Open University of Cyprus

Faculty of Sciences and Applied Sciences

Sustainable Energy Systems (SES)

Energy Efficiency and Decarbonisation of a small or medium Enterprises

Theodotos Argyrou

Professor:

Dr. Efrosini Giama

May/2021

Open University of Cyprus

Faculty of Science and Applied Sciences

Sustainable Energy Systems (SES)

This postgraduate thesis has been submitted to partially meet the requirements for obtaining a master's degree in the program of

Sustainable Energy Systems (SES)

Which offered by the Faculty of Sciences and Applied Sciences

Open University of Cyprus.

May/2021

Summary

Small and Medium Enterprises (SMEs) named business that have a certain restrictions on employee number, financials number and usually are family enterprises. Also, SME can separate into medium-sized business, small business and micro-sized business according to personnel or annual revenue of enterprise. According to their purpose SMEs divided into technical, hybrid, instructional, factional and sentinel. Furthermore, due to the fact that economics around the world support young entrepreneurship to develop a portfolio for new enterprises, year by year SME number increasing around the world. Educated young people prefer to benefit from funds and try to begin a new business than working under a large enterprise with minimum advantages. SMEs usually provide the knowledge and expertise in specific subjects, business area or technical area for a project/program

Last decades high energy demands and increasing consumption worldwide of electricity and energy demand, create an adjective for SMEs in the sector of expenses. SME try to find solutions to reduce their expenses and many of them try to implement an Energy Management System (EMS) to improve energy efficiency and reduce carbon footprint. Decarbonisation strategies and energy saving measures can change behavior of personnel and consumptions of enterprise.

At this thesis, main points are energy efficiency improvement possible solutions with the aid of EMS. Analyze of the most famous EMS about energy efficiency that is ISO50001. Moreover, decarbonisation strategies and possible solutions with a target the reduction of CO2 emissions at enterprises reported. Furthermore, barriers and benefits of those solutions mention. All of the above in thesis are mainly were recorded with analyze of European Union targets and long-term objectives, Cyprus SMEs and Swedish industrial SMEs.

Lastly, a case study with electricity consumption, equipment and suggestions to improve energy efficiency of a SME which interest and produce in the sector of coffee, food and frozen products.

Contents

1. Introduction

Linking climate change with challenges of economic crisis with worldwide energy needs render important efforts to improve energy efficiency. Energy efficiency and Renewable Energy Sources (RES) is the path for a sustainable environment with a low-carbon percentage. Increasing of energy savings under reliable measures in respect with the needs of modern lifestyle is necessary. Moreover, to achieve specific targets about social and environmental patterns, mentality and behavior of citizens require changing at all levels. All those parameters will help people to understand the energy usage, reduce energy consumption, reduce carbon emissions and improve quality of life at working and residential environment. In addition, this phenomenon, with innovative technological and friendly solutions about environment supports economic of each country with the creation of new jobs and competitiveness of economy. Energy efficiency improvements and opportunities sometimes are not suitable and differ from enterprise to enterprise. An average SME can reduce energy bill from 18-25% with average payback of 2 years. Possible savings will prepare will zero capital cost. If SMEs were a country, they would ranks in the world in terms of energy use, behind only China and United States of America.

Europe illustrates at 2010 a comprehensive strategy. Countries require to improve their energy efficiency, changing their citizen's behavior and following strategies for a sustainable and environmental friendly continuously growth. Main target of strategies assume that until 2020 all European Union state members will cover electricity needs of 20% by RES, reduction of greenhouse gas emissions (GHG) at least 20% and improve of energy efficiency by 20%. Targets that set by European Commission within the framework of Paris Agreement include specific results until 2030. Energy consumption from RES must be 32% and energy efficiency improvements must be at least 32.5% and reduction of GHG emissions at least 40% to change phenomenon of climate change. European Union (EU) primary energy consumption is not presents the targets that taken by European Commission. For this reason, each country that is not regulate under the district terms and conditions that set for a sustainable environment will punish with penalty.

2. Decarbonisation strategies for SMEs

Greenhouse emissions related with negative impacts for a SME sustainability and environmental behavior. Beginning of new revolutions, create opportunities for enterprises to reconstruct their behavior with innovative technologies and projects. Development of low carbon technology for example for subsidies fossil fuel can replace by zero carbon dioxide emission technologies. Decarbonisation plans especially in case of EU business sector include:

- Search for new alternatives to replace carbon dioxide technologies
- Developing and implement constructions and projects with zero carbon solutions
- Explore and develop zero carbon technologies, promoting diversification and reducing risk of early and risky choices
- Emphasize system level innovation so that the individual elements of decarbonisation fit together.
- Focus on Research & Innovation (R&I) investments in the high added value segments of the value choose

Those actions should combine at different period of time and each particle requires different approach. Horizon separates into three different terms, short-term, medium-term and long-term. Depend on the target that is set for each program the technology approach differ.

Decarbonisation is presented as the need to minimize emits of CO2 emission globally. Example is often the high temperatures or chemical process that industries use. Decarbonisation in industry or SME defines as a difficult procedure because carbon not only includes into fuels but also carbon is use as a raw material or plays a crucial role in the chemical transformation reactions. Carbon use as a source of energy and as a feed-stock which is what makes these industries difficult to decarbonize. Industries especially at the last decades use innovative, effective and sustainable procedures to produce electricity and then transfer this environmental behavior into SMEs. [6]

1) Electrification of heat => Furnaces are powered by electricity instead of burning fuels, always has to be renewable electricity.

2) Use of hydrogen as fuel in furnace or as a feed stock in chemicals or as a reactant in chemical process.

3) Use of biomass as a fuel or feed stock. Replaces coal with bio coal and gas with biogas.

4) Carbon capture and storage: GHGs are separated from other industrial gases. Then compressed and pumped into the ground so that they are not released in the atmosphere.

5) Carbon capture and usage: Process that aims to transform industrial gases into something useful, for example ethanol or raw materials that can be used in chemical industry.

2.1. Practices to reduce Greenhouse Gases (GHG) emissions and Carbon Footprint

Helpful practices than can help SMEs to generate green energy and reduce emissions with a target to transfer into low-carbon energy consumption with fewer expenses.

A. Energy and Environmental Audits

Audits help SMEs to understand how much and where to reduce energy. In addition, those reports are helpful to change the environmental behavior of enterprises. Therefore it helpful to identify and controls the emissions and other substances and SMEs legally help from this approach. Identification of energy savings up to 30% can observe at the financial sector of an enterprise. From this, owners of SMEs can identify that advantages are not only at environmental sector but also for their benefits at financial level. Also, increase of competitiveness and encourage for investment and alongside improvements maybe define. [5], [14]

B. Product Life Cycle and Ecological design

Those two techniques are helpful for SMEs to improve in terms of quality and performance. Moreover, are creates a sustainable manufacture process with less expenses and higher production. Eco-design importance shows in the production design and development stage when a product produces. Life Cycle Analysis (LCA) is a key tool to remain sustainability of product at high level and reduce environmental impact due to production with analyze of carbon footprint of SMEs.

C. Eco - labeling

Worldwide environmental practice with proven discrimination, which identifies and label product or service under specific product category. Eco-labeling is suitable for a variety of SMEs for example at sectors of construction, agriculture, fashion, tourism and consumer products. Company's preference and interest to this practice show because is offer flexibility and improve environmental performance in cooperation with low investments. Moreover, eco-labeling flexibility observes from the fact that not all studies are related directly with CO2 emissions.

D. Available techniques for attaining lower consumption of resources and environmental impacts.

Due to large range of different SMEs new innovative technologies implement to reduce emissions. Energy efficiency of SMEs can improve with the aid of best possible technological and environmental improvements. Identification, evaluation and selection of the best suitable and available technology improvement help enterprises to improve production with a possible reduction of GHG emissions.

E. Recycling, reuse of sub-products and waste products

Each enterprise has to construct specific places at every office for recycling. Recycling is a method to use waste products as raw materials in the production of the same or similar product. Reuse defines as the use of waster as raw material with different process without structural change and recycling define a structural method to change waste products to products with the same process. Especially at companies of electricity and construction

where the products harm environment, SMEs have to involve into a waste minimization and recycling program.

F. Waste and Recycling materials to generate energy

Overproduction with cheap technological procedure at previous centuries increases waste. Moreover, waste creates new and sometimes hazardous substances. Waste incineration help to protect environment and transfer dangerous organic waste to energy. Moreover, this phenomenon reduce carbon footprint and GHG emissions by generate low-carbon energy. Lastly, an innovate, cheap and environmental friendly procedure is the use of cotton waste than producing thermal energy

G. Cogeneration and trigeneration

Cogeneration systems which combined together to produce heat and power, are necessary because they have the ability to save an amount of power in comparison with the separate production of the same amount of heat. Trigeneration systems are based on combined heat and power system and combine together with absorption coolers. Moreover, unused heat that waste during summer months can exploit effectively to produce power for the air-condition systems.

H. Adoption of Renewable Energy

RES in the last decades show a preference by shareholders and SMEs. Especially sector of photovoltaic with the aid of state grants prepare an increasing rate in the installation either of small or large photovoltaic plans. RES also called alternative energy sources and categories of this energy depend on the sector which separate into solar, wind, geothermal, hydro or biomass. Renewable energy technologies are considered cleaner than other technologies and use of them can minimize environmental impact and CO2 emissions. They consider cleaner because they have zero emissions due to production of energy and remain sustainable with the aid of proper maintenance and better in a point of view, at technological level. Therefore change of fossil fuels with RES can minimize CO2 emissions in the atmosphere.

With the aid of those procedures, specific technology and requirements have the possibility of stepping up decarbonisation of SMEs products and process. On the other hand, especially for micro and small enterprises considers more difficult to apply those techniques and technological improvements because mostly of those enterprises present lack of knowledge and absence of financial resources. Moreover, another disadvantage for those enterprises in most cases is the small amount of clients.

Power Generation Technologies	GHG emissions in gCO2eq/Kwh
Lignite	800-1600
Coal	750-1300
Natural Gas	400-800
Oil	500-1200
Hydro	0-30
Solar PV	0-70
Wind	0-30
Nuclear	0-50
Biomass	0-70

Table 1: Life-Cycle GHG emissions of Power Generation Technologies in g of CO2 – equivalent.

2.2. Decarbonisation of electricity – Europe Model

Power generation defines as the procedure to convert primary energy to electricity. Types of primary energy are fossil fuels for example natural gas, diesel, oil and RES for example solar, wind, falling water, biomass and geothermal. [36] In cooperation with power generation technologies allow enterprises to convert primary energy to electricity. Also, this phenomenon can provide from government and cooperation via long-term contract with

enterprises to buy or sell cheap electricity to SMEs. Power generation technologies have different association with GHG emissions and impacts to climate change.

First of all, fossil fuels are converts to electricity via combustion and steam electric process or internal combustion process. Those technologies use mineral fossil fuels like coal, natural gas and oil. Coal technologies and process require high temperature and pressure and for those reasons define as a lower efficient and with higher GHG emission technology than other process. On the other hand, natural gas and oil technologies operate at lower temperatures and pressures and can achieve higher energy efficiency results but sometimes with double investment than coal technologies. This phenomenon depends on the quality of natural gas and oil.

Conventional power generation technologies of fossil fuels at the last decades substitute with renewable energy technologies especially in the sector of solar and wind energy. Photovoltaic (PV), Concentrating of Solar Power (CSP) and wind energy turbines technologies are the most significant procedures. [36]

PV converts solar energy or sunlight to electricity with the aid of photon, which absorb sunlight. CSP power plants use thermal energy of sunlight to drive a steam process or support gas combustion process. Large scale technologies are tower and parabolic through concept. This power generation process has the ability to store energy and allow operation through cloudy days or nights. Wind turbines also consider as an alternative renewable energy technology. Wind turbines absorb wind masses and transfer them into kinetic energy and extract energy to produce electricity. Electricity generate with the aid of a generator which is connected to the motor. Preferred technology is a horizontal axis with three-blade rotor design with different generator concepts. Moreover, other renewable technologies are hydro power generation with flowing or falling water. Direct combustion, gasification and pyrolysis are three conversion process of biomass into energy. Renewable energy technologies mostly observe in the last years especially in Europe after the Paris Agreement and renewable energy electricity target that set for 2020, 2030 and long term of 2050 target.

Electricity generation is associated with the cost of the fuel cycle which consider as a part of electric utility cost. Fuel Cycle include all the steps of the procedure from extraction until

disposal of fossil fuel or renewable energy. Fuel cycle include extraction, preparation, transport, storage, processing, convention, and disposal. For example natural gas especially offshore requires a Liquefaction Natural Gas (LNG) plant or pipelines procedure under the water for transportation. For this reason, sometimes (e.g. Cyprus) the inventories of natural gas cannot encourage companies to invest into those projects because safety and sustainability are not guarantee. Transportation require large investment and in cases of insufficient quantity or low quality of inventories. [22]

Those procedures to generate electricity with different and sustainable power generation technologies can help member states of EU. This will have a beneficial path for SMEs especially in the sector of financial because electricity consider as a huge problem for SMES. Cheaper electricity can help SMEs and encourages them to proceed into sustainable projects.

3. Energy Efficiency at SMEs

SMEs characterize as the backbone of the economy in most countries. Majority of enterprises defined as small enterprises and energy efficiency potential related to energy use remain larger than industrial SMEs. Lack of knowledge, absence of training and high costs are the main barriers for energy efficiency improvements. On the other hand, almost 50% of industrial SMEs activate policy programs to introduce cost-effective energy efficiency measures and organize under an energy audit program.

Example of Sweden, shows that previous energy efficiency SME programs are not present any increasing levels of deployment. Follow-up procedures without a routine and methodology result with insufficient results, difficulties into measurements and not measurable goals. [8] Also, gaps due to methodology and evaluation emphasize the need of energy policy due to implementation. In addition, Swedish model at energy industrial sector mix and collaborate with the Swedish Environmental Code. Energy audit program are apply with energy efficiency network programs for SMEs and follow the procedure that apply into large enterprises. High energy efficiency networks built with the aid of German LEEN (Learning Energy Efficiency Networks). Main target of German LEEN approach at several companies is the continuously improvement of efficiency under certain terms and considerations. Administrative fractions lead to reduction of transaction costs and risks. [4]

• Past and Present Energy Use • Relevant that affective energy use	=> =>	• Analyze use and Consumption • Identify significant energy use and consumption • Identify opportunities to improve energy Efficiency	=> =>	• Energy Baseline • ENPI • Objectives • Targets • Action Plans

Table 2: Diagram of Energy Efficiency Procedure [4]

3.1. Importance and Role of SMEs

According to table 3, SMEs plays an important role in financial capacity and employment availability of every country. Each type of enterprise, micro, small or medium with technological innovation or without technological capability achieve into competitiveness and be helpful tool at economical contribution of country.

Europe	Asia	Africa	America	Australia
25.1million	17.4 million	17.4 million	30 million	2.5 million

Table 3: Number of SMEs in each region [4]

Moreover, SMEs offer new jobs opportunities and create motivation for new investments to create a small enterprise. With the necessary experience, small enterprise transfer into large enterprise. In difference with large enterprises, SMEs can create an innovative and flexibility environment for the owners and the workers. Smaller enterprises create a friendly environment between personnel and mutual assistance increase advantages of enterprise.

Furthermore, SMEs adopt and develop technological improvements. Technological process made easier than large enterprises because of flexibility and less effort because they turn into different projects. This phenomenon, conclude with faster production for SMEs and create healthy and competitive economy. In addition, SMEs with that procedure hold the competitiveness with large enterprises in sector of economy, design and efficiency and help large enterprises in certain activities. Also, SMEs sometimes help large companies into different projects with the aid of transport of raw materials and parts. Without those cooperation between large enterprises and SMEs production of goods and service may not be so efficient and large enterprises will be monopoly in some regions.

Economic crisis and modern lifestyle usually create a gap between people. Year by year this gap between middle class and high society is increasing with specific disadvantages into society. SMEs are the main source for jobs and financial assistance for middle class. Survive and support of SMEs decrease this scale and make a better sense into consumer needs.

SMEs especially in small countries and islands focus on innovative processes and technologies. Also, technologies and certain decisions are easier to illustrate and implement than large enterprises because decision usually has taken by one or two people. Especially in cases that SMEs are founded by families, the enterprise show higher strength in case of trouble, financial problem or adaptation into different markets. Lastly, SMEs play an important role for the creation of large companies. Except from cooperation and assistance between large enterprises and SMEs, growth of small companies ensures the development of large companies because creation of large companies requires the need to begin from zero.

SMEs secure a high quality of life, performance and satisfaction of middle class people mostly. Close relationship between workers and manager is the main characteristic for a technological, sustainable and safe procedure for SMEs.

3.2. Recommendations to improve energy efficiency of SMEs

Improvements of energy efficiency require sometimes passion and strategy. Some of them require from enterprise to spend money and some other will not cost. Final measures with help of innovative ideas and sustainable technologies will start saving money for the enterprise. Moreover, most of enterprises identify micro and small so they have to cover a number of simple steps to create a financial and comfortable profile to illustrate high cost procedures. This section covers a number of simple steps.

3.2.1. Heating

Installation and checking of thermostats can reduce energy consumption in case of useful and creative use. Sometimes timers and thermostats are forgotten due to winter and summer months at the same temperature. Moreover, air conditioning system can minimize energy bill. For example, ensure air conditioning or heating system are not work with open windows. Set temperatures of machines at the appropriate temperature which recommended by the manufacture. Possible timers at those systems need to change in case

of weekends or public holidays with a target the reduction of energy waste. In addition, timers and thermostats need to locate at areas where not affected workers or affected by sunlight. Modern electronic thermostats are more sustainable if they are wireless and accurate

Also, workers need to perform appropriate due to enterprise improvements. Especially at office environment when people need to feel warm. Most of the times, doors and windows are open with electric heaters are not free from obstructions. Workers have to educate because these phenomenon is a possible risk for their health. Nevertheless, heating system affected by doors, windows and openings. As bigger the openings of building construct, the lower efficiency ensure. Enterprises with low cost can identify possible windows and doors that are not use and try to close them. Lastly, SME can prepare maintenance to air conditioning, air extraction systems and pipes. Significant heat lost and energy waste are increase energy consumption. Reduction of energy losses will ensure high level of comforts for workers and managers, control operation and maximize efficiency of the systems

Implement simple steps and maximize efficiency can create an impressive cost saving portfolio for enterprises. Savings with additional investment can create a sustainable, structural and long-term technology that will offer a bigger saving plan.

Heating working environment can increase due to some cost investments. New windows with double glazing can reduce heat losses through windows and reducing in the same time the air-conditioning or heating consumption. Furthermore, those measurements and change must be included at least at large areas where few people work or use daily. Moreover, a computer that controls heating systems requires so to control temperature into the appropriate temperature specific at winter. Temperature must remain into an average 10% increasing or decreasing with the aid of those controls. Also, replace of an old boiler with controls will be 10-30% more efficient. Last but not least, insulation of roofs, walls and roof spaces installation can reduce heat losses. [13],

3.2.2. Lighting

Ample lighting is important for every indoor or outside business. Lighting sometime account up to 40% of a business or building electricity use. Some changes can reduce lighting cost with better lighting results and sufficient suggestions to improve working environment and save money for business.

Building and Companies with meeting rooms, storage areas and corridors that are not use often they have to introduce some no cost solutions. For example, close lights at unoccupied areas, change to Coloured switches and make clear each switch usage, create reminders do the staff turned off lights and write the rule “last one turns out the light”. Moreover, in case of office natural light from sunlight is not exploits into the appropriate way because objects maybe interrupt windows or window blinds are close due daylight. Nevertheless, low cost procedures can introduce by organization. Lighting maintenance and cleaning of building lighting systems has to include into organizations maintenance procedure. Lighting systems have to clean at least once a year. Due to maintenance procedure makes sure that all the bulbs are necessary and in case of surplus, disconnect dome bulbs. Security lighting can be high-powered and energy intensive, so the timer and daylight sensor controls are set accurately. Also, unnecessary rooms can install automotive lighting with sensors or check at the end of the day work for possible switch-on lights. With the aid of lighting controls and sensors can reduce more the lighting cost under simple actions, easy measures and low cost investments. Areas that often left unoccupied or end of the day sensor will help for minimum expenses. For example, toilets, meeting rooms, first aid room can install sensors to minimize consumption and energy use. Workplaces and offices can use daylight and artificial light.

Traditional lighting and old sodium lighting are inefficient than T5 fluorescent tubes or LEDS bulbs. Upgrades like this can provide with a financial option and even from first quarter of investment make the solution profitable.

- T5 fluorescent tube: Last from 20000-30000 hours and save almost 45% energy costs than older T8 or T12 tubes

- Led Bulbs: Expensive solution but with the most efficient energy use, almost 90% and five times longer than old traditional lumps. LED lights can replace halogen spotlights and reduce heat.
- Dimmable fittings: Modern lighting systems that usually operate in cooperation with daylight. Sensor switch on automatically when daylight absence observe.

Moreover, retrofitting of building with double glazing to use skylight and installation of reflection of lights can improve efficiency of lighting system. [13],[

3.2.3. Office Equipment

Out of the working timetable, consumption of the electricity counted up to 50%. Limited knowledge and bad habits conclude with those results. Better and more practical solutions with aid of energy measurements can minimize the unwanted energy. Office equipment unwanted parts must switch off even in cases that equipment leave under stand-by condition can still be a huge waste. All switch-on monitors, computers, printers, kitchen utilities add and make energy bill higher. Moreover when equipment turns off will increase their lifetime or maintenance period. For those reasons staff must educate and switch off monitors that are not use and try to work with the suitable brightness of monitors. Printers, scanners and photocopiers must go into sleep mode often a period of some minutes and a member of staff with a rotational way to check at the end of the day that all monitors and machines are turned off.

Most significant unnecessary energy consumption observed into communal areas where the staff focus only into the task and forget the switches. One of the most significant places is the kitchen where people use it at least once a day. All electrical kitchen items must switch off or unplug at the end of the day. Moreover, fridges have to be in the appropriate temperature to work more efficient depending on the weather and must be repair in cases of damaged doors. Furthermore, dishwasher machine need to fill full before use.

Modern office equipment and new productions present an increasing into efficiency. In case of buy new equipment take under consideration the fact of energy cost lifetime because this estimation is possible the energy cost to be greater than the initial price.

- Laptops: Possible usage of laptops or replacement with desktop will reduce energy cost and prevent a flexible working environment with less heat and quicker results.
- Printers: Replace individual and small printers with a printer that has more information and working solutions, increase the efficiency and reduce energy cost
- Monitors: Modern flat screen technology reduce by 50% running cost and minimize damage of eyes.
- Fridge/Freezers: Updating them to a low energy-rated model us they run 24/7. [13],

3.2.4. Production Equipment

Enterprises that use equipment for process and production are important to understand where they use energy to control it with simple steps. Due to operation of old, poor and incorrect maintenance equipment energy wastage observes which one of the biggest disadvantage. Enterprises with simple steps and cost can minimize this waste of energy.

Motors and drives are the most significant energy consumption machines for those enterprises. With zero cost can reduce cost and risk of damage. For example, motors switch off in case of break or lunchtime and keep them clean to avoid hotter temperatures. Moreover, machines, funs and pumps must switch off at the end of the day when are not needed. A systematic approach into Consumption, Control and Clean of motors can increase the efficiency and lifetime of motors and help to identify possible replacements.

Compressed air can be responsible for the 10% of energy bill into an enterprise that cause by leaks. Compressed air is very essential at the operation but also is very expensive compare the cost per unit. For this reason, possible leaks create annoying working environment and expenses. Possible leaks need to listen and fix. Also, compressed air pressure must set into the lowest possible level for each application and turn off in neither cases that nor needed.

To maximize efficiency of compressed air and avoid possible leaks can follow those steps:

- Avoid possible movements of pipes that are possible to cause leaks.
- Install automatic valves to control air lines and reduce air losses.
- Change filter to maximize efficiency.

Furthermore, refrigeration and cooled space can reduce energy wastage by 20% with minimum or no investment. Efficiency use of refrigeration requires circulate air inside and outside. Areas need to cool at best suitable temperature because increase of one degree can reduce energy by 2%. Refrigerators condensers are regularly cleaned to prevent longer lifetime, fill faster and therefore reduce cost. Lastly, space around refrigeration units vents to allow air to be drawn in and work more efficient. Refrigerators maintenance and managed of cooled spaces are some ways to reduce electricity cost. Poor maintenance can increase energy use of refrigeration by 10%. Some enterprises can conclude with 50% of their electricity bills from their refrigerators.

Cleaner and maintain equipment maybe reduce cost but otherwise new most up to date machinery especially main parts will conclude with the best efficient results.

Variable Speed Drives (VSD): Controller that varies the frequency and voltage supplied to an electrical motor. VSD can save money because it rotates depend on the level of owner's needs. If the load slows down, reduce energy use and reduce consumption. Another action is the installation of valves to control heat. Heat can use with the aid of valves to demand hot water. [13],

3.2.5. Transport

High levels of diesel, petrol and electricity are the main points for an enterprise to reduce greenhouse emissions. Due to increasing of main fuel in the last decades enterprises can achieve savings into the transport sector by simple steps and procedures. Aggressive driving style can increase the consumption of fuel by 10-12%. On the other hand, average driving style can reduce fuel consumption and is better for environment. Keep in mind to check at least once time per week and record the fuel in liters for each vehicle. Tire pressure must

check at least one time per month and unnecessary loads need to take off. Better knowledge of those tools increase with telematics intergrade tools of driving style, fuel management and maintenance. Moreover, with the pandemic of COVID-19 staff becomes more independent to technology. Sometimes journey can replace with a conference video call or a Schechule journey with multiple stops for more works is an efficient idea to replace daily road trips.

Electric vehicles look to be the future of cars and trunks. Companies turn into electricity to produce friendly and zero-emissions cars for the environment. Researches show that electricity vehicles can reduce by 74% compared to diesel engines the greenhouse gases and diesel cost of an enterprise. Advantages of electric vehicles are:

- Reduction of maintenance and service costs.
- Charge overnight the vehicle and no need to worry about fuel.
- Low registration tax. [13],

3.2.6. Case Studies

1. Installation of Building Management system => Air conditioning of Brown Thomas Corporation work according to building need and save 24000 Euro and 118 tons of CO2 per year
2. Sun Life Financial installs a building management system and allows them to control heat energy and save 2900 Euros per annum.
3. Fox rock Golf Club reduce heating bills by 20% and save 6600 Euros and 17.8 tons of CO2 emissions per year after replacing boilers, switch led lighting with sensors and replace three inefficient refrigeration compression Units.
4. Electronic components (sensors) at store area and toilets=> Investment of 225 Euro and save 813 Euro and 5 tons of CO2 at first year.
5. Sun Light Financial changes into T5 and LED energy while occupancy sensors install at the new offices. Savings count 24000 Euros per year.

6. Codena in 2016 saved 11000 Euros and 70 tons of CO2 in a year by implement a switch off campaign for 1500 employees at Dublin City. Council Offices ensure that all non-essential electrical items were turned off at the end of the day and weekends.
7. Simply Soups, a soup maker install control devices to reduce unnecessary steam consumption and reduce energy cost that is associated with hot water by 55%.
8. Install inverter drivers on six production lines, Text File Robin manufacturer is saving 6570 Euros and 36 tons of CO2 per year and has four-month payback period.
9. Fix 9 leaks in compressed air system, can save 1265 Euros and 7 tons of CO2 per year. [13],

3.3. Benefits

Energy Efficiency improvements with the help of EnMS can create short and long term benefits for SMEs. At the beginning enterprises will not understand and identify the necessity of EnMS but profit of energy measures will identify year by year. Payback of some measures might not seem worthless but enterprises will consider the profitable amount of money with the possible profit of extra sales. At the beginning, cost and low actions are help to begin and observe possible savings. As the time passes more energy savings will implement and benefit the SME. A list of possible benefits show:

- Increase production with same energy or remain at the same production with less energy
- Improve client's list and ability to sign new contracts.
- Improve quality of work.
- Improve environment and improve working places.
- Reduction of energy consumption and bills. With that amount of money enterprise can create job opportunities or invest for renovation.
- Increase profitability and competitiveness.

- Improve environmental profile of SME.
- Benefit to society from carbon dioxide emission reduction and improvements of air quality

[10], [

4. Energy Management System and SMEs (EnMS)

Energy considered an essential pylon to achieve economic, environmental and social targets. Cooperation between human sustainability and economic growth drives by the forces of energy efficiency especially in cases of SMEs. Achievement of high energy efficiency into SMEs must be a crucial responsibility for governments especially at developing and high population countries. Continues and reliable energy under an effective supply management energy plan have as a result an economic development region. Main target for a sustainable energy supply and a modern industry is the stable and affordable energy price for industries. Energy generation and energy consumption result to environmental disadvantage for example GHG emission and carbon footprint. Production process with aid of a management program force SMEs to improve energy efficiency and production with less environmental impacts. Energy savings can reduce emissions under certain changes into electric motors, boilers, facilities and lighting systems. Adoption of new and innovative technologies can track energy waste and untapped energy can observe. With little or no cost technologies greenhouse gases emissions can reduce up to 30%. Energy management is considered a combination of energy efficiency activities, techniques and managements of related processes which result in lower energy cost and CO2 emissions. Nevertheless, energy management program help SMEs to achieve competitiveness. Possible lack of information, positive management systems and application gaps effect negative for SMEs to participate into a management system. Due to researches, show that companies and industries follow the instructions until the reward. After that, SMEs obtain the certification of ISO or other management system is not following the instructions and applications that set from certification organization. [20],

Type of Industry	Energy Saving/ Existing Technology	Energy Saving/ Modern Technology	Annual Savings	Possible Reduction of Operating Cost	CO2 Emissions (million tonnes)	Possible pay pack Period
Rubber Producing	Electrical Motor	VSD Motor	Up to 202 Billion(Europe)	€10 Billion per year	79	3 years
Cheese Factory	Vacuum Evaporation	Nano filtration	Reduce Natural gas and electricity use by more than 25%	€1.25 million per year		8 months
Textile Industry	Conventional Motors in ring	Energy Efficiency motors		$426	1.22 to 2.93	16 months
U.S. Pulp and Paper Industry	Convention Pumps	Energy Efficiency Pumps	30% of Electricity	Due to Sustainable technologies U.S. pulp and paper industry reduce CO2 emissions from 44 million metric tons to 35.7 million metric tons from 2011 until 2018		3 years
	Worm Out Pumps	Energy Efficiency Pumps	30% of Electricity			3 years
	Conventional Motors	Energy Efficiency Motors	30% of Electricity			
	Cooling towers and electric form	Invertors to cool towers and pumps	30% of Electricity			
Glass Industry	Existing no heat recovery system	Recuperator	25% to 30% energy per year			6 months

Type of Industry	Energy Saving/ Existing Technology	Energy Saving/ Modern Technology	Annual Savings	Possible Reduction of Operating Cost	CO2 Emissions (million tonnes)	Possible pay pack Period
Chemical Industry	Air Compressor	Efficiency management, maintenance and leakage control	20% to 30%	Chemical reduction until 2050 can reduce up to 36%. This conclude with 72.5 Million tons of CO2.		
	Water heat recycle	Installation of heat exchanger	20% to 30%			2 years
	Cooling tower	By adding inverter to pump electric motor	20% to 30%			
Food Industry	Steam system and Boiler	Proper Maintenance	3% -*% reduction in fuel consumption		3.3	1.7year
	Control System	Insulation air leak free, recovering exhaust	5% to 15% energy saving consumption			2 to 4 years
	Compressed air for	Blowers	25% energy saving			1 year

Table 4: Information of existing SMEs with potential technology and Payback Periods [25], [39], [40], [41], [42]

4.1. Energy Management and Energy Efficiency

EnMS defines as the systematic approach and continuous improvement of energy efficiency according to organization policy and standards. A successful assessment of an EnMS has a regular and increasing interval and a positive for organization change into energy consumption. It can involve all comparisons and forms of energy and include all the sectors. EnMS based on the model of Plan, Do, Check, Act (PDCA) and main target is to introduce sustainable strategies for technological improvements and behavioral changes. Structural framework design flexibility depends on the size and the needs of each organization. Basic structure remains the same for every SME but implementation depends on the size and complexibility of organization's operation. Organization should choose some or all components of EnMS based on their specific circumstances and requirements. Possible difficulties occur for organization for example to manage risk or to measure consumption. Organizations should make measures at the consumption of electricity, gas, diesel etc. Effective procedures characterize with the management of organization assets, facilities, and process and transport activities. Monitoring and targeting of energy is the first step to manage energy, understand energy performance, conclude with realistic results and improve energy performance. With the aid of monitoring and targeting of energy can identify possible energy savings and opportunities. Monitoring use to establish existing patterns and targeting refers to the identification of the desirable of energy use.

4.1.1. Benefits

According to effectiveness of EnMS and how well organizations follow instructions of management conclude with advantages in fewer period. Main advantages that organizations identify at a period of time are:

- **Reduction of energy costs and minimizing risks**

Manage energy consumption reduce expenses and conclude with financial benefits for SMEs. Fossil fuel and electricity cost increase all over the world in the last decades. Countries with political responsibilities try to reduce energy demand and increase energy efficiency with different methods. EnMS tries to encourage SMEs and provide them with positive opportunities to minimize energy risks. Increase of energy efficiency can also increase competitiveness, services and change energy portfolio.

- **Increase social responsibility**

Management of energy use can be an aspect of a SME in cooperation with social responsibility. Illustration of an energy policy creates opportunities for better practices at the level of customers and shareholders. Benefits at profile level gain SMEs into a competitive advantage profile in the market

- **Complying with regulatory frameworks**

Each SME has to introduce a framework with specific energy policies and a framework with specific targets with the aid of an energy management to introduce low carbon and innovative technologies. Examples of international policies are the European Union Energy Efficiency Directive with all 28 members, China's program with almost 20000 organizations of the country and UK's climate change Act which established at 2008 and target is to reduce gas emissions up to 80% until 2050. Most significant Energy Managements Systems include practices of ISO to introduce good practices for energy and financial benefits. [10], [25]

- **Improving organizations effectiveness**

Implementation of EnMS can achieve for a SME high productivity levels, better working environment with advantages into health, safety and equipment performance. Final results of those phenomenons can increase employee productivity and provide better working environment. Moreover, sometimes staff mobility, morale and comfort increase. With the aid of personnel can reduce energy use and reduce unnecessary usage of equipment, improve safety at industrial level and risk of equipment damage. Better usage of equipment also reduces maintenance and extend lifetime of machineries.

4.1.2. Management of energy

Main disadvantage or aspect for SME is the correct way and procedure to implement an EnMS to have the best energy efficiency results. EnMS range depends on the level of the organization or enterprise. Effective and positive procedure at the beginning with a team can show final positive results and help the other workers to train under certain policies. Senior management or hire of energy manager can help the procedure to train or encourage the personnel. Step-by-step process is the best and most efficient way for organization to form a continual cycle of assessment and improvement. Following logical steps under the structural and recycling procedure of Plan-Do-Check-Act which characterize as the backbone of EnMS can drive into repeating improvements. [28] ISO150001 is the most significant approach to improve energy performance and ensure better energy results. Implement from a range of enterprises and SMEs be in place to adopt this system. Also, Environmental Management System (ISO14001:2015) and Quality Management System (ISO9001:2015) known as the best solutions about international management systems for SMEs. [16]

4.2. Analysis of ISO50001 Structure

Standardization process of ISO50001 been developed from more than 60 countries and consider as the leader of Energy Management Systems worldwide. Implement by a range of different organizations and main target is the structured approach to improve energy performance and energy efficiency levels of enterprises. In addition main benefits of the standard are: [15], [16], [17]

- Process of measuring and verifying (M&V) the energy performance of an organization
- Use from a large scale of organization, from small and medium sized enterprises across a broad range of commercial, industrial and public sectors.
- Enables energy management best practices to introduce into business operations.
- Increase transparency and effective communication on the management of energy measures.

- Encourages the adoption of energy efficiency measures across an organization will be involve in the process.
- Takes into account any external financial incentives.

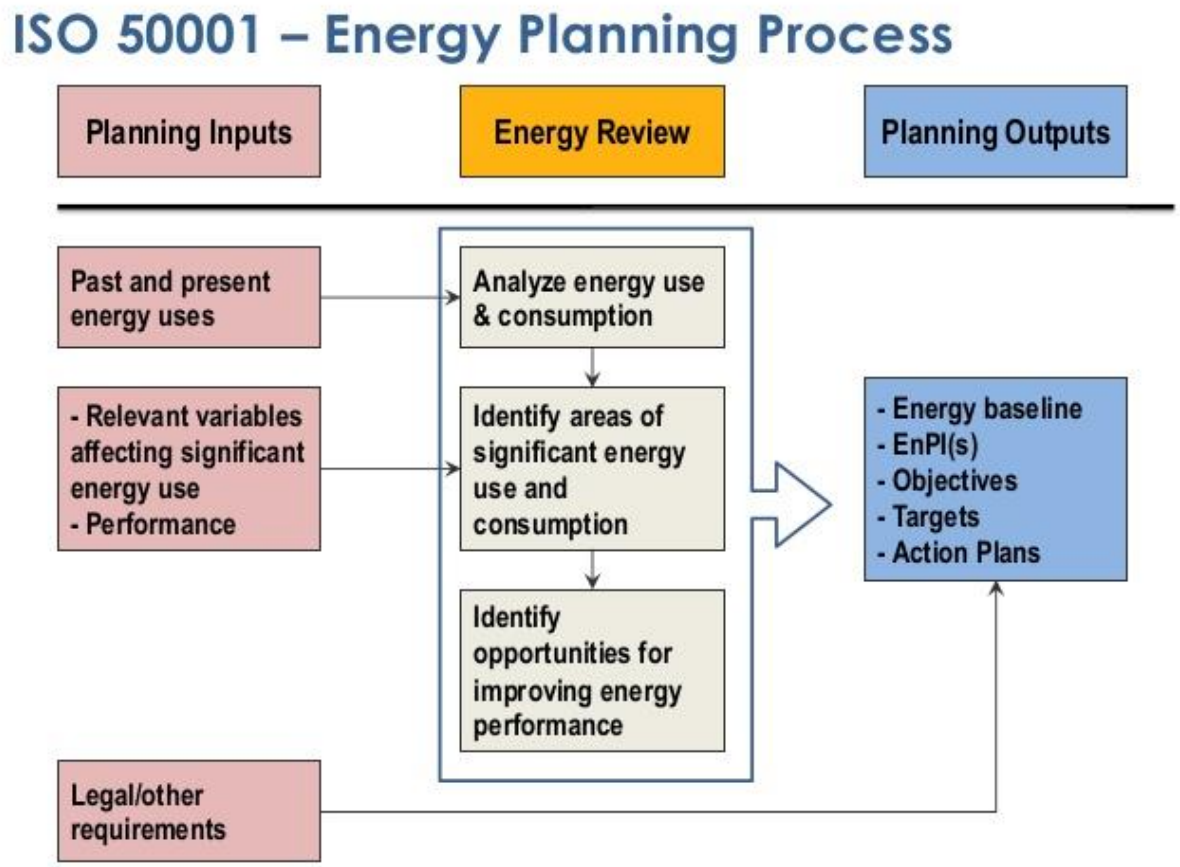


Figure1: ISO50001 – ENERGY PLANNING PROCESS WITH EMPHASIS TO INPUTS, OUTPUTS AND ENERGY REVIEW [ref. 16, page 16]

Standards on how to conduct energy also developed with general requirements and methodology. Also, process with emphasis of energy audit establish at sectors of buildings, industrial process and transport. For better results and practices ISO standards are reviewed and updated always with the best possible solution and with the latest available version, following the sections of the Plan-Do-Check-Act structure.

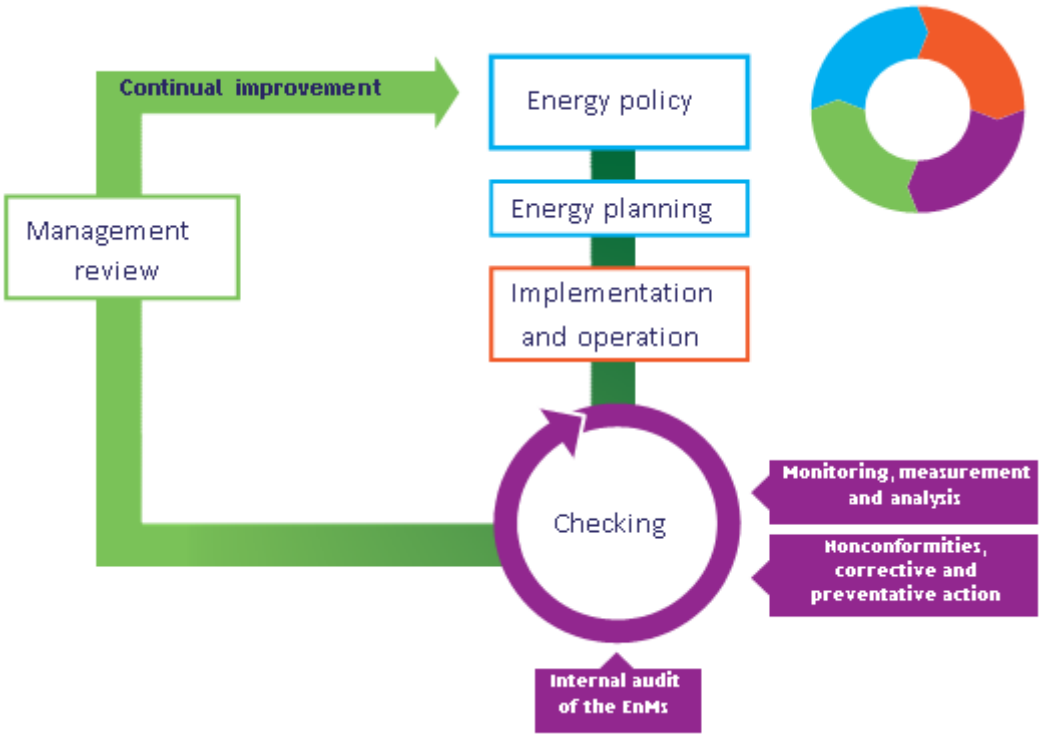


Figure 2: Steps to implement an Energy Management System (Structural procedure with Plan-Do-Check-Act)[ref.16 page 15]

4.2.1. PLAN

Planning stage of an EnMS separates into two main stages. First to understands organization energy use and second, to constructs a plan or row of policies to improve energy performance. Basic steps of this procedure or planning stage illustrate at figure 1. Energy Management process is a cyclical procedure and improve energy performance of enterprises under certain parameters with the aid of measures and estimations. Outputs that include into energy review based on those measures or estimations and according to results, enterprises establish possible targets and objectives. A reference document named organizations energy policy establish and contains missions of organizations regarding energy. Energy policy should use information of the planning stage and outline current organization energy performance, future scopes and targets and the process to achieve those targets. Also, a fundamental process of monitoring and targeting develop in the planning stage. Main scope of this process is to understand better and in-depth the energy

use of enterprise, identify areas of energy consumption and establish possible energy efficiency opportunities for improvement.

Energy planning process requires a more detailed explanation in the sectors of energy review, energy baseline, energy performance indicators and targets and objectives of organization. First energy review will include energy analysis of past and present energy consumption and then must analyze energy consumption patterns, peak periods energy consumption and intensive consumption areas. Moreover, identification and prioritization of cost-effective energy saving opportunities include in the energy review.

Energy baseline defines as the reference point for future consumption. Data of energy baseline in combination with energy review significant show the current level of organization energy consumption. Energy baseline can be established at various levels for example whole organization, a building, a piece or specific equipment or an individual energy efficiency opportunity. Furthermore, can be use to identify and help understand the reason for fluctuations in energy consumption, identify energy performance indicators and estimate energy savings from the implementation of an EnMS. Effective energy baseline represents a specific period of time and includes all variables that may affect process or equipment at the next years or due to maintenance procedure.

Energy Performance Indicators (EnPIS) are essential for monitoring and measuring energy performance. They are metrics that an organization can relate its energy requirements to the various driving factors that have an impact on the consumption. Use of EnPI provide a relationship between energy consumption and one of its driving factors and define as the energy consumption per unit of an activity metric.

$$EnPI = {}^{Energy\ Consumption}/_{activity\ metric}$$ [16]

Examples of factors that influence energy consumption include a process output, outside air temperature, time, staffing and occupancy levels and building characteristics.

Targets and objectives examine and usually establish by the collected date through monitoring procedure. Objectives must include specific details, quality results and measures and describe goals for organizations energy use. Objectives always included into policy

document. Energy targets should be specific and related into objectives of the organization. Targets and objectives achievement period also determine and include into policy document. They always have been driven by energy strategy of enterprise. Energy strategies based on the collected information and illustrate by the range of shareholders and explain possible procedure, resources and tools that require. Key components of energy strategy include clear roles and responsibilities of shareholders and personnel, measures and items, setting timetable, establish the specific process with procuring energy and equipment, possible funds and financial incentives and promotion of behavioral change activities and encourage staff members to participate in energy management training courses.

Planning part of an EnMS define as the backbone of a successful and sustainable energy structure. Successful and detailed planning of EnMS has a larger possibility to conclude with better energy efficiency results.

4.2.2. DO

Energy component of Planning stage help organization to understand components and procedure to implement measures and reduces energy consumption into the DO stage of an EnMS. DO stage of an EnMS includes

- Changes to process and behavior
- Procurement of energy services and products
- Installation of new equipment specifies in the planning stage

This stage of EnMS involves individual procedures for every sector of the organization to achieve targets and objectives. Involve training courses for all employees, campaigns and discussions between the different departments according to the needs and workplace.

Those actions will help SMEs to keep everyone inform according to energy policy and create communication channels for better actions across the status and progress of the project. Alongside, of those actions take personnel into an advantage point to understand more easily short-term and long-term goals and motivate them to participate into the procedure

of EnMS. Actions divided into three categories, low or no-cost technologies, medium-cost technologies and high-cost technologies. Usually, depend on the investment require less or more period of time for example change of boiler require limited time but is define as a high amount of investment. On the other hand, low cost for example switching off the lights when are not in use, require long period to change the personnel behavior and achieve goals of the enterprise.

Simple Payback Periods (SPP) and Life Cycle Cost Analysis (LCCA) are the two most common methods to estimate future cost savings. Moreover, proper maintenance of existing energy equipment or machineries can improve lifespan, reliability and energy efficiency. Energy efficiency and opportunities for energy limitations can define via understand of energy use. Another procedure that helps SMEs to reduce energy cost may be the demand respond program. This term can reduce energy cost and mitigate risks, because with an efficient usage can reduce electricity consumption due to high demand periods. Also, gives the opportunity to machineries for transportation of energy consumption into off-peak period.

Demand response programs and financial incentives help to ensure the electricity network can cope with high demand.

Ensuring Staff Engagement

Innovative and sustainable technologies or high efficient machineries without participation of educated personnel cannot reduce consumption. Effective energy management requires continuous education and support of personnel. Main benefits of those phenomenons are sense and encourage of staff members to take responsibilities for better solutions and working of staff members into a specific workplace can identify easier possible issues and work environment leakage. On the other hand, challenges and barriers are identify in the sector of communication, absence of motivation, lack of understanding and fear of not having the necessary skills. Communication channels between personnel at all levels of the enterprise can minimize those barriers. An open forum for ideas and suggestions can be creating from enterprise to determine where and how energy savings can be focus. Also, online energy management training courses according to responsibilities and knowledge of employees can introduce by organizations.

4.3.3. CHECK

At the “Check” stage actual performance should be compare with the energy policy targets and objectives. This will examine when the organization goes hand by hand with EnMS and find possible process and operation that need improvements. Key component of this stage is the Measurement and Verification (M&V). Introduction of methods to achieves energy saving in an accurate, reliable and transparent way in cooperation with results of Measurement and Verification present. Moreover, this stage require an assessment of the management process to show if the system is effective and has a continual improvement with monitoring, analysis and areas where energy performance have the biggest impact. A successful Measurement and Verification process will increase the credibility of energy management within the organization and allow especially SMEs for future implementation of energy projects. Enterprises can introduce the International Performance Measurement and Verification Protocol (IPMVP), which is a protocol to promote good practices in the sectors of record, estimation and energy saving opportunities. Include a large scale of energy saving methods and wide range of successful projects. Throughout of this stage include communication as an objective and identify with the aid of an assessment if the system operating properly and show planned results. Possible errors and non-conformities should be identified and organization is in place for corrective actions. Lastly, “Check” stage include test for compliance and report of the results to the senior management.

4.3.4. ACT

Final stage of the Plan-Do-Check-Act cycle requires the review of the existing results and energy performance. Due to results, enterprises must take all the necessary actions to ensure system reliability and workings. Previous stages examine at this point and possible inputs or actions, significant change something especially in procedure or equipment for better outputs. Possible outcome results may change into energy policy, measurements of energy performance and targets or objectives of the energy management process.

In addition, an EnMS does not close into the Act stage. The cycle begins again from planning stage and enterprises try to avoid possible mistakes and learn from mistakes. The cyclical nature of this process in not important only for working future improvements of energy performance but also for maintains the existing improvements.

5. European Union Profile

European Energy Regulatory Authorities support and help the Small and Medium Enterprises (SMEs). Biggest percentage around Europe consists from SMEs. The EU directive 27/2012 on energy efficiency represents correspond way to encourage SMEs to participate in the energy programs. Energy programs include scheme of SMEs, agreements between parties and energy audit which illustrate cost of audit and payback period and implementation of energy with cost-effective recommendations. Cost of energy audit and absence of knowledge as a result of limited experience are usually barriers of SMEs. Necessary actions must be prepared from member states especially in the region of cost. Recommendations about financial support and agreements must mention. Via this procedure of SMEs need to understand not only energy efficiency important, cost and energy reduction and reduction of greenhouse gas emissions but also the necessity to improve knowledge, profile of enterprise and flexibility to survive into difficult era of economic crisis. In addition, SMEs is important to know the interest and effort to implement a management system. SMEs must be in place to meet specific requirements under Quality Management System (ISO 9001), Environmental Management System (ISO 14001), and Health and Safety Management System (ISO 18001). Under certain requirement that published at 2018, SMEs has to prepare for ISO 50001 to define energy efficiency and energy consumption. Sometimes instead of management project under ISO 50001, SMEs develop and implement energy policy to achieve targets and action plans.

EU climate and Energy Targets	EU 2020 target	EU 2030 target
Reduction of GHG than 1990 levels	20%	40%
RES for the final Energy Consumption	20%	32%
Increase of Energy Efficiency, energy saving target	20%	32,5%

Table 5: Targets that set from European Commission and publish at with Paris Agreement

SMEs in European Union

	Percentage
Energy Supply	28%
Transport	24%
Residential and Services	12%
Industry (Fuels and Process)	19%
Waste	3%
AFOLU	12%
Other Sectors	2%

Table 6: EU-28 GHG emissions, Based on EEA, 2015

SME generally defined as small and medium sized enterprise which has fewer than 250 employees or has an annual turnover not exceeding 50 million Euros. SMEs at EU estimated up to 25 million and employ up to nine people per SME as an average number of employees. SMEs contribute the 99% of companies at EU. Provide almost 66% of private sector jobs and operate mostly at national level. SMEs support by different programs like Small Business Act, Horizon 2020 and COSME. Primary target through support and knowledge of those programs is increasing of competitiveness and provide financial support. SMEs legislation can affected from taxation, company law and competition. In general SMEs can define a company with

less than 250 employees and usually provide jobs and opportunities all over European Union.

Main objective of SMEs is the continuously growth to keep a source of enterpreurial spirit and innovation. Those characteristics help European Union to continue decisive rivalry between companies. The quality and price of competitiveness will help enterprises to grow economical, join the potential for new placements and increase the European Union attraction for other companies. European Union policy for SMEs ensure those results and small business are attractive for citizens.

5.1. Programs to support SMEs in Europe

Small Business Act (SBA) is the main program that almost all the companies join but also is a European Law to protect SMEs that establish in 2008. SBA illustrates a row of policies with the aid of a framework and help European Union to integrate existing instruments for Small enterprises to keep the growth and employment. SBA with the phrase of "Thinking small first" and cooperation of member states try to enroll a new behavior to improve overall entrepreneurship and innovation. [7]

A) SBA announce a set of aids to support SMEs

- Smart regulation: Enroll into European Union member states, the necessity to cut red tape and change the Late Payment Directive. With these actions achieve connection between SMEs and public administrations. E-envionicing and modern practices into public banks introduce in European Union to help SMEs. Moreover, some approaches illustrate to introduce simpler financial applications with a target to reduce administrative burdens for SMEs.
- Access to finance: European investment Bank (EIB) and European Investment Fund (EIF) support last years in the process of SMEs. Provision of guarantees, loans and capital investments, SMEs availability and help organizations about financial.

- SMEs in the single market: The SBA and Commission help SMEs to stroke into different areas. For example taxation, company law and competition rules. Those results prepare for yeas through different seminars and different procedures. Target is the continuously improvement of SMEs about the framework conditions for business in a single market.
- Competition policy: At 2014, Commission adopted a modern and flexibility financial policy for SMEs. According to Commission and difficulties that SMEs usually define because of their size, member states of European Union allow granting SMEs without any approval. Based on this regulation SMEs can benefit up to 7.5 million Euros.

B) European Union Networks for SMEs

European Union support SMEs though different networks. Most important networks are including general support services and support for innovation and research.

C) SMEs and Research

The Horizon 2020 is a research and innovative program which introduce at 2014. Main scopes are the benefit, success and growth of SMEs into a sustainable environment. Program helps SMEs to fill possible financial gaps and promote research to organizations. With the aid of these researches, main target is to promote competitiveness. Other target is the reduction of carbon dioxide and communication technologies.

LEAPuSME include nine national energy agencies from Austria, Croatia, Greece, Italy, Malta, Poland, Portugal, Slovakia and United Kingdom. Main target is to inform and mobilizes shareholders and SMEs for existing opportunities through training and workshops in each country for an energy efficient future. LEAPuSME aims to build effective policies through an assessment and try to understand energy needs of SMEs. Objectives of this audit are:

•Identify barriers and construct an energy audit recommendation row with the best energy efficiency measures

•Announce to SME possible energy opportunities according to company's policy

•Create solutions with the aid of graphs, energy efficiency schemes and benefits.

•Research to analyze and involve stakeholders in the procedure through training and information

D) Program of the Competitiveness of Enterprises and SMEs (COSME)

COSME at 2013 announce a budget of 2.3 billion Euros for the period of 2014-2020. COSME through budget need to reach the following objectives

- Promotion of entrepreneurships, with different activities especially for young people with developing skills.
- Improve finance access for SMEs and equal facility improvements to cover possible financial gaps with the aid of loans, agreements and low-risk investments.
- Improve access to market inside the Union and globally with a scope to expand facilities inside European Union but especially outside European Union.

5.2. European Union Projects

EU energy efficiency target of 32.5% need the introduction of some projects. SPEEDIER, SMEmPower Efficiency, E2DRIVER and Innoveas are Horizon 2020 projects. Main target is the improvement of energy efficiency of SMEs by helping them to undertake energy audits and implement possible energy efficiency measures. At those four project participants SMEs from Cyprus, France, Germany, Greece, Ireland, Italy, Poland, Romania, Slovenia, Spain and UK observe. [29] , [26]

	Cyprus	Ireland	Germany	Greece	Italy	Poland	Romania	Slovenia	Spain	UK
YES	50%	15%	44%	46%	24%	25%	33%	30%	27%	57%
NO	50%	75%	56%	54%	71%	75%	58%	70%	68%	43%
DON'T KNOW	0%	10%	0%	0%	5%	0%	9%	0%	5%	0%

Table 7: Identify the level of implementation of an energy audit at SMEs in the participating countries [29], [26]

Regarding to those results can identify that fewer than 50% of SMEs use an energy monitoring system. Financial barriers to construct energy managements project show at most of SMEs. Funding regarding to European grants, loans and national support schemes due to lack of awareness by SMEs and banks results with an absence of motivation. Moreover, COVID-19 pandemic, with SMEs are try to survive and investment into energy efficiency are out of their plans. As a result, of the phenomenon energy efficiency improvements have low priority than other investments.

Projects cover different pylons of economy for example construction, food industry, education, energy, services, chemicals, heavy industry, commercial and trade, automotive industry. Results show that European Union SMEs do not have as a primary the need to improve their energy efficiency or implement an energy audit. Unfortunately, level of energy management within SMEs that construct an energy audit continue to implement some energy efficiency improvements. Main reasons to implement energy efficiency actions are the reduction of expenses and then climate changes or reduction of carbon footprint. Significant measures are related into technical system.

Employ around 100 million people which represent another serious reason to improve energy footprint of SMEs. Approximately, improving of efficiency of SMEs can change the environmental behavior and mindset of people. In my point of view, training of staff and lack of knowledge conclude as a major disadvantage for all SMEs. Perfect construct of energy audit under certain conditions and improvements at environmental and consumption profile of SME cannot illustrate without proper education and training of personnel. Main

guidelines of four projects explain briefly the training strategies and pedagogical approach that a SME must follow. Innovative approach with the aid of technology creates by each project to help future project effectiveness and efficiency improvements.

A. SPEEDIER-Outsourced Energy Management

Main objective of SPEEDIER project is to provide a one-ship shop solution and help SME to manage their energy consumption. An energy auditor is the main responsible for the project in the role of manager and advises the business with the appropriate energy efficiency measures and solutions due to process. Possible barriers are lack of time, knowledge and resources.

SPEEDIER project financial plan include a non-cost measures and possible financial savings, re-invest into other energy efficiency actions. Cycle and re-invest continue until the SME react desired level of energy savings. Payment of auditor prepare from the savings, so SME ensures that always the auditor will act at his best. Assistance of SPEEDIER expert is done with the aid of two software tools.

1. The SPEEDIER tool for Experts
2. The SPEEDIER mobile application

B. SMEmPower-Internal Capacity Building

Target of SMEmPower project is to provide energy audit to SME and implement energy saving for possible energy efficiency improvements. This will be done by promote traditional and innovative technologies and decisions. Educational and Training programs offered undergo of this project with a lot of examples under certain certification of specific courses or associated with Universities. Educational and Training programs train key members of SME to use sustainable energy management solutions, pathways to implement energy savings and ways to change SME energy consumption. Finally, when the theoretical part of

Educational and Training programs finish, a practical action project with the collaboration of SMEs will include.

C. E2DRIVER- Sector-Specific Approach

E2DRIVER- Sector-Specific Approach is a collaborative training platform which tries to boost with best suitable knowledge the SMEs. Require training and sustainable methodologies are the main targets of platform in order to make SMEs aware of the multiple benefits of energy efficiency improvements and implementation of energy audit. This type of project differs from others because it has a single-sector approach which try to focus on automotive sector with scope the training and understand the reality of activity.

Training approach of E2DRIVER separates into three parts:

- E2DRIVER Adjustment sector where projects experts meet with the company in order to present best suitable training Schechule and prepare final corrections.
- E2DRIVER training depend according to needs and position of the employees. Training material will follow a cycle-training Schechule for the best training knowledge under a pedagogical procedure
- E2DRIVER capacity-building program with the aid of virtual reality where trainers will learn more about energy measuring.

D. INNOVEAS-Building Lasting Expertise in SMEs

INNOVEAS is an initiative program which promoted by 10 partners from 6 European Union countries and creates a capacity-building program that removes the non-technical barriers. Main objective of the project is to create a cooperation between continuously and permanent training and knowledge in sectors of self-sustainable services and raising of awareness in the field of energy efficiency measures and energy audit. Creation of an international network is an important step to reach the targets and final outcome. Training activities are structured as follow:

- Web-based modules developed by each partner
- In situ training for group of companies
- In company training at the premises of few selected SMEs
- Training videos and web seminars

Training will not only help SMEs but also the intermediaries who will be responsible for the dissemination and sustainability of the projects outputs after the conclusion of the activities.

Requirements and helpful tools of the four projects, SMEs that implement an energy audit need further assistant, in the sector of energy measures. Developing projects are not help SMEs at high percentage yet researches show that SMEs show phenomenon of dysfunction and lack of knowledge. Each project has a different approach into energy management and examples of possible mechanisms are possible to adopt from European Union member States in the future.

Despite the implementation of a project, none of the approach can eliminate all barriers of a SME. Combination of projects and follow of policy recommendations will increase uptake of energy audit and implementation of the resulting energy efficiency measures. Develop of suitable mechanisms in sector of finance, energy efficiency benefits, training of SMEs employees and stakeholders and energy management are the pylons of a beneficial project.

5.3. COVID-19 and Limitations for SMEs

Research and Developing of clean energy and Decarbonisation for European Union at the last decade cost up to 20 billion euros for European Union and Member States. Greenhouse gases targets of European Union and decarbonisation of electricity generation emits to a huge percentage into SMEs. Prior to pandemic SMEs implement high investment EnMS to reach those targets with the aid of grants. Difficulties into financial procedure can pauses some projects or SMEs will turn into short time profitable decisions with high carbon emissions. [2]

On the other hand, energy innovative solutions and recovery of the financial framework of EU must continue and ensure the progress of Union. Lack of support due to crisis of pandemic will be heavily impact for Europe's SMEs. Almost 66% of European Union citizens are employed by SMEs and with bankruptcy of some SMEs chained disadvantages for example high increasing of unemployment will identify. RES, hydrogen solutions, storage technologies and low-emission solutions can change barriers into opportunity for new jobs and new economic and public opportunities. Moreover, in case of European Union failures to support SMEs the business trust of Union will underestimate. Entrepreneurs will not encourage starting a new business or will not tend to invest capitals for renovation or improvements.

The European Union through the recovery plan of "Next Generation EU" shown his ability to support member states and recover economy plans for green investments. Investments muse support SMEs into clean and green energy sector to achieve also long term goal about climate change until 2050. Challenges can transport into opportunities with innovative investments and sustainable cooperation between SMEs and European Union. Also, European SMEs need to support in this difficult pandemic era to strength their competitive advantages, protect entrepreneurial culture and defend its industrial future. [1]

6. Cyprus

Sustainability of Cyprus economy based with a huge percentage from SMEs. COVID-19 pandemic create economic barriers for SMEs, especially micro and in the sector of catering centers, restaurants, bars and all the level of tourism. Governments with the aid of European Union funds try to encourage financial affected sections of economy. Cyprus SMEs have to implement an energy management system with limited cost or no-cost technologies at this difficult era. New innovative technologies, computer science technologies and automations are the main ways for an owner of Cyprus SME to reduce cost and improve knowledge and financial of his enterprise. [2]

6.1. Cyprus SMEs

According to statistical service of the Republic of Cyprus, number of enterprises at 2017 was 96936. The number of enterprises at 2016 was 93066. In addition, index of Cyprus enterprises presented increasing of 4.2%. Period between 2011-2014 index of enterprises present decrease due to economic crisis but since 2015, increasing observe at this number. Table 7, Table 8 and Table 9 show important statistics about number of Cyprus enterprises, job opportunities and energy efficiency of SMEs. [4]

Number of Employees	Number of Enterprises	Percentage (%)
0-9	92095	95
10-49	4060	4.2
50-249	674	0.7
249+	107	0.1
	Total=96936	**100**

Table 8: Number of Enterprises in Cyprus [3]

Year	Change into number percentage of active SMEs (%)
2012-2013	-1,2
2013-2014	-1,7
2014-2015	2,1
2015-2016	3,2
2016-2017	4,2

Table 9: Increasing or Decreasing of Cyprus enterprises per year until 2017 [3]

Economic Activity	Number of Enterprises	Energy Efficiency	Potential
Activities of Heterogeneous Organizations	1		
Agriculture, Forestry and Fishery	3618	Low	High
Mines and Quarries	50	Medium	High
Processing	5024	Medium	Medium
Electricity, Gas, Steam and Air Conditioning	75	High	Medium
Water Supply, Sewage treatment, Waste Management	201	High	Medium
Constructions	7847	Medium	High
Wholesale and Retail Trade, Repair of Vehicles, Motor and Motorcycles	16704	Low	Medium
Transport and Storage	3113	High	High
Activities of accommodation and catering services	5770	Medium	High
Information and Communication	1644	Medium	Medium
Financial and Insurance activities	2956	Medium	Medium
Real Estate Management	1000	Low	Medium

Economic Activity	**Number of Enterprises**	**Energy Efficiency**	**Potential**
Professional, Scientific and Technical Activities	7988	High	High
Administrative and Support Activities	3082	Medium	Medium
Public Administrative , Defense and Social Security	296	Medium	Medium
Education	2667	Medium	High
Activities related to Human Health and Social Welfare	3940	High	Medium
Art, Entertainment and Research	2073	Low	Medium
Other Service Activities	5234	High	High
Households Activities: For own production of goods and services	23653	Medium	Medium

Table10: Cyprus SMEs [3]

Regarding to these tables Cyprus has limited companies with more than 250 employees. Moreover, most of companies have less than 10 employees. Also, most of companies that are active in Cyprus show a high or medium potential for possible energy efficiency improvements. SMEs mostly waste energy at transport, heating and cooling systems, lighting and manufacture.

In Cyprus 99.9% of enterprises are SMEs. Research shows that from this percentage 93.6% are micro enterprises. Significant barriers of Cyprus SMEs are financial support and financial limitations. Moreover, lack of knowledge with regulations and laws conclude with administrative issues for enterprises. In addition, SMEs without a management who has the necessary knowledge about energy efficiency cannot benefit from a possible implementation of energy saving measures. Ministry of energy, Commerce and Industry of Cyprus show that Cyprus SMEs are interest about implementation of an energy management program but limited knowledge difficult the procedure. At small and micro enterprises significant changes to improve energy efficiency, deal with lighting or education of personnel

because these activities are cheap and is possible to achieve with the aid of larger companies. Useful and innovative procedure characterizes the cooperation between companies. Opportunities for reduction of consumption and energy have been identified but limited interest and good examples limitation are discouraging other companies for similar endeavors. Also, a survey of Cyprus Employees and Industrial Federation conducted in the scale of European SMEs power efficiency program which founded by Horizon 2020 about energy savings of Cyprus SMEs show that:

- Almost 60% of Cyprus SMEs believes that they have high electricity bill and consumption. On the other hand, majority of enterprises do not has different meter for electricity consumption and oil and gas consumption. Result of this phenomenon, the enterprise cannot understand the specific numbers of consumption about electricity and gas
- At the next three years, 66% of enterprises will take advantage of possible grants to achieve energy savings
- The 36% of enterprises that participate in the research, they reach some energy savings into the last two years and 25% of those enterprises have taken low cost measures and train personnel
- Most important reasons for Cyprus SMEs to participate into these programs are reduction of energy bills, improving of enterprise profile and climate changes take under consideration for some companies.
- Main barriers for energy efficiency improvements and time-waste procedures for administrative and public reasons.
- Research shows that priority for some enterprises is energy efficiency improvements but management of enterprise examines energy efficiency projects with the same criteria as all other investments. This concludes with trouble into the payback period. For example if a company sells accessories about cars will not have the same payback period with the energy efficiency improvements. For this reason, energy efficiency project must show as a beneficial project for the life cycle of the SMEs.

Specific financial support and policies should give by governments to help Cyprus SMEs to improve energy usage. Implementation of innovative technologies in cooperation with

knowledge and train of personnel would simplify the procedure. Moreover, tax exemption and access to finance to simplify procedure. Those actions will encourages Cyprus SMEs and meet the requirements that set from European Union. Ministry of Energy, Commerce and Industry of Cyprus show that Cyprus SMEs are interest about implementation of an energy management program but limited knowledge difficult the procedure. At small or micro enterprises significant changes to improve energy efficiency deal with lighting or education of personnel because those activities are cheap and are possible to achieve with the aid of larger companies. Useful and innovative procedure characterizes the cooperation between companies. Opportunities for reduction of consumption and energy have been identified but limited interest and effective examples absence are discouraging other companies for similar endeavors.

6.2. Motives for Cyprus SMEs

Governments in Cyprus, continue their effort to support with new financial grants SMEs with a scope to improve effectiveness, competitiveness via new projects and energy management systems. Information about relevant funds and possible improvements provided through seminars, campaigns and events that organized by European Union groups. According to measures of European Structural and Investment Funds (ESIF) Cyprus SMEs identify financing gaps in the sector of energy. Creation of a financial engineering instrument to support financial SMEs with a target the improvement of energy efficiency and renewable energy projects was recommended by ESIF. The study will create under certain governance options for the management of financial instruments.

Small Business facilities have taken into account in a sustainable and caring developing and support. Specific financial programs with objective of expert assistance, business advice and train of personnel illustrate on the program. Measures and schemes with the aid of European grants will help Cyprus SMEs to create new jobs under energy efficiency programs and remain the competitiveness of enterprises on high standards.

6.3. Cyprus plan for reduction of GHG emissions

Long term target of Cyprus according to Cyprus National Plan for Energy and Climate for the period of 2021-2030 set to 40% compared to 2005 about energy efficiency results. Reduction of GHG emissions requires permeation for Renewable Energy Systems (RES) and policies depend on energy efficiency projects. Cyprus SMEs can react as a protagonist and play an important role to reach these targets. New technologies and SMEs that will be under construction have to design according to national legislation and will be nearly Zero Energy Building. Use of solar systems for water and heating and cooling systems require especially in Cyprus. Increasing of RES projects introduce the exploitation of solar power. Moreover, grants scheme for upcoming years show that new energy efficiency loans for promotion of energy efficiency projects into industry sector and SMEs introduce. Operation Program "Competitiveness and Sustainable development 2014-2020" encourage competitiveness and construction of SMEs with energy updates. Moreover, programs of Natura 2000 and Horizon 2020 will help into this procedure for Cyprus. [19], [22].

7.Energy Efficiency program for Swedish industrial SMEs

Swedish Government proposed a national program about Industrial SMEs that use 500Mwh of energy annually. The industrial energy program of Sweden implement with the aid of energy audits programs and long-term agreements (LTA). Industrial energy of SMEs consider as one of the most expenditure factor of energy waste at the country. Main target of program is to minimize the "energy efficiency gap". That means to minimize the gap between the potential cost-effective energy efficiency measures and measures that actually implement. Largest Swedish industrial program include: [12], [23]

- EKO – Energi (1994 – 1997), a voluntary agreement programs towards around 70 energy intensive companies
- PFE – Program to improve Energy Efficiency in Energy – intensive Industries, an LTA towards electricity intensive industry involving about 120 companies.
- Project Highland (2003 – 2008) a local clean cut energy audit program in six Swedish municipalities involves 340 SMEs among where 140 were industrial enterprises. [20]

Important of those programs is the design and effective way to reduce CO2 emissions into industry and programs to remain sustainable and design more effective design programs for future.

Participants of the group were two lawyers that set up from the Swedish energy agency and one specialist who is responsible for the delivery of the design program. Methodology was schechule from Swedish energy agency and first meeting with a literature study on how the program has to construct and the constructed report. The working group reviews the report and conclude with interviews where national specialists on energy efficiency of industry give their view for the design and the necessary steps of the program.

The literature study includes and based at the:

- National and International reports on energy audits
- Energy programs for industrial SMEs
- Publications and studies that related with barriers about energy efficiency among Swedish industrial SMEs. Include cost-effective measures, market failures and market imperfection. Participation of Energy Services Directive (ESD) that launched by European Union help to face those barriers with effective mechanisms, financial and legal frameworks and create conditions for the development and promotion of markets.
- Based on energy program of Norwegian and Finnish model.

After the theoretical developed design and practical implementation factors with political targets and financial budgets design the final program structure.

Energy Management practices illustrate with the aid of energy audit. Energy audits at this level go beyond the traditional because they analyze specific energy programs about SMEs and include all the necessary steps. For example, they involve the certification steps according to European Union standards, energy procedure based on the related barriers of energy efficiency and a structure energy plan for the company. Furthermore, design of energy program covers a number of elements that needs to be considered such as the formulation of program targets, implementation structures, identification of key steps and administration difficulties.

Energy program for industrial SMEs depend on the subsidy. Energy audits depend on the level of subsidy, so depend from Swedish governments and Swedish industry program SMEs will have the proportional increase. Most effective solution is the scenario of long-term contracts which involves energy policies for energy technologies.

The life-spam of the energy programs set to five years, with specific goal of 900 energy audits to SMEs or 25% of Swedish companies to join the program. Proposed budget of Swedish program estimated to be around 3500000 euro, where 30% of this estimated to be allocated into administrative sector. Due to this fact, implementation of energy efficiency measures savings counted from 700-1400Gwh annually.

7.1. Swedish SMEs

Class size	Number of Employment		
	Sweden		EU-28
	Number	Share (%)	Share (%)
Micro	797617	23,8	29,7
Small	748188	22,3	20,1
Medium	638490	19	16,8
SMEs	2184295	65,1	66,6
Large	1167660	34,9	33,4
Total	3351955	100	100

Class size	Number of enterprises		
	Sweden		EU-28
	Number	Share (%)	Share (%)
Micro	699377	94,6	93
Small	33411	4,5	5,9
Medium	58006	0,8	0,9
SMEs	790794	99,9	99,8
Large	1062	0,1	0,2
Total	1582650	100	100

Class size	Value		
	Sweden		EU-28
	Number (Billi	Share (%)	Share (%)
Micro	51,9	22,3	20,8
Small	44,3	19,2	17,6
Medium	45,8	19,7	18
SMEs	142	61,2	56,4
Large	90,2	38,8	43,6
Total	232,2	100	100

Figure 3,4 & 5 show Number of Employment, Number of Enterprises and Value of Swedish Enterprises than EU-28. [23]

Swedish SMEs with an increasing and beneficial rate continue step by step scaled up their operations at the last years. Value and environmental behavior under certain energy restrictions remain at higher percentage than the other European Union member states. Number of enterprises and number of personnel are almost at the same level as European Union. On the other hand, due to innovative programs that offer from Europe, Sweden SMEs has better skills and innovative solutions, especially at the past five years. Moreover, increase level of entrepreneurship, with the aid of media and education from school rank Sweden above the European Union average. Lastly, Sweden sign long-term agreements with other sustainable economics to reach future targets results into energy efficiency and in environmental portfolio.

8. Barriers

SMEs each day have to face with possible challenges and barriers. Globally at recent year enterprises need to construct an energy management system. Financial, knowledge and information barriers significant are limitations about energy performance or energy savings. Researches show that SMEs always need to identify possible energy and financial savings from an energy management system before implementation. Energy efficiency programs and financing opportunities usually perform into energy audit with policy and energy management recommendations. Until this point possible barriers for an enterprise define

[38]

- **Communication, Knowledge and incomplete Background**

Improvements and Decarbonisation strategies at a level of enterprise need an engineering background with the aid of energy audit and management. Auditor must perform to interest parties possible outcomes of research with a percentage about reduction and actions of enterprise. Personnel and manager of enterprise knowledge identify usually as a barrier for the auditor. For this reason, energy efficiency importance and improvement framework actions must be analyze to personnel. Personnel of enterprise have to frame their background about energy experience. Communication between enrolment parties will help with possible energy savings. For example, energy efficiency program can separate into different scales according to work experience and work place. Personnel also separate depend o the importance of their job, experience and accessibility into energy consumption machines. Due to the final result of this research auditor can identify possible knowledge gaps of personnel, separate workers according to job category and train them with applicable and specific programs. In addition, knowledge and experience can split into two parts through communication. Into existing knowledge and knowledge that need to learn through training.[24]

Training of personnel needs to perform based on their skills and abilities. Less experience and more experience members must train together. Separate them into small groups and

with the aid of communication, small group discussions and group search new knowledge topics can identify and analyze in a sustainable way. Participation into a small group with low and high paid workers provides the sense of belonging. Through this process, best practices with helpful tools increasing business trust and awareness about enterprise can achieve from manager until low paid workers.

- **Limited Knowledge in Energy Efficiency and Energy Management Systems about financial advantages**

Energy efficiency improvements with the aid of Energy Management System (EnMS) is a long term investment that take some years for payback about SMEs. Improvement of energy efficiency, reduction of carbon dioxide and minimize of greenhouse gases are interconnected. Most of the times, energy efficiency require a capital cost. Significant due to public grants and other loans can minimize cost or cover a percentage of investment. Technical, behavioral and organizational obstacles significant need to overcome to simplify procedure at SMEs. EnMS require establishment of energy policy to proceed about energy saving measures. Management of SMEs needs to identify the possible energy savings of enterprise. Limited knowledge of energy savings and energy efficiency financial viability are significant barrier of an auditor. In case that the manager of enterprises does not know the necessity of energy efficiency, auditor needs to explain the main targets. Also, due to EnMS possible payback period depend on the investments must show.

- **Dependence to a group of clients**

SMEs require having specific clients to ensure their viability. On the other hand, sometimes this phenomenon is a weakness especially for small or micro enterprises. Due to this fact, enterprise need to recycle their clients if it possible. For example, for a construction company advertisement will be a helpful tool for new technological partners and clients with the aid of EnMS. In case of enterprise depends on some clients and those clients left, the viability of enterprise and financial balance will change. Moreover, dependence o a group of clients has limitations about enterprise competitiveness and cannot increase to a large company or has profitable future.

- **SMEs financial availability**

Economical l crisis and economical potentials of citizens last decades are not encourage the development or unnecessary expenses of SMEs. Energy efficiency improvement of a SME can identify as an additional expense for the enterprise. Due to this fact, energy management system implementation can burden. With those situation worldwide, and due to economic shock especially micro and small enterprises will have some issues.

Main barrier for SMEs to implement an energy audit and introduce energy efficiency improvements is the financial support. A possible opportunity for money is percentage from last year profit if the company has a beneficial season. Possible financial support can take for supplier in case of new equipment, from an Energy Authority Office and from banks. A supplier is possible to has its own financial options or be able to recommend alternative ways of finance. SME financial support program, for example in case of European Union can detail from an Energy Office an banks can offer a loan for energy efficiency updates with rates links to the return of investment and long to energy saving potential of the project. Better financial and easier procedure with banks and energy offices will happen with share of existing success projects. Use of case studies especially with model of companies that do business at the same sector and competitors can be a push to illustrate an energy policy. Also, payback period and total saving per annual and lifetime should point for more efficient procedure. Last but not least, SME which is interest for energy efficiency improvements and need financial support is able to check for programs with loans, grants and energy communities that is possible to offer financial support for energy improvements. Energy brokers or organization can help to find what is suitable for your business at value for money option. Owner has to know which supply they represent and how to pay the broker. On the other hand, id enterprise owner understand the energy consumption and cost can make a market research and find the best profitable and working product that suits to his business under the terms and conditions of the SME.

- **Training of Personnel**

Measures, investments and procedure of a project cannot implement without training and teamwork and professionalism. Many pressures and difficulties through procedure can

overcome with effective teamwork and a planned project design. Moreover, this combination of personnel will help enterprise to understand better energy efficiency potential and identify possible savings opportunities

Staff and management especially in large enterprises will help the procedure. In those cases supervisor of each department can provide the best solution because job, equipment and procedure know it better the personnel that is related with specific positions. Each procedure at each department has to done at the best time annual. For example, when the staff of a department is missing for any reason the final measures will present gaps. Moreover, communication between the employees and suggestions will improve sense of employees and suggestions will improve sense of belonging and improve energy ideas. Final ideas of employees must report from supervisor with energy performance, measuring and report with the aid of graphs to compare them.

Consultation with staff helps into final energy efficiency results. Strong business activity plan require all staff to understand the need of improvements, introduction of innovative ideas that will help to make their job easier and communication enforce into final actions. Environmental friendlier procedures can change mentality of personnel with limited information. For better results staff managements need to motivate employees with some rewards. Motivations can be financial, ethnical, business benefits. Extra motivation for employees can be a percentage for those cost savings will return into the staff, charity group team or the department with the highest energy saving percentage will benefit with a free lunch for a week or a day-off.

Best practical information and integration encourage staff to include energy considerations into other application of their work. In case of new equipment or new employees are possible actions through implementation. Teamwork and engagement help enterprise to identify easier energy saving opportunities. Those savings take in place the company for new contracts, stronger business profile, investments for improvements and savings. Step by step with low cost and limited data the enterprise can change the environmental and energy profile.

Procedure includes a row of simple questions for example:

- How much energy are you actually using?
- When are you using it?
- How much is it costing you?
- What can you do to reduce it?

Energy consumption requires measuring and tracking otherwise, you cannot manage it. Meters can be a useful tool for SMEs. Readings of gas and electricity must check daily, weekly or monthly and record of bills must prepare. Energy provider, it is possible must to send energy consumption per quarter, check it and see high demand periods, energy anomalies and cost usage. Also, with the calculation of energy base, consumption data will help understand where and why use energy and can track it during holidays, days off and time-break during the day. This procedure, of energy must do before work start. In case of reception of automatic meter, readings can be taken manual. Energy use can be a part against the enterprise output. Possible estimation of output with specific amount of electricity can monitor better the energy consumption against production of company.

9. Case study

L.N. FROZEN LIMITED & Espresso Bar Agias Varvaras

The enterprise is located at Ayia Varvara of Nicosia in Cyprus, in a property of 650m2 and its operation since 2018 at Ayia Varvara. Before the enterprise was just L.N. Frozen limited at Latsia and main facility was made pizzas for small supermarkets. L.N. Frozen limited prepare frozen pizzas and sell them to small supermarkets or in the store. Moreover, sells frozen products. Espresso Bar prepare take out coffees, so the clients are not stop for a long time or has a place to sit and drink coffee.

The building is separate into two different halls. The inside which personnel are prepares pizzas for the small supermarkets and the main hall which are selling frozen products, frozen pizzas and coffee. Inside building has a room for the preparation of pizzas slides and cut of the products and another room which has furnaces and fridges. The personnel cannot define with a specific job characteristics because is a family enterprise and everybody is possible to work at all positions. At the enterprise work 5 persons, the one of them is working for delivery.

For heating and cooling of the building during winter and summer period uses air-condition. The heating and the cooling are a serious problem for the owners but on the other hand because the clients are usually take a coffee and leave or just be in the place for 10 minutes this is not an issue for the enterprise to lose some clients.

Equipment

A. Inside (Pizza Preparation Hall)

- Large Refrigerator LU-VE
- Fermenter
- Furnace X2
- Air – Condition X2 Mitsubishi
- Package Machinery

Suggestions for this place

- Switch off all the lights, air-conditions and turn off all machineries when are not use
- At weekends when nobody prepares pizzas the switches must turn down.
- Furnace must change position because are near of the large fridge and this has a result the furnaces not running with high efficiency.

B. Outside (Frozen Product Hall)

- Large refrigerator X2
- Air Condition

Suggestions for this place

- A door which is near of the refrigerator always must be close to remain the temperature into refrigerator and work at high efficiency levels
- High cost investment is the refrigerator market as a future plan

C. Main Hall (Coffee Maker Hall)

- Coffee Machine
- Coffee Blender Mazzer Luigi
- Mixers X2
- Fresh Juice Blender
- Blender
- Small Fridge X2 Tefcold
- Tying Machine
- Small Furnace Deli-Hot
- Air Condition Mitsubishi

Suggestions for this place

- Timer into coffee machinery to control energy consumption and don't lose time to warm up machine.
- Change position of ice maker because is near of the coffee machine and do not work at high efficient levels

D. Office Equipment

- Printer

Suggestions for this place

- The printer switch on when they need it.

E. Other energy waste

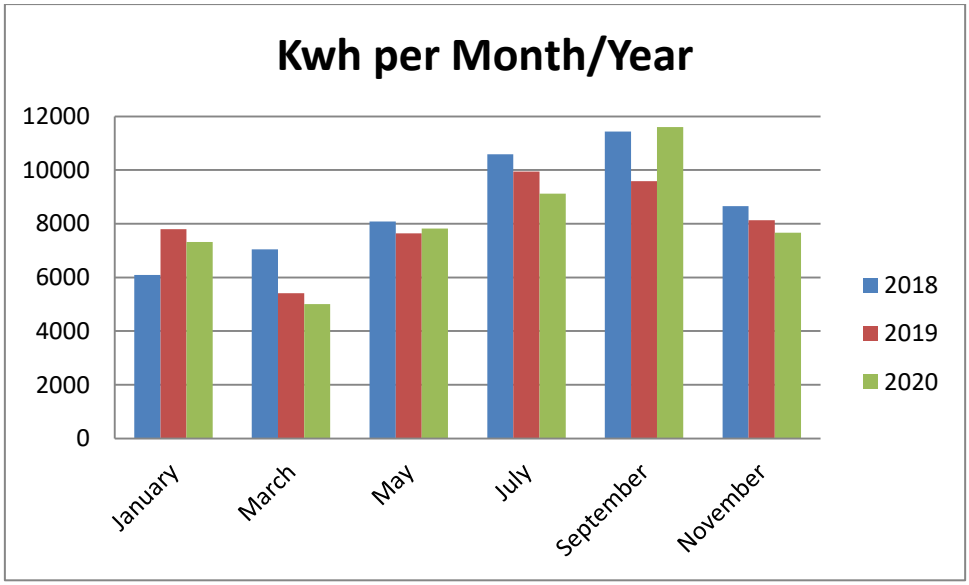
- Large Refrigerant Le-Vu outside of the building that work at -10 degrees and place under a shadow place
- 16 lamps on the building. All are LED and sometimes are not open because the building has good openings.

Suggestions for all the equipment

- For all the refrigerant temperatures must written once a day and control temperature according those details.
- Lumps must switch off in case of not use.
- All the switches must turn off, especially at Sunday when the shop is close.
- Maintenance to all the products at the appropriate period.

Year	2018	2019	2020
January	6089	7803	7320
March	7047	5415	5005
May	8078	7644	7825
July	10583	9939	9124
September	11436	9591	11602
November	8659	8135	7663
Total	51892	48527	48539

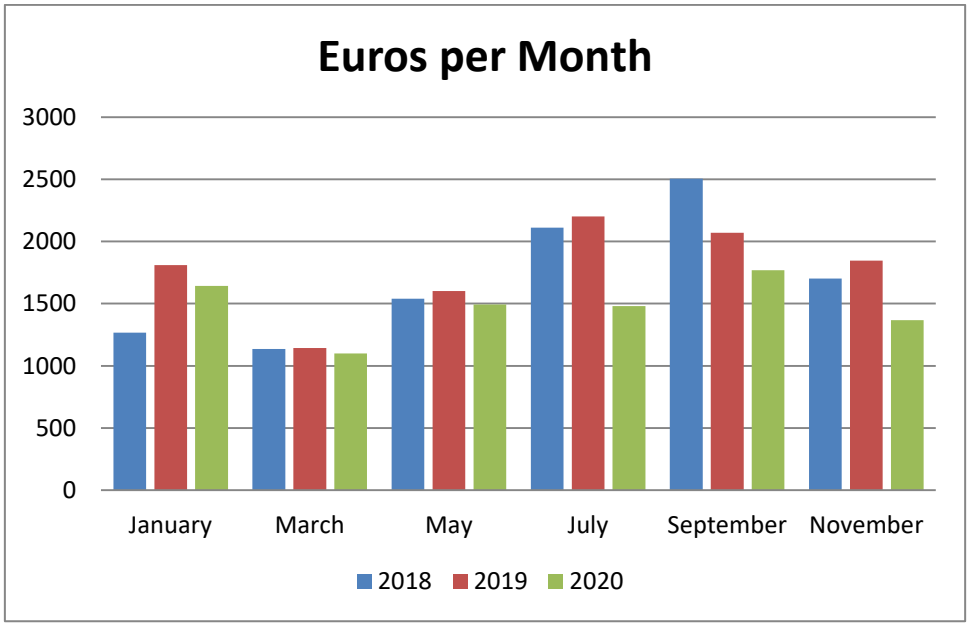
Table1: KwH per Month



Graph 1: Energy consumption counted every 2 months for 2018, 2019, and 2020. Kwh are counted by Electricity Authority of Cyprus (EAC)

Year	2018(€)	2019(€)	2020(€)
January	1267,41	1810,89	1643,32
March	1134,39	1142,23	1098,15
May	1539,29	1600,83	1492,83
July	2110,64	2200,72	1480,43
September	2504,35	2069,09	1768,41
November	1701,67	1846,53	1368,09
Total (€)	**10257,75**	**10670,29**	**8851,23**

Table 2: Money that enterprise pay (Due to reduction of 2020 the amount of money in 2020 are less)



Graph 2: Electricity Bill is related to energy consumption. Months of 2020 from May and July are less due to some reduction from EAC because of COVID-19.

Suggestions for reductions with Payback Period

Main issue for the enterprise is the two large refrigerators which are in the outside hall that prepare pizzas and outside which is working under 5 degrees minimum.

Case: Le-Vu Refrigerant: Replacement of evaporators will reduce energy consumption of the refrigerant cost up to 25%. Estimated Kwh annually of refrigerants will reduce more than 6000kwh in combination. The two evaporators cost 2900 euros. Each year due to nowadays price of EAC payback period is: 6000kwh almost 1300 euros. [5], [6]

Payback period is 2900/1300 = 2.25 years.

Photovoltaic Panels to reduce electricity and CO2 emissions

Photovoltaic Panels up to 5kw cost 6450 euros due to Suntechnics prices. Photovoltaics panels can produce an average of 8000Kwh annual. Also, due to government grants the price of 6450 euros can minimize up to 50%. In addition, payback period can reduce to 2 years and enterprise must benefit from this. Due to nowadays prices

8851(Amount of money for 2020) / 48539 ((Total consumption of 2020) = 0.183 Kwh / €

0.183Kwh / € X 8000Kwh (Annual production of Photovoltaic) = 1.464 euros per year

6500 € (investment) / 1464(euros in production per year) = 4.4 years payback period

10. Conclusion

Sustainability of earth threaten, population of earth and needs of people increasing day by day and all over the world a sense of insecurity define. Market pressures and worldwide unknown future because of those phenomenons and due to COVID-19 pandemic have negative impacts for psychology and financials at the life of people. On the other hand, governments make clear that they will support and encourage SMEs at the sectors of economy and sustainability. SMEs define almost 90% of the world enterprises and employ millions of people. Due to sustainable procedures SMEs can improve energy efficiency, competitiveness and remain at least at a stable financial level. Short-term and long-term targets have to set for every SME in the sector of decarbonisation

In conclusion, every SME have to adopt strategic measures towards curbing the effects of the enlisted factors to remain unsunk and functional in the expanding business world infested with financial crises.

11. References

[1] Union, E. (n.d.). *No Title*. Dialogue of European Dicarbonisation Strategies. https://deeds.eu/the-impact-of-covid-19-on-the-critical-role-of-small-and-medium-enterprises-smes-in-electricity-sector-decarbonisation/

[2] Mirror, F. (n.d.). *No Title*. COVID19: EU Commission Tells Cyprus to Bolster Health System, SMEs. https://www.financialmirror.com/2020/05/21/covid19-eu-commission-tells-cyprus-to-bolster-health-system-smes/

[3] Κύπρου, Σ. Υ. (2018). *Μητρώο επιχειρήσεων*.

https://www.oeb.org.cy/mitroo-epicheiriseon-2017/

[4] Marika Bröckl, Julia Illman, Laura Oja, Iivo Vehviläinen, G. C. L. (2015). Energy Efficiency in Small and Medium Sized Enterprises. © *Nordic Council of Ministers 2014*, *A*(A), 80.

[5] Preston Llewellyn, John Llewellyn, and D. Z. (n.d.). Decarbonisation: Future Growth for Manufacturing. *Llewellyn Consulting*, *The Manufa*(a), 49.

[6] Mr Prosanto Pal, M. R. S. (2015). LOW-CARBON TECHNOLOGIES IN SMEs. *HIGH LEVEL CORPORATE DIALOGUE*, 41–44.

[7] *INTELLIGENT ENERGY EUROPE*. (n.d.). https://wayback.archive-it.org/12090/20210201143503/https:/ec.europa.eu/energy/intelligent/projects/

[8] *INTELLIGENT ENERGY EUROPE*. (n.d.). https://wayback.archive-it.org/12090/20210201143503/https:/ec.europa.eu/energy/intelligent/projects/

[9] Adnan Hrustic, Per Sommarin, M. S. (n.d.). A Simplified Energy Management System Towards Increased Energy Efficiency in SMEs. *Department of Management and Engineering*, *5*(Industrial Energy Efficiency), 10.

[10] Shankara Naik1, 3 and Dr. S B Mallur. (2018). The Benefits of Energy Efficiency in Small and Medium Enterprises. *IOP Publishing*, *B*, 12.

[11] María A. Quintás, A. I. M.-S. * I. and A. S. (2018). The Role of SMEs' Green Business Models in the Transition to a Low-Carbon Economy: Differences in Their Design and Degree of Adoption Stemming from Business Size Title. *Faculty of Economics, Universidad de Vigo, Campus Universitario*, *Third Edit*, 18.

[12] Sweden. (2019). SBA Fact Sheet. *European Commitee for Sweden*, 10.

[13] SEAI. (2020). SME Guide to Energy Efficiency. *Sustainable Energy Authority for Ireland*, *A*, 74.

[14] Avelina Ruiz, Fernando Olea, G. G., & Valeria López Portillo, A. N. (2019). Decarbonization challenges and opportunities for the light manufacturing industry in Mexic. *HBSC, Together We Thrive*, 72.

[15] HM Goverment. (n.d.). Industrial Decarbonisation Strategy. *Presented to Parliament by the Secretary of State for Business, Energy & Industrial Strategy*, *CP399*(A), 165.

[16] London, E. I. (2016). A guide to Energy Management. *Energy Institube*, *First Edit*(A), 20.

[17] Argyrou, T. (2017). ISO50001 COSTA COFFEE. *SES*, *A*(A), 10.

[18] Agency, S. E. (2019). *Sustainability for Cities*. Gredbyvägen 10 Eskilstuna Rosenlundsgatan 9 Stockholm. https://www.energimyndigheten.se/en/

[19] Standarisation, C. O. for. (2011). Energy Management Systems. *CY EN:ISO*, *ICS127.10*, 29.

[20] Agency, I. E. (2019). Energy Policies for IEA countries. In *Sweden review*.

[21] Kilili, A. (2016). Environmental Management. *CYS EN ISO14001*, *First Edit*, 30.

[22] P. D.-I. A., Hahn, & P. D. C. Agert, (n.d.). *Modeling decarbonisation pathways of Europe's electricity supply system until 2050*.

[23] Patrik Thollander a,*, E. D. b. (2010). An energy efficiency program for Swedish industrial small- and medium-sized enterprises. *Journal of Cleaner Production*, *First*, 7.

[24] Backman, J. P. & F. (2020). Energy efficiency in SMEs: overcoming the communication barrie. *Energy Efficiency*, *Original a*, 12.

[25] Mallur, S. B., & Naik, S. (2018). *The Benefits of Energy Efficiency in Small and Medium Enterprises*. *A*, 7–10.

[26] Union, E. (2019). https://ec.europa.eu/environment/archives/sme/legislation/energy_efficiency_en.htm. *Environmental Compliance Assistance Programme for SMEs Small, Clean and Competitive*, *Energy Effic.*, 3.

[27] ΥΠΟΥΡΓΕΙΟ ΕΝΕΡΓΕΙΑΣ, Ε. Κ., & ΒΙΟΜΗΧΑΝΙΑΣ. (n.d.). ΣΤΡΑΤΗΓΙΚΟ ΣΧΕΔΙΟ 2021-2023. *Κυπριακή Δημοκρατία*, *A*(DRAFT 13.3.20), 83.

[28] 2, C. (n.d.). Demand Side Management. In *Integrated Resource Strategic Planning and Power Demand-Side* (p. 71).

[29] (2012). DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL. *Official Journal of the European Union*, 55A.

[30] DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL. (n.d.). *3 RD NATIONAL ENERGY EFFICIENCY ACTION PLAN OF CYPRUS*, *First Edit*, 280.

[31] Cibela NEAGU. (n.d.). The importance and role of small and medium-sized businesses. *University of Bucharest, Romania*, *No. 3(608)*(O10, O31, P12), 8 pages 331-338.

[32] Vaze, I. V. (project leader) and P., With, & Leah Corr, Eva Kasparova, F. L. (n.d.). *SMEs in a Low Carbon Economy*.

[33] Πρόγραμμα Κατάρτισης Ενεργειακών Ελεγκτών. (n.d.). *Σύστημα Ενεργειακής Διαχείρισης*.

[34] Madeline Schneider (adelphi), Jessica Weir (adelphi), A. B. (adelphi), Anthi Charalambous (OEB), Panayiotis Kastanias (OEB), M. P. (OEB), & Aris Ikkos (INSETE), Michalis Kyriakides (INSETE), S. M. (INSETE). (2020). Financing options to support GHG reductions in Cypriot and Greek hotels. *Experiences from Focal Countries and the EU Hotels4Climate*, *AI.3*(Report on potential for financing GHG reduction measures), 49.

[35] Department, C. E. (n.d.). *EUROPE 2020 CYPRUS NATIONAL REFORM PROGRAMME 2019*.

[36] THIMANN, C., , , Professor Paul EKINS, Beata JACZEWSKA, Barbara KUX, Karin WANNGÅRD, Laurence TUBIANA, Hans-Joachim SCHELLNHUBER (Chair), Commissioner Carlos Moedas, Maria VAN DER HOEVEN (Vice-Chair), C. B., & Novamont, C. E. O. of. (n.d.). *Final Report of the High-Level Panel of the European Decarbonisation Pathways Initiative*.

[37] Aikaterini Piripitsi, Evangelos Stougiannis, Nikos Chatzinikolaou, Giannis Thoma, C., & Ellinopoulos, Marios Kakouris, Savvas Ioannou, K. K. (n.d.). *4 TH NATIONAL ENERGY EFFICIENCY ACTION PLAN OF CYPRUS*.

[38] Susana Municio, Patrik Thollander, Svetlana Paramonova, Marie Rosenqvist, A. C. (2016). *Energy efficiency networks for small and medium sized enterprises – boosting the energy efficiency potential by joining forces, Industrial Efficiency*.

[39] Christopher M.KeinathSrinivasGarimella. (2017). *An energy and cost comparison of residential water heating technologies*.

[40] *Most of the energy used in paper production is renewable and carbon intensity is surprisingly low*. (2019). Navigant. https://twosidesna.org/much-of-the-energy-used-to-make-paper-is-renewable-and-carbon-footprint-is-surprisingly-low/

[41] *Most of the energy used in paper production is renewable and carbon intensity is surprisingly low*. (2019). Navigant. https://twosidesna.org/much-of-the-energy-used-to-make-paper-is-renewable-and-carbon-footprint-is-surprisingly-low

[42] EU SCIENCE HUB. (2017). The chemical industry can achieve a 36% reduction in annual greenhouse gas emissions by 2050, study shows. *EU SCIENCE HUB*, 1. https://ec.europa.eu/jrc/en/news/chemical-industry-can-achieve-36-reduction-annual-greenhouse-gas-emissions-2050-study-shows

Case study references

[1] Effrosyni Giama, Elli Kyriaki, P. F. & A. M. P. (n.d.) *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, *A*(A), 14.

[2] Kyriakia, E., * Efrosini. Giama., Papadopouloua, A., & V. Drosoub and A.M. Papadopoulosb. (2017).. *Energy and Environmental Performance of Solar Thermal Systems in Hotel Buildings*, *Internatio*(Procedia Environmental Sciences 38), 6.

[3] Papadopoulos, E. G. & A. M. (2016). . International Journal of Sustainable Energy, A(Carbon footprint analysis as a tool for energy and environmental management in small and medium-sized enterprises), 9.

[4] ΠΡΟΔΙΑΓΡΑΦΕΣ ΕΝΕΡΓΕΙΑΚΩΝ ΕΛΕΓΧΩΝ, (2018).

[5] JAB PRODAJA. (2021). *JaBSales*. EVAPORATOR F35JC 59 E6 LU-VE | €776.00 (jabsales.eu)

[6] JAB PRODAJA. (2021). *JaBSales*, EVAPORATOR F35JC 323 E4 LU-VE | €2,199.00 (jabsales.eu)

[7] Green Energy Group, Suntechnics, Net metering Cyprus - GDL Green Energy Group - Φωτοβολταικά Κύπρος (geg.com.cy)