

Estimation of the Energy Saving Potentials in Residential, Commercial and Service Sectors of Cyprus

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An overview

In the framework of SRSS/S2016/002 project, the following energy saving potential was estimated:

- the theoretical (technical) energy saving potential and
- the economically viable energy saving potential on:
 - (a) residential sector (buildings),
 - (b) service sector (commercial buildings) and
 - (c) industrial sector in Cyprus.

In this presentation the methodology for the estimation of the aforementioned energy saving potentials and the final results are presented.

Residential sector - Theoretical

The theoretical (technical) energy saving potential for the residential building sector is defined as:

“the amount of the current energy consumption that will be saved if the existing residential building stock is upgraded to nearly zero energy buildings based on the provisions of decree 366/2014”

This potential was estimated in terms of percentage reduction in:

- (a) heating energy consumption,
- (b) cooling energy consumption,
- (c) energy consumption for domestic hot water production and
- (d) electricity consumption for lighting and appliances

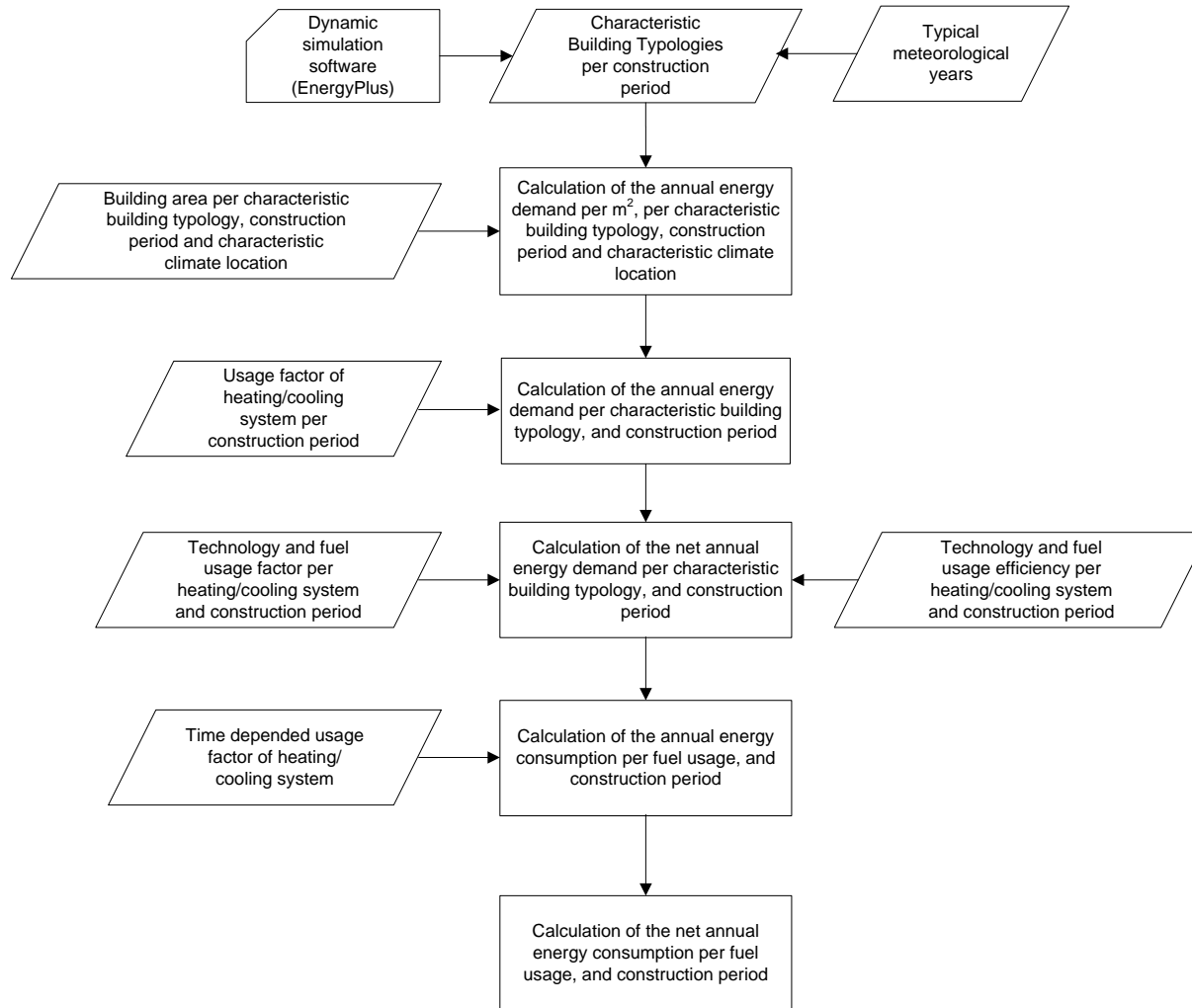
Residential sector - Theoretical

assuming the gradual penetration of the following technologies:

- High efficiency heat pumps for cooling in all buildings
- 90% High efficiency heat pumps + 10% high efficiency boilers for heating in multi-family buildings, located in urban and rural areas
- 80% High efficiency heat pumps + 20% high efficiency boilers for heating in single family buildings located in urban areas
- 50% High efficiency heat pumps + 50% high efficiency boilers for heating in single family buildings located in rural areas.

Residential sector - Theoretical

In order to achieve this the 3EP-CUT group developed and validated the “Energy Estimation Model for Residential Sector - 2EMRS”.



Residential sector - Theoretical

The model uses four characteristic residential building envelopes of the current building stock of Cyprus which are:

- (a) a single-family house
- (b) a two storey house
- (c) a detached house and
- (d) a multi-family building

In four characteristic construction periods:

- (a) before 1970
- (b) 1971-1990
- (c) 1991-2007
- (b) 2008-now

Residential sector - Theoretical

The characteristics of each building envelope have been selected according to the construction practice of each period, resulting in 28 different envelopes in total.

These envelopes have been simulated using the EnergyPlus software in 3 different climate zones of Cyprus:

- (a) coastal zone (Limassol)
- (b) mainland zone (Nicosia)
- (c) mountainous zone (Saittas)

resulting in 84 different case-studies overall.

In order to estimate the theoretical energy saving potential for the residential sector two series of simulations are needed (168 case-studies in total).

Residential sector - Theoretical

Based on the energy simulation results and taking into consideration proper weighting factors regarding the use of:

- heating/cooling system per construction period,
- technology and fuel per heating/cooling system
- efficiency per technology and fuel per heating/cooling system
- time depended use of heating/cooling system

which was retrieved from the:

- (a) final energy consumption survey for residential sector performed by CYStat,
- (b) energy balance of Cyprus between 2010-2015 developed by 3EP-CUT
- (c) building construction survey performed by CYStat,

the 2EMBS model estimates the final energy consumption of the residential sector of Cyprus.

Residential sector - Theoretical

The following table summarizes the theoretical (technical) energy saving potential for the residential building sector

Heating				
Electricity	Diesel	Kerosene	LPG	Biomass
66.2%	100.0%	100.0%	36.2%	100.0%
Cooling				
80.3%				
DHW				
26.2%	100.0%	100.0%	27.1%	100.0%
Lighting and Appliances				
55.0%				
Overall				
60.1%	100.0%	100.0%	35.6%	100.0%
Overall reduction equal to 67.4% (based on fossil fuels' balance) or 51.3% (accounting RES production)				

Commercial sector - Theoretical

As with the residential sector, the theoretical (technical) energy saving potential for the commercial building sector is defined as:

“the amount of the current energy consumption that will be saved if the existing commercial building stock is upgraded to nearly zero energy buildings based on the provisions of decree 366/2014”

Due to the significant diversity of building types, pattern uses, equipment etc., as well as the lack of an adequate existing model, this analysis was performed with the aid of:

- in-situ visits of CUT personnel and interviews with the energy managers of large facility owners, such as banks, hotels and office blocks;

Commercial sector - Theoretical

- interviews with directors of energy management companies;
- data provided by local companies that are highly involved with the design, construction and maintenance of facilities;
- data provided by MECIT retrieved by previous analysis of the Service sector;
- the findings of the JRC study “Energy Efficiency: Technical Assistance in the framework of the directive 27/2012/EU for the assessment of the potential for the application of high efficiency cogeneration and efficient district heating and cooling in Cyprus and identify measures to exploit it a cost effective manner” that was conducted in 2016.

Commercial sector - Theoretical

The following table summarizes the theoretical (technical) energy saving potential for the commercial sector

Fuel	Savings
Electricity	73.0%
Gas oil	100.0%
LPG	-115.2%
Kerosene	100.0%
Light fuel oil	100.0%
Biomass	60.0%
<i>Overall</i>	<i>64.7%</i>
Solar & Recovery	-35.6%

Industrial sector - Theoretical

The theoretical (technical) energy saving potential for the industrial sector is defined as:

“the amount of the current energy consumption that will be saved if industrial plants upgrade and/or replace their equipment and install high efficiency one which is available in the market.”

Due to the significant diversity of industries, pattern uses, process and equipment use, as well as the lack of existing data, the analysis was based on:

- in-situ visits of CUT personnel and interviews with the energy managers of the following plants:
 - (a) cement industry,
 - (b) food and beverages,
 - (c) water supply,
 - (d) plastics,
 - (e) building material industry.

Industrial sector - Theoretical

- data provided by local companies that are highly involved with the design, construction and maintenance of industrial equipment.

Based on the available collected data the main fuel that the industries are using is electricity.

The results show that the theoretical (technical) energy saving potential in industry is 34% for electricity and 5% for fuel oil and gas oil (weighted average ratio).

Economically Viable Potential

Residential sector - Economically Viable

According to the analysis results of the theoretical energy saving potential the following energy interventions should be the priority in order to improve the energy efficiency of the current residential building stock:

- (a) insulation of the horizontal elements (roof, ceiling, etc.)
- (b) insulation of the vertical elements (reinforced elements, masonry)
- (c) installation of shading devices
- (d) high efficiency windows (frame and glasses)
- (e) installation of LED lighting bulbs
- (f) high efficiency heat pumps
- (g) solar thermal collectors
- (h) high efficiency boilers (in rural areas)

Residential sector - Economically Viable

The JRC study on “Building stock in Cyprus and trends to 2030” have shown that under Scenario 1 which integrative policies recognized as particularly appropriate to the Cyprus context the total expenditure in renovations is about 450-500 million €

Taking into consideration the average intervention costs for fully intervention and individual interventions per dwelling an overall of 65,000 interventions are foreseen.

Residential sector - Theoretical

Based on these assumptions and using the CUT-2EMRS model the economically viable energy saving potential for the residential building sector was estimated

Heating					
Electricity	Diesel	Kerosene	LPG	Biomass	
-2.7%	14.4%	12.7%	2.0%	12.2%	
Cooling					
9.9%					
DHW					
-22.1%	20.9%	35.6%	20.7%	49.8%	
Lighting and Appliances					
3.9%					
Overall					
4.8%	15.2%	14.1%	3.2%	13.6%	
Overall reduction equal to 7.4% (based on fossil fuels' balance) or 5.2% (accounting RES production)					

Commercial sector - Economically Viable

According to the analysis and results of the theoretical energy saving potential as well as the review of the existing literature the following energy interventions should be the priority in order to improve the energy efficiency of the current commercial building stock:

- (a) insulation of the horizontal elements (roof, ceiling, etc.)
- (b) installation of shading devices
- (c) insulation of the vertical elements (reinforced elements, masonry)
- (d) high efficiency windows (frame and glasses)
- (e) installation of LED lighting bulbs
- (f) high efficiency heat pumps

(in all subsectors)

Commercial sector - Economically Viable

In Hotel and Lodges

- (a) heat recovery from cooling systems
- (b) heat pumps for HW
- (c) solar thermal collectors
- (d) solar cooling
- (e) CHP+trigeneration

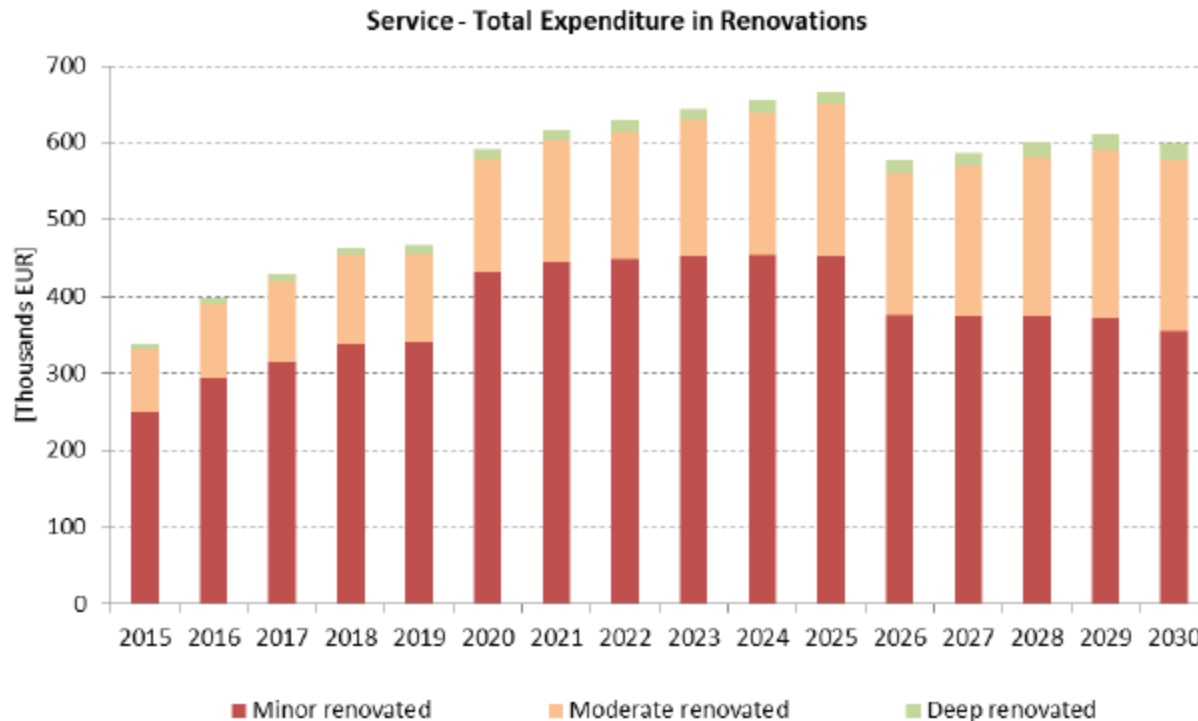
In Health facilities

- (a) heat recovery from cooling systems
- (b) heat pumps for HW
- (c) solar thermal collectors
- (d) solar cooling

- (e) CHP

Commercial sector - Economically Viable

The JRC study on “Building stock in Cyprus and trends to 2030” have shown that under Scenario 1 which integrative policies recognized as particularly appropriate to the Cyprus context the total expenditure in renovations is about 7.5-8.0 million €



This is an extremely low expenditure amount and budget for EE measures in the service sector, would lead to relative low savings

Commercial sector - Economically Viable

Considering the current and foreseen expenditures during the period until 2020, it was assumed that an average annual total expenditure for energy efficiency interventions for both public and private buildings in the service sector of around 25-30 mil EUR should be regarded as realistic for the period until 2030 if an appropriate mix of instruments and policies are in place.

Based on that and taking into consideration specific potentials that came out during discussions with the consultants, energy managers and owners of specific facilities, a potential of 6% was considered as realistic.

On top of this, an additional amount of electricity savings at the range of 2.4% were assumed for the same period, in order to take into account the foreseen replacement of all street lighting.

Industrial sector – Economically Viable

According to the analysis and results of the theoretical energy saving potential the following energy interventions should be a priority in order to improve the energy efficiency of the industrial sector:

- (a) high efficiency electrical motors
- (b) inverters
- (c) automations
- (d) heat recovery
- (e) installation of LED lighting bulbs
- (f) installation of energy efficient compressed-air systems
- (g) CHP

Industrial sector – Economically Viable

As agreed during meetings between MECIT and the study group, the economic potential for the industrial sector is defined as:

“the amount of the current energy consumption that will be saved if industrial plants upgrade and/or replace their equipment and install high efficiency one which is available in the market based on their economic capability/programming”

Based on that and taking into account the results of the discussions with the energy managers of the specific industries, the economically viable energy saving potential for the industrial sector is estimated to 6.2% in electricity and 0.5% for fuel oil and gas oil.

**Thank you very much for your
attention and contribution!!**