section, however an update is included, showing the most recent changes in construction methods and styles.

“Buildings in Malta were typically 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 were 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 buildings 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

⁹ <https://www.airmalta.com/destinations/malta/best-of-malta/gozo-air-malta/sports-in-gozo>

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.

Concurrently and led by the necessity to reduce construction costs and desire to make use of the limited land available, most buildings started being built using thinner walls (without insulation) and lower ceilings.”

As an update to this it is worthwhile mentioning two important aspects, which could potentially have an effect on the construction methods and style, mentioned above.

- Limestone as a finite resource is fast diminishing, and the hollow concrete block (of similar dimensions to the limestone block) has now become the most commonly used building block for most constructions. In this context it is worthwhile mentioning the fact that, driven by the requirements to satisfy the minimum criteria for energy performance of buildings, some local entrepreneurs are coming out with ideas (and products) of how to provide ready-made insulated concrete blocks thus rendering the job of the builder easier and faster. This apart from the energy performing (low U-value) imported concrete blocks already present on the market.
- Apart from the profession of architect, and some trades such as that of a mason or electrician, most building related jobs were up till recently being performed by persons who did not possess any form of certification, license or accreditation. Unfortunately, such a situation occasionally resulted in workmanship not always being up to scratch. Also there has always been a demand for workers in the construction industry to be given formal recognition for the skills which they would have acquired over the years, through apprenticeship. To address this issue, the Building Industry Consultative Council (BICC), the local forum for building stakeholders, has recently introduced the Construction Industry Skill Card (CISC)¹⁰. The skills card is intended to improve and maintain the highest standards in the construction industry. The CISC will strive to improve quality standards, health and safety practices and employment conditions. The CISC is to be introduced this year and will be the recognised registration scheme for the construction industry in Malta. Following a five-year transition period, it is being proposed that the CISC will become mandatory for all

¹⁰ BICC Construction Industry Skill Card (CISC). Information available from:
<http://bicc.gov.mt/en/Pages/Skill%20Cards/Information.aspx>

public procurement contracts and cardholders will be requested to update their card on a regular basis (every 5 years), after having completed an up to date Health and Safety awareness certificate as well as a CPD course in their particular trade, covering innovations and best practice during the previous five years. The first trades to be hosted by this scheme are plumbers, assistant electricians, decorators and tile layers.

2.7.2 Construction Trends, Life Span of Buildings & Refurbishment Trends

Construction Trends

Similarly, to the previous section the first part follows on from the 1st Strategy to present a historical progression of facts on construction trends in Malta.

“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, effectively leading to the increase in the number of multi-family buildings. By the late 1970s almost all towns and villages had newly built housing estates on their peripheries¹¹. 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.

As had happened anywhere else, the financial crisis slowed down the building industry in the latter part of the first decade of the 2000s, with the number of new constructions seeing 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.”

Since the writing of the first strategy, Malta’s economy has recovered well from the recession and is again in the middle of another construction and development boom. As shown in Figure 1, in 2015, building permits increased by 34.4 per cent over 2014. This is the highest increase registered during these last years and is much higher than the average increase of 7.2% registered at EU level.

¹¹ MEPA, 2002. *Malta Structure Plan - Housing Topic Paper*

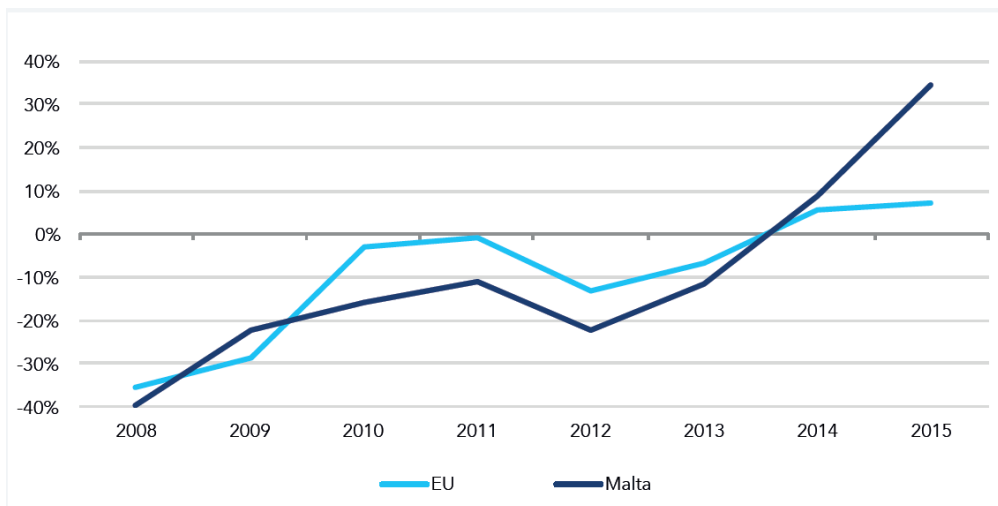


Figure 1: Building Permits - number of residential buildings (annual % change)¹²

This is in line with the amount of useful floor area registered in 2015, which increased by over 19% when compared to 2014. Again, this was the highest increase registered in the past years and more pronounced than the increase registered at EU level of 6.6%.

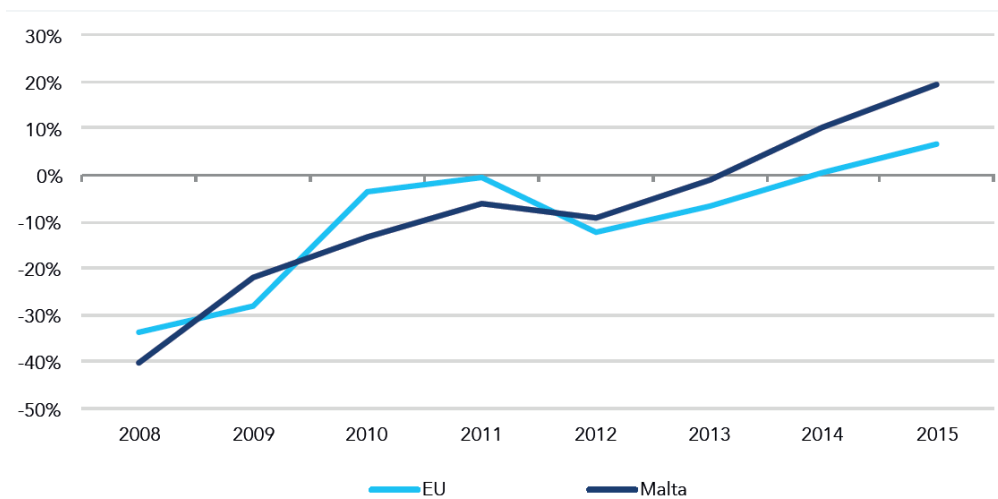


Figure 2: Building Permits - useful floor area in square metres (annual % change)¹³

In terms of building categories, other than residential, since the last report:

- A number of government schools have been extended (while others are planned) to cater for the increased number of student population, in specific areas of the country;
- A number of mixed-use buildings specifically catering for dedicated high-end office space have been earmarked for construction, and have been given planning permission or are in the process of obtaining permission;
- A new speciality hospital, the Sir Anthony Mamo Oncology Centre has been built in 2015; and

¹² Trends in Malta 2016, National Statistics Office, Valletta

- A number of hotels have increased the number of beds available, driven by a relaxation in height restrictions in certain touristic areas.

Life Span of Buildings and Renovation Trends

As can be seen by the numerous historical buildings present in Malta, Maltese buildings were historically built to last. In fact, as discussed earlier, for most Maltese residents, purchasing or building a property is seen as a life-long investment, which will require little, possibly no modification over a person's lifetime. Such a consideration has led to a low annual refurbishment rate (currently estimated at 0.3%, increasing to 0.5% in 2020 and then to 0.7% in 2025)¹³ throughout the residential sector with only few property owners significantly refurbishing their property over the years. It should also be pointed out that an energy renovation of a building is typically undertaken when there is a change of ownership, and such a renovation is typically accompanied with other architectural or structural works. Also, unless a building is a scheduled building, which must be preserved due to its architectural or historical importance, the current trend is for buildings to be demolished and re-built, rather than renovated. This is especially true in the case of terraced houses, which are being demolished to make way for apartment blocks.

In terms of buildings other than residential, renovation trends are diverse, depending on the sector, and ownership. In terms of offices, the most predominant changes are related to the installation of roof installed photovoltaics, wherever possible, the changeover of old split-unit air conditioners to modern energy-efficient ones and a changeover to energy-efficient lighting fixtures. Changes of an architectural nature have been more difficult to come by, mainly because of the low payback period envisaged. The same logic has been applied to schools, although a notable exception is the Siggiewi Primary School, where changes were far more reaching¹⁴. Some hotels have been more

¹³ *Analysis for a Cost-Effective and Efficient Heating & Cooling, 2015*. Report drawn up in line with the requirements of Article 14(1) and 14(3) of Directive 2012/27/EU on Energy Efficiency.

¹⁴ As taken from the National Energy Efficiency Action Plan for Malta 2017 *'Example – Energy retro-fitting plan for the Siggiewi Primary School: The aim of this pilot project was to implement a holistic energy retrofitting solution to a typical primary school building in Malta while improving thermal and visual comfort for the students. Implemented energy retrofitting measures included Building Management System controlled external shading (Louvers and PV overhangs); movement of warmer corridor air to class-rooms in winter, CO2-controlled ventilation, infra-red panel heating instead of resistance heating, intelligent lighting, a Building Energy Management System (BEMS), Photovoltaics and an unglazed solar thermal*

adventurous and have included some architectural changes (in the form of double glazing and roof insulation), but these have mostly been accompanied by other architectural or structural works being carried out simultaneously as part of a renovation process.

2.8 Buildings' Energy Use

2.8.1 Malta's Climate

Malta's climate is characterised as a typical Mediterranean climate with dry summers and mild wet winters. Being an island surrounded by the sea the seasonal air temperature is fairly constant, with the annual mean being 18°C. The relative humidity is regularly high with low values rarely falling below 40%. Winters are mild with daytime winter temperatures almost always higher than 10°C and night-time never falling lower than 0°C. Summers are warm, dry and very sunny. July and August are Malta's hottest months with daytime temperatures usually above 30°C often peaking at 35°C¹⁵.

Given its (small) size of 316 km², weather conditions can be considered as homogenous, with weather conditions typically being uniform across the whole territory, albeit with very small differences based on the exact location.

2.8.2 Energy Use in the Residential Sector

When considering the energy consumption in the residential sector in Malta, one has to consider two important aspects. Firstly, the fact that Malta does not have a dedicated natural gas infrastructure, therefore electricity is the predominant energy source at final consumer level. Secondly and more importantly, are the climatic considerations.

Considering the period between 2006 and 2015, the electricity consumed by the Maltese residential sector has been fairly stable at an average of 620 GWh, with an interim dip during the 2009-2011 period when the electricity consumed by dwellings in Malta was below the 600 GWh mark¹⁶. Over this same period (2006-2015) such consumption accounted for about 28% of the total electricity generated annually in Malta. This is

system for the pool. For hot water, instant water heaters were used instead of storage water heaters. The project is continually monitored and optimized.'

¹⁵ 'Malta's Climate'. Maltaweather.com

<http://www.maltaweather.com/information/maltas-climate/>

¹⁶ Eurostat Database – Electricity Consumption by Sector (Residential)

<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdpc310&plugin=1>

slightly higher than the European average of 24.7%¹⁷.

Considering the base year 2011 (last National Census Year) as reference, the electrical energy consumption per dwelling was around 3,890 kWh/annum. Such a value is practically identical to the European average of 3,942 kWh/dwelling per annum, therefore in terms of electrical consumption alone, Maltese dwellings are on par with their European counterparts. In terms of final energy mix, given that no natural gas network exists, electricity in the Maltese residential sector accounts for around 72.2% of the total, with the remaining 23.6% and 6.9% being covered by (site-stored) petroleum products used at point of use, and from renewable sources of energy¹⁸ respectively.

The main difference between Maltese and European Dwellings arises when one considers the total final energy consumed by the residential sector, and here is where the climatic considerations do have a huge impact. Whereas the electrical consumption is practically identical, the final energy consumption differs considerably between an average of 0.45 *toe*/dwelling per annum consumed by Maltese dwellings (calculated assuming the base year 2011), compared to an average 1.38 *toe*/dwelling per annum consumed by European dwellings¹⁹. The difference, arises from the fact that in European dwellings the bulk of this energy consumption (approximately 70%, is utilised in space heating, and is derived from sources other than electricity). In this context, Malta's mild 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.

Given the local mild winters, requiring only periodical heating and lasting only for a short period of time (compared to mainland Europe), most Maltese households tend to heat buildings either using portable LPG gas heaters or reversible heat pumps (in the form of

¹⁷ Eurostat Database – Total Gross Electricity Generation

<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdpc310&plugin=1>

¹⁸ Eurostat Database – Final Energy Consumption in the Residential Sector by Fuel Type

http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_rk210&plugin=1

¹⁹ Eurostat Database – Final Energy Consumption by Sector

<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdpc320&plugin=1>

split-unit air conditioner [AC] units)²⁰. As had been discussed in the previous strategy such reversible AC units have become very popular as heating devices given that they are readily available for the cooling market.

A reasonable approximation of how energy is consumed in Maltese dwellings can be found in the work which had been done in 2014 on the ‘*Cost-optimal energy performance levels in new and existing residential buildings in Malta*’, commissioned as part of the requirements satisfying Directive 2010/31/EU Energy Performance of Buildings (recast). Table 8 shows the calculated annual (delivered) energy consumption for six different residential building typologies, assuming existing buildings, therefore built prior to 2007, the year of entry into force of the first minimum energy performance requirements. Table 9 shows the calculated annual (delivered) energy consumption for the same six residential building typologies, assuming new buildings therefore built compliant with the minimum energy performance requirements in force in 2014²¹. Calculations were performed as per national methodology established in Malta for the energy performance rating/certification of dwellings, the **Energy Performance Rating of Dwellings in Malta (EPRDM)**.

<i>Building Typology</i>	<i>Heating</i>	<i>Cooling</i>	<i>Lighting</i>	<i>Domestic Hot Water</i>	<i>Total</i>
	<i>kWh/m²annum</i>				
<i>Mid-floor flat</i>	27.6	5.1	7.6	19.2	59.5
<i>Top floor flat</i>	39.7	13.1	7.6	19.2	79.5
<i>Ground floor maisonette</i>	40.5	2.0	8.5	15.9	66.9
<i>Top floor maisonette</i>	38.8	8.1	8.4	16.0	71.3
<i>Terraced house</i>	20.1	5.4	8.8	12.9	47.3
<i>Semi-detached villa</i>	22.2	9.4	7.6	12.9	51.2

Table 8: Calculated (delivered) energy consumption per m² by building typology – Existing residential buildings

<i>Building Typology</i>	<i>Heating</i>	<i>Cooling</i>	<i>Lighting</i>	<i>Domestic Hot Water</i>	<i>Total</i>
	<i>kWh/m²annum</i>				
<i>Mid-floor flat</i>	8.4	4.0	2.2	19.2	33.8
<i>Top floor flat</i>	9.0	5.8	2.2	19.2	36.2
<i>Ground floor maisonette</i>	16.6	1.7	2.4	16.0	36.7
<i>Top floor maisonette</i>	8.2	4.0	2.3	13.7	28.2
<i>Terraced house</i>	5.1	3.4	2.3	13.0	23.8
<i>Semi-detached villa</i>	7.2	2.7	2.4	12.1	24.4

Table 9: Calculated (delivered) energy consumption per m² by building typology – New residential buildings

²⁰ Enerdata. 2012. *Energy Efficiency Trends in Buildings in the EU, Lessons from the ODYSSEE/MURE Project*. D.Bosseboeuf. Paris, France.

²¹ In 2015 new regulations came into force, therefore the calculated (delivered) energy consumption values per m² (Table 9) are slightly different from those quoted in this report.

2.8.3 Energy Use in the Non-Residential Sector

Based on billed data in 2013 the non-residential building sector accounted for 653 GWh or 56,111 *toe*, with the ‘office’ sector accounting for the largest share, 38%²². Table 10 shows the total final electricity consumption by specific building category.

<i>Final Electricity Consumption</i>	<i>GWh/annum</i>	<i>toe/annum</i>
Hospitals	25.2	2,164
Hotels & Accommodation	129.5	11,134
Offices	246.0	21,150
Restaurants & Food Services	43.0	3,694
Schools	22.1	1,904
Shops	129.2	11,107
Sports & Recreational Facilities	12.7	1,093
Territorial Services	0.30	24
Warehousing, Repairing & Maintenance	44.7	3,839
Total	652.6	56,111

Table 10: Final electricity consumption – Non-residential sector

In the following sections the different building typologies are discussed in more detail.

For offices, the ‘*Cost-optimal energy performance levels in new and existing office buildings in Malta*’, prepared in 2014 as part of the requirements satisfying Directive 2010/31/EU Energy Performance of Buildings (recast) will be used to further sub-divide the energy consumption on a per m² basis. For the other building categories being analysed in this report, a number of studies which will (later) form the basis for the cost-optimality studies will be used. In all cases the calculations were performed as per national methodology established in Malta for the energy performance rating/certification of non-dwellings, the **Simplified Building Energy Model for Malta (SBEMmt)**, on an ‘as-built’ basis.

On a sectoral macro level, details of final energy consumption for heating, cooling and energy for hot water usage, will be presented based on information gathered from the ‘*Analysis for a Cost-Effective and Efficient Heating & Cooling*’, 2015 report.

Offices

On a macro level, it was estimated that offices accounted for a final electricity consumption of 21,150 *toe* in 2013. Considering just heating, cooling and electricity but extending the energy consumption to all fuel types, including electricity, the energy

²² *Analysis for a Cost-Effective and Efficient Heating & Cooling, 2015*. Report drawn up in line with the requirements of Article 14(1) & 14(3) of Directive 2012/27/EU on Energy Efficiency.

consumption for the three energy loads was equal to 6,070 toe^{23} , with the cooling load at 4,936 toe being the largest load.

In terms of how energy is consumed by the different office building typologies a good understating can be obtained from the ‘*Cost-optimal energy performance levels in new and existing office buildings in Malta*’, 2014 report. In the analysis carried out, nine different office building typologies were chosen. The building typologies included variations related to the *type of building*: detached, terraced and mixed use typologies; *floor configuration*: open plan/cellular office layouts; and *floor area*: less than 250m², larger than 250m² but smaller than 1,500m² and offices with a total floor area higher than 1,500m². Table 11 shows the calculated annual (delivered) energy consumption for nine different offices building typologies, assuming existing buildings, therefore built prior to 2007, the year of entry into force of the first minimum energy performance requirements.

Building Typology	Heating	Cooling	Auxiliary	Lighting	Hot Water	Total
	kWh/m² annum					
<i>Detached – Open Plan/Cellular</i>	7.6	89.6	1.9	51.8	5.3	156.3
<i>Detached – Cellular</i>	4.9	56.8	56.3	40.4	3.8	162.3
<i>Detached – Cellular</i>	1.9	55.4	47.2	59.8	4.3	168.5
<i>Terraced – Open Plan/Cellular</i>	10.5	86.5	1.5	58.1	4.7	161.4
<i>Terraced – Cellular</i>	19.3	63.0	77.9	67.1	5.8	233.1
<i>Terraced – Cellular</i>	3.4	47.8	56.6	59.6	3.4	170.7
<i>Mixed Use – Open Plan/Cellular</i>	13.3	59.5	0.0	58.9	3.8	135.6
<i>Mixed Use – Cellular</i>	7.7	115.7	192.3	50.5	6.7	372.9
<i>Mixed Use – Cellular</i>	3.9	97.2	12.3	38.4	2.4	154.2

Table 11: Calculated (delivered) energy consumption per m² by building typology – Existing office buildings

As can be seen the cooling and the lighting loads are the two largest energy loads with the heating and hot water energy loads being comparatively much smaller. The auxiliary energy load depends on the type of space conditioning system utilised. Low auxiliary energy requirements are associated with split-unit air conditioning systems (typically of the ‘On/Off’ type), whilst high auxiliary energy requirements are associated with package ducted or chiller and fan coil systems.

²³ Such a value does however not include lighting, auxiliaries and all the plug loads.

Table 12 shows the calculated annual (delivered) energy consumption for nine different offices building typologies, assuming new buildings, therefore built compliant with the minimum energy performance requirements in force in 2014²⁴. The cooling systems in this case are of the split-unit air conditioning (inverter) or VRF type, hence the substantial reduction in auxiliary energy loads.

Building Typology	Heating	Cooling	Auxiliary kWh/m²annum	Lighting	Hot Water	Total
<i>Detached – Open Plan/Cellular</i>	4.4	52.7	1.9	43.8	5.3	108.1
<i>Detached – Cellular</i>	3.2	30.1	8.1	35.9	3.8	81.1
<i>Detached – Cellular</i>	1.6	37.4	6.0	48.9	4.3	98.2
<i>Terraced – Open Plan/Cellular</i>	10.4	49.3	1.5	55.2	5.3	121.7
<i>Terraced – Cellular</i>	10.1	38.9	1.1	53.7	5.8	109.6
<i>Terraced – Cellular</i>	3.3	33.4	13.3	48.7	3.4	102.1
<i>Mixed Use – Open Plan/Cellular</i>	13.4	37.1	0.0	53.5	6.8	110.8
<i>Mixed Use – Cellular</i>	3.1	38.3	11.0	47.4	6.7	106.5
<i>Mixed Use – Cellular</i>	3.0	35.2	12.3	39.4	2.4	92.3

Table 12: Calculated (delivered) energy consumption per m² by building typology – New office buildings

Educational Buildings

As part of a study on the energy consumption in schools, five primary and secondary schools were selected to be studied using the national methodology SBEMmt. Table 13 shows the calculated annual (delivered) energy consumption for the five selected schools, assuming the ‘as-built’ conditions. Also included is the calculated EPC rating and the grade obtained by the building.

School	Heating	Cooling	Auxiliary kWh/m²annum	Lighting	Hot Water	EPC Rating (Grade)
<i>School 1</i>	50.6	0.0	10.8	32.5	80.3	148 (C)
<i>School 2</i>	41.7	0.0	1.7	27.2	53.6	153 (D)
<i>School 3</i>	40.6	1.3	1.8	23.4	14.4	134 (C)
<i>School 4</i>	31.1	0.0	0.8	29.9	27.8	137 (C)
<i>School 5</i>	57.5	0.0	0.8	30.2	15.5	148 (C)

Table 13: Calculated (delivered) energy consumption per m² – Schools

²⁴ In 2015 new regulations came into force, therefore the calculated (delivered) energy consumption values per m² (Table 12) are slightly different from those quoted in this report.

As can be seen, contrary to offices where the cooling load is the predominant energy load, school buildings used for compulsory schooling in Malta, have traditionally been characterised by the lack of any cooling systems, other than in selected spaces such as offices. Classrooms have traditionally been left naturally ventilated supplemented with mechanical means such as ceiling fans. Occasional heating is provided via electric heaters. Hot water usage varies depending on the type of sports facilities annexed to the school, and this energy load is typically satisfied via an electric water heating system. None of the schools studied had photovoltaics installed.

Details on a macro level for school buildings used for compulsory schooling in Malta is not available.

Hotels

On a macro level, it was estimated that hotels and accommodation services accounted for a final electricity consumption of 11,134 *toe* in 2013. Considering just heating, cooling and electricity but extending the energy consumption to all fuel types, including electricity, the energy consumption for the three commodities was equal to 6,274 *toe*²⁵, with the cooling load at 2,643 *toe* being the largest load.

Similarly to schools, five hotels were selected to be studied using the national methodology SBEMmt. Table 14 shows the calculated annual (delivered) energy consumption for the five selected hotels, assuming the ‘as-built’ conditions. Also included is the calculated EPC rating and the grade obtained by the building.

<i>Hotel</i>	<i>Heating</i>	<i>Cooling</i>	<i>Auxiliary</i>	<i>Lighting</i>	<i>Hot Water</i>	<i>EPC Rating (Grade)</i>
	<i>kWh/m²annum</i>					
<i>Hotel 1</i>	39.0	50.7	127.0	50.5	206.8	n.a (C)
<i>Hotel 2</i>	36.2	46.9	112.5	44.1	234.9	116 (C)
<i>Hotel 3</i>	44.1	35.8	118.2	36.6	238.6	109 (C)
<i>Hotel 4</i>	54.6	53.8	257.3	43.9	199.6	181 (D)
<i>Hotel 5</i>	45.0	37.4	105.7	36.8	153.1	114 (C)

Table 14: Calculated (delivered) energy consumption per m² – Hotels

It can be observed that heating, cooling and lighting are all of the same magnitude, while the two highest energy loads are the auxiliaries and the hot water energy loads. In the case of Hotel 4, the high auxiliary energy load arises from the fact that the hotel is a resort also offering spa facilities. Air conditioning is of the fan coil type, while the hot water energy load is satisfied through the use of a fuel fed boiler. None of the hotels studied had

²⁵ Such a value does however not include lighting, auxiliaries and all the plug loads.

photovoltaics installed.

Hospitals incl. Retirement Homes

On a macro level, it was estimated that hospitals accounted for a final electricity consumption of 2,164 *toe* in 2013. Considering just heating, cooling and electricity but extending the energy consumption to all fuel types, including electricity, the energy consumption for the three energy loads was equal to 1,630 *toe*²⁶, with the hot water energy load at 801 *toe* being the largest load.

For the purpose of this report two retirement homes were selected to be studied using the national methodology SBEMmt. Home 1 is state owned; Home 2 is privately owned. Table 15 shows the calculated annual (delivered) energy consumption for the two selected retirement homes, assuming the ‘as-built’ conditions. Also included is the calculated EPC rating and the grade obtained by the building.

<i>Home</i>	<i>Heating</i>	<i>Cooling</i>	<i>Auxiliary</i>	<i>Lighting</i>	<i>Hot Water</i>	<i>EPC Rating (Grade)</i>
	<i>kWh/m²annum</i>					
<i>Home 1</i>	44.8	55.0	152.3	30.3	115.1	155 (D)
<i>Home 2</i>	39.2	34.7	89.9	33.7	119.1	131 (C)

Table 15: Calculated (delivered) energy consumption per m² – Retirement Homes

The magnitude of heating and cooling energy loads is similar to hotels, albeit slightly higher, indicating a higher demand possibly due to the specific thermal conditions required by the residents. Compared to hotels the lighting energy load is lower. The hot water energy load is similarly to hotels, the largest energy load and this is similarly satisfied via a fuel fed boiler.

Sports Facilities

On a macro level, it was estimated that sports facilities accounted for a final electricity consumption of 1,093 *toe* in 2013. Considering just heating, cooling and electricity but extending the energy consumption to all fuel types, including electricity, the energy consumption for the three energy loads was equal to 1,002 *toe*²⁷, with the hot water energy load at 696 *toe* being the largest load.

Two sports facilities were selected to be studied using the national methodology SBEMmt. Sport Facility 1 is the Gozo Sports Complex, while Sport Facility 2 is the

²⁶ Such a value does however not include lighting, auxiliaries and all the plug loads.

²⁷ Such a value does however not include lighting, auxiliaries and all the plug loads.

Cottonera Sport Complex. Both are state owned. Table 16 shows the calculated annual (delivered) energy consumption for the 2 selected sports facilities, assuming the ‘as-built’ conditions. Also included is the calculated EPC rating and the grade obtained by the building.

<i>Sports Facility</i>	<i>Heating</i>	<i>Cooling</i>	<i>Auxiliary</i>	<i>Lighting</i>	<i>Hot Water</i>	<i>EPC Rating (Grade)</i>
	<i>kWh/m²annum</i>					
<i>Sports Facility 1</i>	24.4	27.2	76.1	35.3	97.3	111 (C)
<i>Sports Facility 2</i>	25.0	34.9	71.9	38.3	284.9	94 (B)

Table 16: Calculated (delivered) energy consumption per m² – Sports Facilities

2.9 Energy Performance of Buildings Related Legislation

Currently the main piece of legislation related to the energy performance of buildings is Legal Notice 376 of 2012 transposing *Directive 2010/31/EU of the European Parliament and of the council of 19th May 2010 on the energy performance of buildings (recast)*.

Following the transposition of the first Directive on the energy performance of buildings (Directive 2002/91/EC) locally, ‘*Technical Guidance F – Minimum Energy Performance of Buildings in Malta*’ regulating the minimum energy performance of buildings was issued in 2006. This first technical guidance on the energy performance of buildings only specified certain aspects of energy performance, such as the maximum building element U-value and design parameters, such as the maximum allowable glazing to wall ratio or the building services efficiency, without specifying any energy thresholds. In 2015, and following the cost-optimal studies conducted in 2014, a new document ‘*Technical Document F – Minimum Energy Performance Requirements for Buildings in Malta*’ was issued, updating the existing minimum energy performance requirements.

This new document is divided into two parts.

Part 1 specifies the minimum energy performance requirements for buildings in Malta. Following the cost-optimal analysis studies carried out in 2014, apart from specifying design parameters as had been the case of the first Technical Guidance, the new Part 1 Technical Document F also lists the ***Overall Energy Performance Requirement for new Dwellings*** (Table 17) and the ***Overall Energy Performance Requirement for new non-Dwellings*** (Table 18), specifically for offices.

Building Category	Flatted Dwellings	Terraced Houses	Semi-detached Housing	Fully detached Housing	Indicative Mean Energy Requirement
Primary Energy Demand (kWh/m²annum)	140	90	55	55	85

Table 17: Overall energy performance requirement for new dwellings

Building Category	Buildings used exclusively as Offices	Buildings with Offices occupying >50% of useful floor area
Primary Energy Demand (kWh/m²annum)	290	350

Table 18: Overall energy performance requirement for new non-dwellings (Offices)

Part 2 of Technical Document F specifically focus on the minimum requirements for building services in Malta.

NZEB Policy

In 2015 Malta published its first plan on how nearly Zero Energy Buildings²⁸ will be addressed in Malta. In this first policy, targets for new nearly zero energy buildings, both for the residential and other buildings, together with what possible barriers may be encountered are listed and discussed. What follows is an excerpt from the policy summarising the main issues and set targets for dwellings and other buildings.

“Malta has a limited range of renewables which may be of use. The most obvious, especially for buildings, is solar-based renewables (mostly photo-voltaic and thermal). However, due to shading and limited access to roofs, this cannot be applied across the board. On the other hand, scarcity of land militates against communal PV farms. Due to this scenario, the definitions of NZEB have been developed with two components: a basic mandatory component which is mostly due to the building fabric and efficient building services; and a component of solar-based RES to be applied whenever possible. The two components would reach a mean figure of 75 kWh/m²annum for dwellings and 220 kWh/m²annum for other buildings.”

²⁸ Nearly Zero Energy Plan for Malta, Building Regulation Office, 2015

3 COST-EFFECTIVE APPROACHES TO RENOVATION

3.1 Approach to Renovation – Residential Sector

In the first strategy, the ‘*Cost-optimal energy performance levels in new and existing residential buildings in Malta*’ was utilised to characterise existing residential building in Malta. The result from that strategy was that:

“Existing residential buildings have the potential of becoming very energy-efficient buildings, possibly also energy-neutral buildings or even net energy exporters. However it is important to stress the fact that such cost-optimal levels can only be reached if the right conditions exists. 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).”

Also, it was proposed that the renovation of an existing residential building should be aimed at achieving an average primary energy value of:

- **80kWh/m²annum** for buildings improving their energy performance without making use of renewable sources of energy (*i.e.* through improvements in the building envelope and building systems only); and
- **40kWh/m²annum** for buildings which in addition to improvements in the building envelope and building systems have the capability of making use of renewable sources of energy to further improve their energy performance.

The reasons which had been given for such a difference were due to the analysis carried out on the renewable energy potential in the refurbishment of buildings. A number of limitations had been highlighted, including *limited land space and conflicting roof use, the lack of solar rights and other policy regulations on available roof space.*

It should be pointed out that the values which had been set in 2014 were irrespective of building typology. Given the limitations described above, inherent to specific building typologies (*e.g.* flatted dwelling), in this update such targets are being revised to address different building typologies. For this reason, the energy renovation targets of existing residential buildings are being modified to reflect more realistic values, consistent with the possibilities and opportunities inherent to the type of building typology.

Additionally, to be consistent with the updated *Technical Document F* setting the *Minimum Energy Performance of Buildings in Malta*²⁹, the new updated energy renovation targets for dwellings are being identical to the overall energy performance for new dwellings as shown in Table 19.

<i>Building Category</i>	<i>Flatted Dwellings</i>	<i>Terraced Houses</i>	<i>Semi-detached Housing</i>	<i>Fully detached Housing</i>	<i>Indicative Mean Energy Requirement</i>
Primary Energy Demand (kWh/m²annum)	140	90	55	55	85

Table 19: Overall energy performance requirement for renovated dwellings

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

Renovation Potential

Currently a detailed analysis of the distribution of residential buildings by Energy Performance (Grade) is not available. It is therefore difficult to assess the full potential of renovation on a territory wide scale, as the number of buildings which could benefit from an energy renovation process is unknown. It is however reasonable to assume that the majority of buildings built prior to 2007, the year of entry into force of the first minimum energy performance requirements, do have energy delivered energy consumption values similar to those quoted in Table 8.

If such buildings are renovated to at least the level required by the current minimum requirements (*e.g.* improved insulation, glazing replacement, replacement of services to more efficient ones, *etc.*), therefore having delivered energy consumption values equal to those quoted in Table 9, the average energy consumption of these renovated dwellings would be go down from an average of 63 kWh/m²annum (average delivered energy consumed by existing buildings) to 30 kWh/m²annum (average delivered energy consumed by new buildings). Assuming the current renovation trend specified in Section 2.7.2 (Sub-Section *Life Span of Buildings and Renovation Trends*), the expected annual energy savings due to renovation varies between 181 *toe*/annum (2.1 GWh/annum) between 2017 and 2019, 302 *toe*/annum (3.5 GWh/annum) between 2020 and 2024 and 423 *toe*/annum (4.9 GWh/annum) between 2025 and 2030; for a total final cumulative

²⁹ Sub-Section 3.02.2 of the *Technical Document F* setting the *Minimum Energy Performance of Buildings in Malta* revised in 2015 specified that, dwellings undergoing major renovation are required to have a maximum yearly overall energy demand per square metre not exceeding that for the dwelling typology.

(delivered) energy consumption savings (over the period 2017-2030) of 4,591 toe (53.4 GWh)^{30,31} equivalent to around 11,611 dwellings renovated. Figure 3 summaries the results.

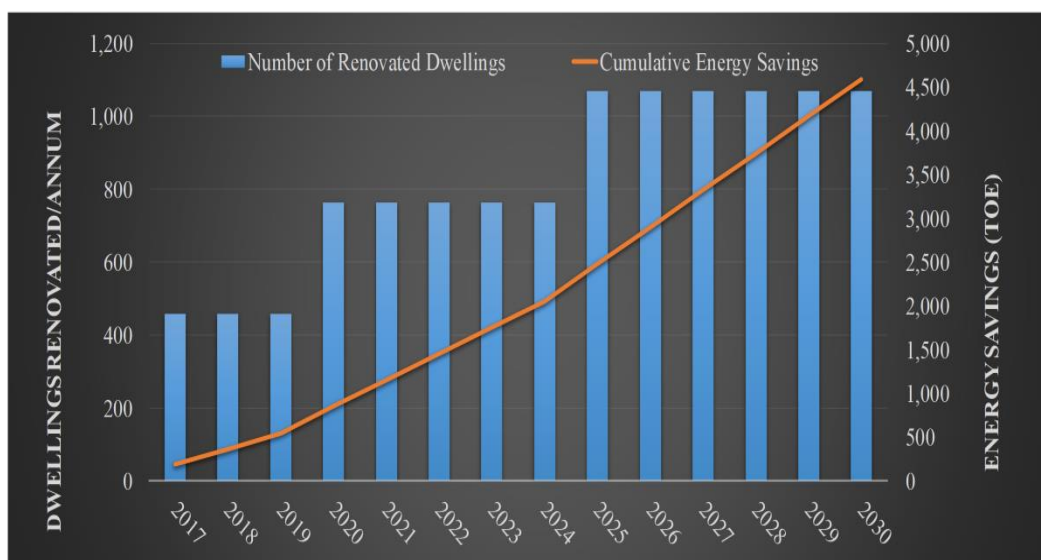


Figure 3: Number of dwellings renovated and cumulative energy savings (2017-2030 period) (Residential Sector)

Cost-Optimal Level and inclusion of Renewable Sources of Energy

The savings presented in the previous sub-section are related to changes in the building fabric and services replacement alone. The cost-optimal levels calculated in ‘*Cost-optimal energy performance levels in new and existing residential buildings in Malta*’, show that more significant savings could be attained, and that existing residential buildings have the potential of becoming very energy-efficient buildings, possibly also energy-neutral buildings or even net energy exporters. Such savings are however only attainable if buildings can avail of the possibly of installing and using renewable sources of energy (mainly solar water heaters and photovoltaics). This may not always be the case and as discussed in the next section specifically these limitations, together with other aspects inherent to the Maltese building industry create barriers to the possibility of achieving a higher renovation potential.

Strengths, Weaknesses, Opportunities and Threats

As has already been discussed, Maltese residential buildings are not energy intensive

³⁰ Assumptions: Number of Occupied Dwellings in 2011 Census: 152,770. Weighted Average Area of a single dwelling assuming building typologies used for analysis is 139m².

³¹ Currently the Cost-Optimal Studies for the Residential Sector and Offices are in the process of being revised. This value is therefore to be considered as indicative.

users compared to their European counterparts, and even though cooling might be thought as a substantial load, in reality only a relatively short period of the year typically really necessitates space conditioning. For a large extent, thermal comfort is obtained through natural ventilation. In terms of space heating, the increased market penetration of reversible heat pumps has led to heating being produced using energy-efficient (high SCOP) air conditioning units. Likewise, the trend for lighting, as had been reported in the previous report is to install energy-efficient lighting (*e.g.* Compact Florescent Lamps and LEDs).

In terms of further reducing the space conditioning energy load, a substantial input needs to be provided by the quality of the building fabric utilised in a renovation, specifically the use of energy-efficient materials (with low U-values). This however has its own challenges both from a demand and supply side. A recent report on the state of the construction industry and property market³² highlighted that from the demand side consumers are still not fully aware of the environmental or monetary benefits, improving the building fabric via energy-efficient materials such as double glazing or insulating materials could have. On the supply side stakeholders highlight two key barriers³³:

- *Low level of skills workforce, with very limited knowledge of energy efficiency related matters; and*
- *A construction industry which is mainly based on small and micro-enterprises, emanating from size of industry and insularity.*

In this regard it is envisaged that the introduction of the Construction Industry Skill Card (CISC), as discussed in Section 2.7.1, will go a long way in improving the overall quality of building workmanship in Malta.

The other aspect which would enable a substantial decrease in the final energy consumption of renovated buildings is the use of renewables. In this regard however, caution has to be expressed, as the lack of space for the installation of renewable energy technologies (often competing with one another and with other services for the little space available on the roof), and the lack of solar rights have been earmarked by stakeholders as significant market barriers for an even further deployment of such technologies.

In terms of other renewable energy technologies, specifically CHP, the ‘*Analysis for a*

³² *The Construction Industry and Property Market in Malta*, Malta Developers Association, 2017

³³ *Nearly Zero Energy Plan for Malta*, Building Regulation Office, 2015

Cost-Effective and Efficient Heating & Cooling, 2015’ report, highlights how:

‘All the studies already carried out in relation to the economic potential of CHP in Malta have identified several barriers to the spread of this technology in the country. Among these, it is important to remember those strictly context-dependent, related to infrastructure framework and climatic conditions of the island:

- a. Currently Malta does not have a network of natural gas distribution (a feasibility study considering a number of distribution hubs is still underway).*
- b. The high level of insolation promotes the use of competing technologies such as solar photovoltaic, solar thermal, solar cooling.*
- c. The connection of the island with the European electricity grid, launched in April 2015, along with the new CCGT electricity generation plant at Delimara, fuelled with LNG, will contribute in the future to a lower cost of electricity.*
- d. The only “renewable” source available in Malta in order to fuel CHP is the biogas from waste.’*

The report continues by describing how for the residential sector under a business-as-usual scenario, the number of applicable cases where CHP could be utilised (given the cumulative size of the multi-apartment block) is very low.

3.3 Approach to Renovation – Non-Residential Building Sector

For the office category the 1st Report had proposed that the renovation of an existing office building should be aimed at achieving an average primary energy range which fits the target range for that particular office building typology. These targets had been based on ‘*Cost-optimal energy performance levels in new and existing office buildings in Malta*’ 2014 report. At that time only a wide range of primary energy values was given.

In this 2nd strategy this target primary energy target is being updated to provide a specific limit value rather than a range, consistent with the updated *Technical Document F* setting the *Minimum Energy Performance of Buildings in Malta*³⁴. The new updated energy renovation targets for office buildings are therefore being set similar to the overall energy

³⁴ Sub-Section 4.02.2 of the *Technical Document F* setting the *Minimum Energy Performance of Buildings in Malta* revised in 2015 specified that, non-dwellings undergoing a major renovation which will be used as offices or which will be occupied by offices over 50% or more of the useful floor area will be required to have a maximum yearly overall energy demand per square metre not exceeding that for the non-dwelling typology having the highest yearly overall energy demand requirement.

performance for new offices as shown in Table 20.

Building Category	Buildings used exclusively as Offices	Buildings with Offices occupying >50% of useful floor area
Primary Energy Demand (kWh/m²annum)	290	350

Table 20: Overall energy performance requirement for renovated office buildings

Specific energy renovation targets for other building categories are currently non-available as the cost-optimal analysis studies for non-residential buildings other than offices are still being formulated.

3.4 Appraisal of Renovation Potential & Identification of Strengths, Weaknesses and Threats – Non-Residential Building Sector

Renovation Potential

The renovation potential of building categories other than dwellings is very diverse, depending on the category. The public sector has been leading by example whenever possible, and the information available is mostly related to renovation projects or quantification of renovation work which has been carried out on public buildings. Nonetheless, the results obtained give a clear indication of which renovation route may be most appropriate (not necessarily due only to energy savings but possibly also as part of a process of creating a better indoor environment or as part of a larger architectural or structural renovation) for different building categories.

❖ Renovation projects already carried out in the public sector

Following is the description of a number of renovation projects which have already been carried out in the public sector (as described in the NEEAP, 2017)³⁵:

- i. Work done by the Foundation for Tomorrow's Schools in incorporating renewable and energy-efficient technologies when planning new schools and refurbishments;*
- ii. Action taken by the Ministry for Education and Employment to invest in double glazing in 11 public schools;*
- iii. Investments in replacing old air-to-air heat pumps in:*
 - a. Various 'Day Centres' and local support offices under the administration of the Ministry for Family and Social Solidarity;*
 - b. The central administration building of the Ministry for Home Affairs and National Security and the Fire Stations; and*

³⁵ National Energy Efficiency Action Plan Malta, 2017

c. The Ministry for Gozo

iv. Investment done by the Police Force in its Headquarters and Police Stations.

❖ *Results from Energy Audits of public buildings*

Apart from the above mentioned projects, already carried out, in December 2016 a selected total of 50 public buildings, predominantly offices were energy audited to gauge their current energy consumption and renovation potential. The calculated total energy consumption based on the list of energy consumers (compared against billed data), resulted in an average delivered energy consumption of about 112,000 kWh/annum per building. Considering the total floor space audited, the average delivered energy intensity per m², was around 85 kWh/m²annum. It has to be stressed that these building had already been audited in 2010, and a number of energy improvement recommendations had already been carried out, including the installation of roof installed photovoltaics. For this reason, they cannot be fully representative of the existing building stock.

Having said that, these Energy Audits still give a clear indication of what type of renovation works could be carried out in such buildings (and the associated potential energy savings) namely, the changing of light fittings, the installation of photovoltaics and/or solar water heaters, the installation of new energy-efficient air conditioners replacing older less efficient systems, motion sensors for rooms with low occupancy and solar films on glazing. The energy audits had to take into consideration the costs involved and had to rank the proposed renovation based on cost effectiveness.

Based on the Energy Audits carried out, the average energy savings per building, if all recommendations are carried out could be equal to 50,748 kWh/annum, such that the average delivered energy consumption of the renovated buildings would go down to 61,422 kWh/annum. Considering the total floor space audited, the average delivered energy intensity per m², for the renovated buildings would be around 37 kWh/m²annum. Excluding renovations due to renewable sources of energy, the savings would be only of around 22,432 kWh/annum per building, such that the average delivered energy consumption of the renovated buildings would go down to 90,218 kWh/annum. Considering the total floor space audited, the average delivered energy intensity per m², for the renovated buildings would be around 67 kWh/m²/annum. Figure 4 summarises the results obtained from the Energy Audits carried out, comparing the current EnPI (Energy Performance Index) based on (delivered) energy demand and renovated potential EnPI (*incl.* and *excl.* RES). It also has to be pointed out that based on preliminary costings which have been made not all changes would be cost-effective.

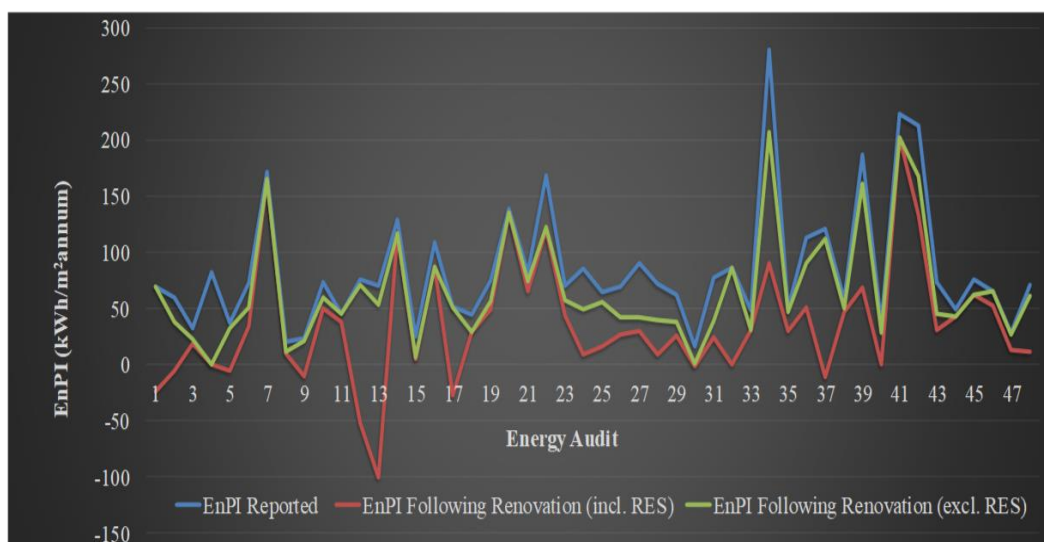


Figure 4: Current EnPI based on (delivered) energy demand and renovated potential EnPI³⁶ (incl. and excl. RES) for the audited public buildings (2016)

As part a wider exercise other detailed Energy Audits are also being carried out on other buildings in other building categories (including those falling under the requirement of having an Energy Audit carried out as part of the requirements set out in Art. 8(4) of Directive 2012/27/EU on Energy Efficiency).

❖ *‘Deep’ renovation study of the St Vincent De Paul Residence*

With regards to building categories other than offices a special mention needs to be made to the St Vincent De Paul Residence (together with the Ruzar Briffa Complex) where, as discussed earlier, recently a study for ‘Deep’ Energy and Resource Retro-Fitting was conducted with the aim of assessing not only the energy efficiency potential but also the cost benefit analysis of these retrofits. Through this study a number of passive and active renovation solutions were analysed³⁷.

For the passive analysis the installation of roof and wall insulation was considered, as roof insulation was missing and walls were single leaf, together with replacement of single glazed apertures with double glazed ones, complete with shutters. Cumulatively the savings for both buildings, assuming the passive interventions, were as follows:

Installation of Wall Insulation to improve the U-Value: 54,550 kWh/annum

³⁶ A negative EnPI refers to the fact that the building is a net exporter of energy, due to the inclusion of renewable energy technologies.

³⁷ ‘Outcome of ‘Deep’ Energy and Resource Retro-Fitting Study of St Vincent De Paul Hospital Residence’. Published on the *The Sunday Times of Malta* November 15, 2015.

<i>Installation of Roof Insulation:</i>	147,040 kWh/annum
<i>Replacement of Single Glazing with Double Glazing:</i>	846,758 kWh/annum

For the active analysis lighting, HVAC, energy for hot water usage, energy-efficient plug loads, energy management, rain water harvesting, cold water and sewage treatment were all considered. Cumulatively the savings for both buildings, assuming the active interventions, were as follows:

<i>Energy Saving Lighting & Controls:</i>	2,446,901 kWh/annum
<i>Efficient HVAC & Controls:</i>	3,197,761 kWh/annum
<i>Solar Thermal:</i>	285,763 kWh/annum
<i>Efficiency Increase in Plug Loads:</i>	323,428 kWh/annum
<i>Energy Management System:</i>	563,170 kWh/annum
<i>Rain Water Harvesting:</i>	43,071 kWh/annum
<i>Flow Reducers:</i>	12,352 kWh/annum
<i>Sewage Treatment Plant:</i>	43,071 kWh/annum

❖ *Preliminary results from the initial work carried out on cost-optimal studies for other building categories*

Though not finalised initial results on the best performing packages can already be formulated, at least on a best energy performance basis. The following is a summary of the results presented in the reports³⁸.

Schools: Compared to the ‘as-built’ results, permutations done using different energy renovation packages showed that the best energy performing results are obtained when:

- The wall U-value is decreased to 0.85 W/m²K;
- The glazing U-value is decreased to 4 W/m²K (replacement to double glazing);
- HVAC is provided by a high-efficiency heat pump (3.8/3.6) for both heating and cooling. Even if cooling is introduced as a new load, the savings obtained from the heating element makes up for this new energy load;
- Hot water is provided by a heat pump instead of an electric water heater; and
- A photovoltaic installation is installed on the roof of the school (~50%).

Based on the schools sampled it is estimated that savings could be in the region of

³⁸ The packages being quoted are not cost-optimal as they do not include a cost analysis element. Rather they are indication of which package of renovations is best performing (in terms of lowest delivered energy consumption) for the particular building category.

between 36% and 50% compared to the ‘as-built’ situation.

Hotels, Retirement Homes & Sports Complexes: For these three building categories, compared to the ‘as-built’ results, permutations done using different energy renovation packages showed that the best energy performing results are obtained when:

- The wall U-value is decreased to 0.85 W/m²K;
- The glazing U-value is decreased to 4 W/m²K (replacement to double glazing);
- HVAC is provided by a high-efficiency VAV; and
- Hot water is provided by a heat pump working in tandem with a combi-solar system.

Energy savings for the buildings investigated are in the range of 50% varying between 47% and 66%.

❖ *CHP and district heating potential for certain sectors*

As part of the requirements of Article 14(1) and 14(3) of Directive 2012/27/EU on Energy Efficiency an analysis for a cost-effective and efficient heating & cooling report was drawn in 2015³⁹. The report includes various scenarios gauging the feasibility analysis of introducing CHP in selected building categories such as hospitals, hotels and industrial buildings (as part of a wide district heating system).

In terms of the results presented by this report, as discussed in the National Energy Efficiency Action Plan, 2017, in terms of district heating ‘*The results of the comprehensive assessment show that it is not cost-effective because of the low heating demand reflecting the mild climate. As such, no large meaningful application of ‘waste’ low-temperature heat is possible.*’ In regards to CHP the National Energy Efficiency Action Plan, 2017, states that ‘*CHP technology seems to have at best a marginal potential role in Malta, even when taking into account provisions of Directive 2012/27/EU of enhancing this technology and district heating. The up-take of CHP technology as small-scale stand-alone installations is rendered even more difficult considering the market competition of equally efficient heating technologies, like heat pumps and condensing boilers. Nevertheless, the economic cost-benefit analysis drawn up in accordance with Directive 2012/27/EU showed some positive results for some scenarios involving CHP plants when considering environmental benefits and health externalities that could receive a better evaluation in the future.*’

³⁹ Full report is available from:

<https://ec.europa.eu/energy/sites/ener/files/documents/H%20%20C%20Comprehensive%20Assessment-%20Art%20%2014%201%20and%2014%203%20.pdf>

Strengths, Weaknesses, Opportunities and Threats

The following is a list of strengths, weakness and threats which could potentially be encountered by the non-dwelling building categories, as part of the implementation of a successful renovation strategy.

- In terms of renewable sources of energy for some building categories, land space is not an issue, though there may be competing issues on the use of the roof for other amenities or services;
- In some cases, entities are not the owners of the buildings and as such there is little the occupying entity can do infrastructurally to improve the energy performance of the building;
- In multi-tenant leased buildings, metering and billing is problematic, especially in common areas or for common services;
- Rate of return expected by certain building owners requires projects to be cost effective in the very short term. The typically low heating and cooling demand (compared to mainland Europe) dictate that certain projects will take more time to pay for themselves; and
- The infrastructure for certain projects is non-existent (*e.g.* district heating).

4 POLICIES AND MEASURES TO STIMULATE COST-EFFECTIVE RENOVATIONS

A number of policies and measures have been put in place to promote renovation and eventually energy efficiency in buildings. Predominantly these have taken the form of financial incentives or grants, made available either through ERDF or other European funding, or local funding.

What follows is an account of the main policies and measures which have been put in place to stimulate cost-effective renovations.

4.1 *Existing Policies and Measures – Residential Sector*

Financial Incentives and Grants (Building Fabric)

The local Regulator for Energy and Water Services (REWS) offers a grant on the purchase of roof insulation and double glazing products for domestic use that reduce the consumption of energy. The grant pays 15.25% eligible costs (material and fixing) of installing roof insulation and double glazing up to a maximum of €1,000⁴⁰. Over the last three years a total of 901 grants were awarded via the scheme.

Financial Incentives and Grants (Renewable Sources of Energy)

Other grant schemes aimed specifically at the residential building category are those related to the purchase of photovoltaics and solar water heaters. Over the last few years Government through the Regulator for Energy and Water Services has been giving grants aimed specifically at increasing the number of renewable sources of energy present on domestic buildings. A number of grant schemes have been opened periodically with success and often where fully taken up. The grant typically involves payment of part of the capital cost (latest for photovoltaics grant covers 50% of the cost of the panels up to € 2,300 per application/installation⁴¹, while for solar water heaters grant covers 40% of the capital cost up to €400 per application/installation⁴²). Additionally, in the case of

⁴⁰ Guidelines on a Grant on the Purchase of Roof Insulation and Double Glazing Products for Domestic Use that Reduce the Consumption of Energy. Information available from:

http://downloads.rews.org.mt/files/2f393645-d588-4f67-9fa9-773d17eac67b_43990c6a-296b-4e36-8a85-7aa2efeed13b.pdf

⁴¹ Government Notice 531 of 2016. Information available from:

<http://www.gov.mt/en/Government/Government%20Gazette/Government%20Notices/Pages/2016/05/Gov-Notices-2405.aspx>

⁴² Solar Water Heater Grant Scheme - Guidelines. Information available from:

http://downloads.rews.org.mt/files/537261ec-9194-4cfb-9791-766d23621aea_b658c1d6-4473-

photovoltaics, the electricity generated and fed into the grid is paid a Feed in Tariff.

The photovoltaic grant scheme has been always very successful and over the last 3 years, around 26,154 kWp were installed on domestic roofs via this grant. This in addition to the installations already in existence. In terms of solar water heating, over the last three years a total of 1,286 grants were awarded via the scheme.

Financial Incentives and Grants (Other)

As part of a process to preserve and restore the built heritage of the Maltese Islands and promote sustainable regeneration, the restoration grant scheme *Irrestawra Darek*⁴³, literally meaning ‘Restore your home’ aimed at *privately owned residential buildings* within *urban conservation areas* and/or scheduled as *Grade 1* and *Grade 2*, was launched to promote investment in such buildings. Although the focus was on the restoration of such buildings, (while preserving the aesthetic and historical value of such buildings) the fund also covered retrofitted green initiatives⁴⁴.

As presented on the Planning Authority’s website⁴⁵ under this scheme, first time private buyers of residential Grade 1 and Grade 2 scheduled buildings may apply for a rebate on 70% of eligible costs of restoration and conservation works on facade and interior up to a maximum of €100,000, whereas first time private buyers of an old residence located within Urban Conservation Areas (UCAs) may apply for a rebate of up to a maximum of €10,000. This scheme which commenced in January 2017 was made available up to a maximum of €8 million on a first come first served basis up until the end of April 2017. The scheme was fully subscribed.

Other schemes not directly involved in the energy restoration of a building, include the *Domestic Cisterns Restoration Scheme*⁴⁶ aimed at encouraging the use of harvested

[4d27-a0d4-8c1524fbd47b.pdf](#)

⁴³ Information available from: <https://www.pa.org.mt/en/irrestawra-darek>

⁴⁴ Defined as ‘Measures aimed to promote the further use of the building which are earmarked to enhance efficiency in energy consumption of the building and microclimate control. For the purpose of the scheme the interventions should not detract from the conservation status of the property and where visible should sensitively complement the architectural attributes’

⁴⁵ Guidelines of the restoration grant scheme, *Irrestawra Darek*. Available from: <https://www.pa.org.mt/file.aspx?f=1920>

⁴⁶ Domestic Cisterns Restoration Scheme – Guidelines. Information available from: http://downloads.rews.org.mt/files/7d564706-002e-4c9c-a22f-8d5be2fb2824_d5614dfe-c9a9-4ee1-bc5e-577aefa94bfc.pdf

rainwater collected in cisterns for secondary domestic uses. In a country with water scarcity and significantly dependent on energy intensive reverse osmosis for its potable water requirements, such a scheme although not directly leading to energy savings at dwelling level, can have an energy savings impact on the territory's final energy consumption. Over the last three years a total of 32,727m³ of water cistern volume was restored.

Energy Incentives for Vulnerable Households

Broadly addressing plug load energy consumption, as discussed in the National Energy Efficiency Action Plan, 2017, *'A measure was introduced whereby technical personnel from the Energy & Water Agency visit vulnerable households to raise awareness on energy usage and provide energy saving tips. The visit shall determine whether key appliances are in need of replacement with more energy-efficient appliances. The target is to replace appliances in a number of vulnerable households annually, achieving cumulative savings of 973 MWh.'*

Private Investment – Soft Loans

All leading banks in Malta offer soft loans targeted specifically for green or energy efficiency investments (*e.g.* photovoltaic systems, solar water heaters, green energy products, insulated glazing units, *etc.*). Such loans typically consist of unsecured loans with low interest rates, typically covering purchases of between few hundreds to few tens of thousands Euros, specifically aimed at mobilizing capital into the sector, thus ensuring that appropriate financing is available at affordable rates. More details about the specific products available on the market can be found in Section 5.3.2.

4.2 Existing Policies and Measures – Non-Residential Building Sector

Financial Incentives and Grants – Malta Enterprise

Between 2016 and 2017 two incentives were launched by Malta Enterprise to assist business in becoming more energy-efficient.

Both in collaboration with the Energy & Water Agency a first incentive was aimed at assisting businesses with an annual electricity consumption in the range of 10,000-75,000 kWh to carry out an Energy Audit with the scope of identifying and prioritizing actions that would lead to improving energy performance, reducing energy waste and obtaining related environmental benefits⁴⁷. The budget available for this scheme was of 100,000

⁴⁷ Scheme for Energy Audits. Malta Enterprise. Information available from:

<https://www.maltaenterprise.com/new-scheme-energy-audits>

Euros. A second incentive was aimed at assisting undertakings to invest in cogeneration equipment⁴⁸. The budget available for this scheme was of 5 Million Euros.

Financial Incentives and Grants – ERDF Grants

A good number of buildings/facilities were renovated via the use of ERDF funding. Most of these projects involved the installation of photovoltaics or solar water heaters on the buildings' rooftops, however some also included some other renovation aspect such as the installation of intelligent lighting systems⁴⁹. A completely different approach was adopted by the Neptunes and Waterpolo Swimming Club whose project⁵⁰, apart from a photovoltaic installation entailed the supply, delivery, installation, testing, commissioning and certification of a Combined Heat and Power system for pool water heating, thus reducing reliance on traditional sources of energy and achieving significant improvements in energy efficiency.

Educational Campaigns

Educational campaigns have been ongoing at every level on a regular basis, targeting specific energy users such as the residential sector, SMEs and non-SMEs. In the latter case this was often done with the help or through the full involvement of constituted bodies such as the Malta Chamber of Commerce, the Malta Hotels and Restaurants Association and the General Retailers and Traders Union (Malta Chamber of SMEs).

Energy Efficiency in the Tourism Sector – Hotels

The Malta Hotels and Restaurants Association, the local constituted body for hotels and restaurants has been a front runner in driving energy efficiency through to its members. Apart from educational campaigns and seminars as discussed in the National Energy Efficiency Action Plan, 2017, *'MHRA in conjunction with Office of the Prime Minister (Energy and Projects) and the Energy & Water Agency has just launched BEST (Benchmarking Energy Sustainability Targets) – a programme aimed at establishing the local hotel sector as a leader in energy efficiency in the Mediterranean. The project will include a Reward Scheme that will allocate funds for future Energy Efficiency Projects undertaken by hotels based on a points system accrued by achieving benchmarking*

⁴⁸ Investment Aid for High Efficiency Cogeneration. Malta Enterprise. Information available from: <https://www.maltaenterprise.com/support/investment-aid-high-efficiency-cogeneration>

⁴⁹ <https://investinyourfuture.gov.mt/>

⁵⁰ ERDF 277: Neptunes Renewable Energy Generation Project. Information available from:

<https://investinyourfuture.gov.mt/project/environment-climate-change-and-renewable-energy-sources/neptunes-renewable-energy-generation-project-50167810>

targets of energy key performance indicators. The project will set off with a study to establish benchmarking categories for like hotels and to establish the KPI criteria. A software will be created to allow the hotels to upload and monitor their performance which will also be normalised to take into account environmental parameters such that year on year analysis will be relevant. The software will also provide information that can be downloaded from the project website which will assist in drawing up energy efficiency policies and create awareness training. A software technology tool will be included that will assist hotels to analyse the return on investment of applying different energy efficiency technology projects.'

4.3 Existing Policies and Measures – Public Buildings

Energy Savings Investment in Public Buildings

This part has already been addressed in Section 3.4 (Sub-Section *Renovation projects already carried out in the public sector*).

4.4 Existing Policies and Measures Targeting the Quality of the Building Industry

Over the years Malta has created or is in the process of creating a certified workforce related to the building industry. Apart from the traditional professions, such as that of an architect, civil engineer, mechanical engineer, *etc.* which always required the person to have an university degree for professional recognition, a number of other trades and activities have had to be given specific training in the form of continuous professional development (over and above their formal qualification) to ensure that the proper standards and good workmanship are adhered to. This has been the case of renewable energy systems installers, energy auditors and energy managers. In addition to this, and as described in Section 2.7.1, the introduction of the Construction Industry Skill Card for certain trades will go a long way in improving workmanship, possibly also improving awareness about renewable energy sources and energy efficiency in buildings.

It should also be mentioned that only persons warranted as architects or engineers, and who have attended a compulsory training course (*incl.* examination) are eligible to act and register as '*Energy Performance of Buildings Assessors*' in Malta. These, similarly to what happens in other countries are responsible for issuing *Energy Performance Certificates* together with recommendations for improving the energy performance of buildings.

4.5 Future Policies and Measures

Residential Sector

As shown from both Table 8 and Table 9 (the delivered energy consumption for existing

and new residential buildings) the energy demand due to domestic hot water requirements is a significant part of the total energy load. Incentives to promote solar water heating has had mixed results, primarily because such an investment is often seen in competition (for space if this is at all available, and capital investment) with photovoltaic systems, and the expectations in terms of supply-demand are often mis-matched. Also, given the typical hard water present in the Maltese Islands, there are concerns on the real useful lifetime of such system, and potential payback especially for small households. Based on the National Census of Population and Housing 2011, around 90% of occupied dwellings still rely on electric water heating for their hot water requirements compared to around 10% which rely on solar water heating. For these reasons one of the incentives which has recently been launched is a grant for the purchase of air-to-water heat pumps. A completely different technology from solar water heating, but which given its high efficiency could yield significant energy-savings. The grant scheme⁵¹ aimed at the residential sector pays 40% of the initial investment costs, up to a maximum of €400.

Non-Residential Building Sector

Currently most of the efforts being carried out to improve the non-residential building category are a result of a number of Energy Audits being carried out. So far apart from getting a snapshot of the current energy usage, these audits have also resulted in a number of voluntary agreements with non-SMEs, encouraging them to invest in energy-efficient measures. As discussed in the National Energy Efficiency Action Plan, 2017, it is expected that such voluntary agreements will be extended to SMEs as well.

⁵¹ Heat Pump Water Heater Grant Scheme – Guidelines. Information available from:
http://downloads.rews.org.mt/files/39fa411b-7017-4744-baf8-4f016ad7a125_6579be8f-f362-4596-8529-2403b7cbf4ab.pdf

5 FORWARD-LOOKING PERSPECTIVE TO GUIDE INVESTMENT DECISIONS

5.1 *Guide to Investment in the Residential Sector*

As had been discussed in the previous strategy, and similarly in this one, compared to its European counterparts, given the relatively mild climatic conditions particular to the Maltese Islands, Maltese dwellings have a final energy consumption which is comparatively much lower. This renders most traditional energy efficiency measures, such as improving the building fabric, effective in terms of reducing energy demand, but cumulatively not necessarily cost-effective, if not on the medium-long term.

In this context, space conditioning heating demand is not of such a significant magnitude to justify investment in district heating, and modular cogeneration units can only possibly be cost-effective in specific high-density multi-apartment blocks, of which currently only a small number exists. Also, improving the building fabric, specifically providing roof insulation and replacing single glazing with double glazing units will, as expected, reduce energy consumption, but depending on the extent of space conditioning used in a particular dwelling the payback period may be a lengthy one. Improving the energy efficiency rating of old air conditioning units may be a more cost-effective measure in terms of reducing the energy demand.

In addressing the domestic hot water energy demand, the main measure promoted has been the use of solar water heating systems. Where supply-demand are adequately matched (*e.g.* households with 3+ members), solar water heating systems can be a very cost-effective measure, however for smaller households the investment again can be a lengthy one to recoup, provided also, that space is available for the installation of such a system. In this regard, the use of energy-efficient air-to-water heat pumps (where supply-demand can be better matched) could be very useful in providing hot water in a more energy-efficient manner.

Lighting demand is known to be a minor energy load in dwellings, also given the fact, that the 2009 scheme to replace incandescent light bulbs with compact fluorescent lamps was very successful in educating the general public, and shifting usage (and purchasing) patterns towards energy-efficient lighting.

Driven by the lowering of the associated capital costs, and coupled with the fiscal incentives (capital grant and FIT) which have been given over the last few years, the use of photovoltaics is as expected the main measure (and publicly most accepted) in

reducing energy demand in the residential sector. Notwithstanding this however, as has already been explained, the limited land space available (and the competition with other uses), the lack of solar right and roof space ownership issues, is a significant barrier to further exploitation of such a resource. To a certain degree this aspect is being addressed through the recent introduction of communal photovoltaic farm scheme⁵² (a contractually linked off-site investment in photovoltaics), specifically design for household residents, not having access by means of a valid title and right to roof space for the purposes of installing a photovoltaic system.

5.2 *Guide to Investment in the non-Residential Sector*

Guiding investment in the non-residential sector is more diverse, as it depends specifically on the type of sector, or building category, and on the major load which requires addressing.

Generally, however, buildings such as high-end offices, hotels, hospitals or retirement homes, where space conditioning is of a continuous nature, improving the building fabric whenever possible to include high efficiency building elements (low U-value) and reduce the solar heat transmission of glazed areas (by utilising double glazing having a low G-value or solar films) can be recommended as the continuous nature of the reduced space conditioning load, would result in a low payback period.

Similarly improving the energy efficiency of the air conditioning system results in significant energy savings. Based on the cost-optimal report for offices, split-unit air conditioning (inverter) type or VRF technology are the preferred technologies for the different types of office building present in the Maltese market. For buildings utilising all air systems (given their ventilation requirements), the preliminary reports which will form the basis for the cost-optimal studies for these building categories, indicate that in terms of energy savings VAV technology (as part of a renovation package) is the preferred technology.

In regards to building categories, which offer some form of residency, *e.g.* hotels, retirement homes and hospitals, important consideration should be given to the hot water system; this being the predominant energy demand. In this case, the preliminary reports which will form the basis for the cost-optimal studies for these building categories,

⁵² Communal PV Farm Scheme 2017 Guidelines. Information available from:

<https://energywateragency.gov.mt/en/Documents/Guidelines%20for%20Applicants%20Communal%20PV%20farms%202017.pdf>

indicate that substantial energy savings may be obtained by utilising an air-to-water heat pumps working in tandem with a combi-solar system.

The use of energy efficiency lighting is also considered as a measure which in non-residential buildings, can yield significant energy savings, potentially with the highest return on investment⁵³.

5.3 Financing of Energy Efficiency Measures in Buildings

As had been the case in the previous strategy, financing mechanisms available for providing energy efficiency in buildings, revolved around either government driven fiscal incentives, some of which partially funded through ERDF funding, and local private banks providing loans with favourable terms and conditions specifically aimed at financing investment of energy efficiency products.

5.3.1 Government Support Schemes

Residential Sector

At residential level Government funding has mainly been aimed at providing fiscal incentives for the purchase of energy efficiency products, namely solar water heaters, photovoltaics, double glazing apertures and roof insulation (*vide* Section 4.1 for more details). A grant on the purchase of air-to-water heat pump has also been recently launched (*vide* Section 4.5 for more details).

Whereas the photovoltaic scheme has been fully subscribed for a number of times, a point is quickly being reached where within the residential sector, all the ‘*easily*’ available space is being taken up, and the remaining sites are not as favourable in terms of their photovoltaic potential (*e.g.* due to issues related to site orientation or shading from adjacent buildings) or indeed the roof space is not accessible for such investments.

The other schemes have been not so successful. Here the main barriers are thought to be the confidence people have in getting a good payback for their investment, and the reluctance in making physical alterations to the building, in the case of changes to the building fabric.

⁵³ ‘*Investing in Energy project presentation on Non-SME findings relating to costs of energy audits and recommendations arising*’, Energy Efficiency for Business & Industry Conference, Bernard Mallia, 2017. Available from:
<http://mbb.org.mt/wp-content/uploads/2017/07/Economist.pdf>

In addition to this, as part of a retrofitting scheme aimed at the restoring Grade 1, Grade 2 and buildings situated in Urban Conservation Areas, funds were also made for the ‘green’ retrofitting of such buildings. This, as already discussed has been fully subscribed (*vide* Section 4.1 for more details).

Non-Residential Building Sector

Schemes to improve energy-efficiency in building categories other than residential have mainly focused on ERDF funding being made available together with local funding. Over 35 buildings, received EDRF funding for the implementation of energy efficiency measures⁵⁴. Apart from ERDF funding, funding for energy efficiency was also made available through Malta Enterprise for the conduction of Energy Audits, and the purchase of cogeneration equipment for the reduction of the final energy consumption associated with heating (*vide* Section 4.2 for more details).

5.3.2 Selected Domestic Bank Products on the Market

A number of local banking operators offer loan facilities and banking products specifically aimed at facilitating the purchase and installation of energy efficiency products. An updated list⁵⁵ of such products include:

- *ECO Personal Loan* (Bank of Valletta)⁵⁶. Finances the purchase of environmentally-friendly equipment.
- *EcoPlus* (APS Bank)⁵⁷. Finances the investment of solar water heaters and photovoltaic installations for both domestic home owners and businesses.
- *BNF Bank Green Energy Loan* (BNF Bank)⁵⁸. Finances clients who wish to buy a range of environment friendly products.
- *Green Loan* (HSBC Bank)⁵⁹. Finances a range of environmentally friendly initiatives and energy saving products.

⁵⁴ <https://investinyourfuture.gov.mt/projects/environment-climate-change-and-renewable-energy-sources-16842756/?lang=en>

⁵⁵ Other banks and financial institutions may offer loan schemes which can be used for the purchase of energy efficiency products, but are not specific energy efficiency financing loans.

⁵⁶ <https://www.bov.com/content/eco-loan>

⁵⁷ <https://www.apsbank.com.mt/en/green-loans>

⁵⁸ http://bnf.bank/green_energy_loan?l=1

⁵⁹ <https://www.hsbc.com.mt/1/2/mt/en/personal/latest-promotions/green-loan>

5.3.3 Future Measures

Government through Malta Enterprise is to introduce a scheme for energy efficiency improvements in industry. Through this scheme energy various categories within the service and industrial sectors will be given funding in the form of financial instruments based on tax rebates, to enact energy efficiency measures. The scheme, to be administered by Malta Enterprise with the technical support of the Energy and Water Agency, will reward those actions that achieve most energy savings. Projected cumulative savings till 2020 are 100 GWh⁶⁰.

⁶⁰ National Energy Efficiency Action Plan Malta, 2017

6 EXPECTED BENEFITS FROM RENOVATION OF BUILDINGS

The most obvious and direct result emanating when (energy) renovating buildings is of course the reduction in energy consumption, both at an individual level, whereby consumers consume less energy and hence pay less for their energy requirements, but also on a national level, whereby less energy consumed could possibly imply less reliance on imported fossil fuels for the production of energy, and less infrastructural upgrade requirements. Other additional benefits however may also be obtained. These include a direct reduction in CO₂ (and other pollutants) emitted, creating the potential for better thermal comfort in certain type of building typologies, and the creation of new jobs in the construction industry, *etc.*

Some type of renovation measures, such as the restoration of domestic water cisterns are also multi-themed, reducing the energy required for the production and distribution of second class water, reducing the abstraction rate required from a finite resource such as the available ground water, and relief from storm water flooding.

6.1 Energy Savings

Residential Sector

As discussed in detail in Section 3.2, notwithstanding the low final energy consumption of residential buildings, renovating an existing dwelling to make it compliant with the energy demand expected from a new building, implies cutting the energy demand of that dwelling by approximately half.

Based on the current renovation trends, and assuming that as legally required, buildings undergoing renovation will be renovated to the level required by new buildings, it is expected that by the year 2030, the total cumulative savings would have reached 4,591 *toe* (53.4 GWh) of delivered energy saved, and over 11,000 dwellings renovated. Assuming a Primary Energy Factor of 2⁶¹, the total primary energy saved from the residential sector alone would be equivalent to 9,182 *toe* (106.8 GWh).

⁶¹ Up till the previous strategy the Primary Energy Factor was assumed to be 3.45. As discussed in the 2017 NEEAP ‘*Two major objective of Malta’s Energy Roadmap was reducing the carbon footprint and greenhouse gas emissions of the country through improved efficiency in generation capacity, and overhauling the generation capacity of the country with a view to achieving higher efficiency gains. Malta has closed down the inefficient Marsa Power Station; completed and placed in operation the 200 MW interconnector with the European grid; and commissioned a new 215 MW Gas-Fired high efficiency combined cycle gas turbine (CCGT)*

Non-Residential Building Sector – Public Buildings

As has been discussed earlier in this report, substantial data specifically covering building categories other than residential is still being collected, or is in the process of being analysed. For this reason, only certain building categories can be described using a certain degree of detail. Considering the ‘*Energy Audits carried out on Public Buildings*’, described in Section 3.4, the estimated potential savings per annum for the 50 audited buildings amount to a cumulative 2.6 GWh/annum if renewable sources of energy are exploited or 1.1 GWh/annum if the renovations carried out exclude the use of renewable sources of energy. Assuming a Primary Energy Factor of 2, the total primary energy saved from fully carrying out the renovations recommended in the Energy Audits would account to 5.2 GWh or 2.2 GWh of primary energy savings per annum, respectively if renewable sources of energy are utilised or not. In the latter case the renovations would be mainly related to replacement of inefficient of air conditioning units, installation of energy efficient lighting and better systems control.

Non-Residential Building Sector – Other Buildings

Specific and detailed energy savings for other building categories is not possible in this current report. Based on the data available thus far, it can be however inferred that certain building categories can too achieve significant energy savings, provided that the right conditions exist. On an individual basis, preliminary studies have shown that some non-residential buildings can be renovated to obtain around 50% energy savings compared to current energy consumption. Such a value however is not inclusive of the financial aspect, but is merely based on a best case technical scenario which does not consider cost-optimality.

It is envisaged that a more detailed analysis on the energy savings which can be obtained from the different building categories will be available in the next updated strategy.

6.2 Reduction in CO₂ Emissions

Energy savings can lead not only to lower utility costs, on the building owner side, but also to lower CO₂ emissions. As has been discussed in Section 2.8.2 (*Energy Use in the Residential Sector*) and Section 2.8.3 (*Energy Use in the non-Residential Sector*), electricity accounts to a significant chunk of the energy consumed in buildings.

power plant as well as infrastructure for the provision of natural gas (LNG) in 2017. In addition, the recently built 144 MW power plant has been converted to run on natural gas instead of on heavy fuel oil. The Distribution System Operator (DSO) executed a number of upgrades in its Distribution Centres to consolidate the national electricity distribution grid.’

Residential Sector

Based on the savings quantified in Section 6.1 (*Energy Savings: Residential Sector*), and considering an end-use emission factor for the electricity network of 0.4914 kgCO₂/kWh, it is estimated that the 53.4 GWh cumulatively saved over the period 2017-2030, will lead to around 26,241 tCO₂ saved (equivalent to around 1,874 tCO₂ saved per annum). Such savings assume the current renovation rate (and assumed growth over the period 2017-2030), and renovations related to changes in the building fabric and services replacement alone (savings from RES are excluded).

Non-Residential Building Sector – Public Buildings

Based on the savings quantified in Section 6.1 (*Energy Savings: Non-Residential Building Categories – Public Buildings*), and considering an end-use emission factor for the electricity network of 0.4914 kgCO₂/kWh, it is estimated that the potential savings from the renovation of public buildings as per Energy Audits recommendations could lead to around 1,278 tCO₂ saved per annum if renewable energy sources are included or 541 tCO₂ saved per annum if renewable energy sources are not included in the renovation strategy.

6.3 Additional Benefits

Improvement in Thermal Comfort & Health

Improving the energy performance of buildings, through for example, improvements in the building fabric, in most cases leads to a direct improvement in the thermal comfort of building occupants, which in turn could lead to a reduction in lost working days due to ill health and a lower stress on the State's health service.

Considering two particular examples:

- *The installation of double glazing instead of single glazing in a number of public schools, not only had the aim of improving the energy efficiency of buildings, but also to improve the thermal comfort of students.*
- *The installation of CHP unit in a privately run water polo and swimming club, as part of an energy retrofitting exercise enabled the facilities to be used during the winter months as well, with obvious direct results on the wellbeing of its users.*

Apart from this, the reduction in energy demand leads to a direct reduction in CO₂ emissions and other pollutants which may reduce the acceptability of air.

Social Dimension

Energy use comes at a cost, and improving the energy efficiency of buildings especially for the most vulnerable sectors of society goes a long way in improving the social dimension. In this context and as part of its efforts towards improving energy efficiency, the scheme addressing ‘*Energy Incentives for Vulnerable Households*’ described in Section 4.1 is a step in the right direction in improving the existing situation, and making sustainable comfortable homes a possibility for vulnerable sectors of society.

Re-sale Attractiveness of Renovated Buildings

Renovating an existing building is a potential way of increasing the attractiveness for re-sale of a building to prospective buyers or to improve its rental potential. This applies for both the residential and the commercial sector especially with the advent of international corporations, requiring the use of high-end offices. Renovation could also lead to higher property valuations.

New Avenues for Employment

If one considers the renewable sector alone, it becomes immediately clear how a new market segment was created. This has led to a number of jobs being created, including the associated educational and teaching requirements, required for the execution of such jobs.

Similarly, the specialised renovation of building could lead to increased employment, and to the creation of jobs in new niche markets at a multitude of levels, including in the manufacturing, supply and installation of products and services related to renovation.

Reduction in Infrastructural Costs

A good example of how the renovation of buildings might lead to reduced infrastructural costs is the restoration of domestic water cisterns for the collection and reuse of rainwater for use as second class water.

Apart from a direct reduction in energy use for the production of water required for mains supply and delivery, reducing surface runoff leads to reducing the chances of flooding and the infrastructural requirement of enlarging existing storm water culverts.