Feasibility study and Cost-Benefit Analysis for an on-shore power supply installation in Souda Port.

Technical University of Crete

School of Production and Management Engineering

Alexandra Georgiou

Diploma Thesis

Thesis Supervisor: Prof. Spyridon Papaefthimiou
Committee Member: Prof. Michail Konsolakis
Committee Member: Prof. Dimitrios Ipsakis

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1. Introduction

This Diploma Thesis will consider the possibility of a Cold Ironing installation in Chania's port, Souda, from a cost-benefit perspective.
The aim of using Cold Ironing is to improve air quality in a port and in the city close to the port area, by reducing emissions of air pollutants such as NOx and SOx. This is achieved by replacing onboard generated power from diesel auxiliary engines with clean electricity supplied by a shore connection.
The present Thesis presents a technical design of the installation as well as its financial and environmental evaluation.
The Green aspect of the project is determined by the development of a photovoltaic park as an alternative way to generate electricity for the Cold Ironing application.
Finally, the viability of the total investment is determined by calculating Net Present Value, while at the same time the environmental benefits for the port of Souda are considered.

2. Cold Ironing

2.1 General Information

Cold Ironing or Alternative Marine Power (AMP) is considered a measure to improve air quality in ports and in the city close to the port area, by reducing emissions of air pollutants. This is achieved by replacing onboard generated power from diesel auxiliary engines with clean electricity supplied by a shore connection.

Figure 2.1 Cold-Ironing equipment in port of Los Angeles [1]

This application requires onshore installations for energy supply and the corresponding equipment onboard, so that they can receive the energy.

When the ships are being loaded or unloaded in a port, alternate marine power is supplied to them with the help of supply cables that are plugged into an electricity supply board in the port on one end and to the ship's power supply board on the other.

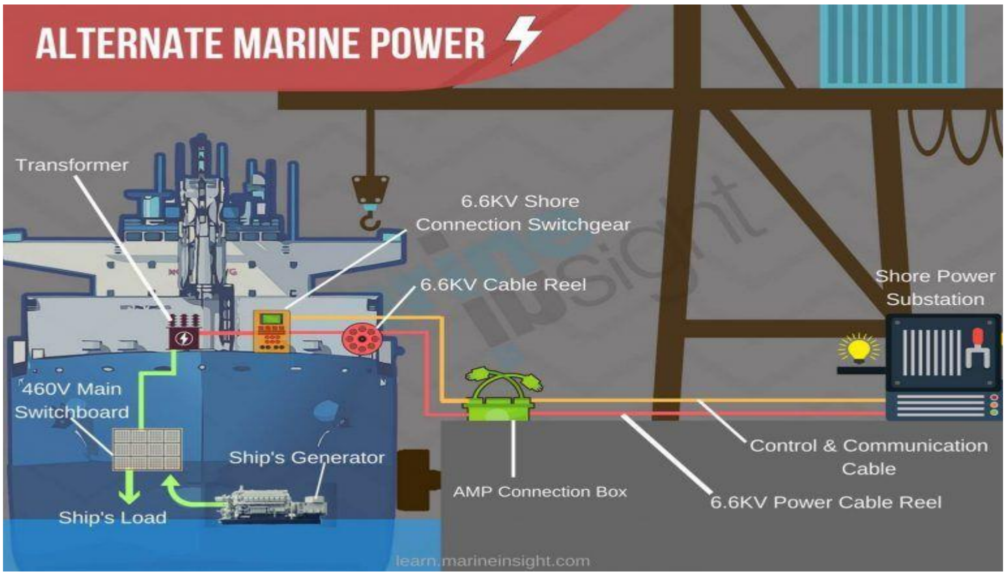


Figure 2.2 Cold Ironing Installation [2]

The process leads not just to preservation of the marine ecosystem but also contributes to lesser usage of diesel and other oily power supply materials. The power coming from the shore can be from a separate power generation unit or from the power plant supplying power to the port city or town. AMP provides power for lights, refrigerators, air-conditioners and other equipment on a ship. [2]

2.2 Cold Ironing System Configuration proposed by EU

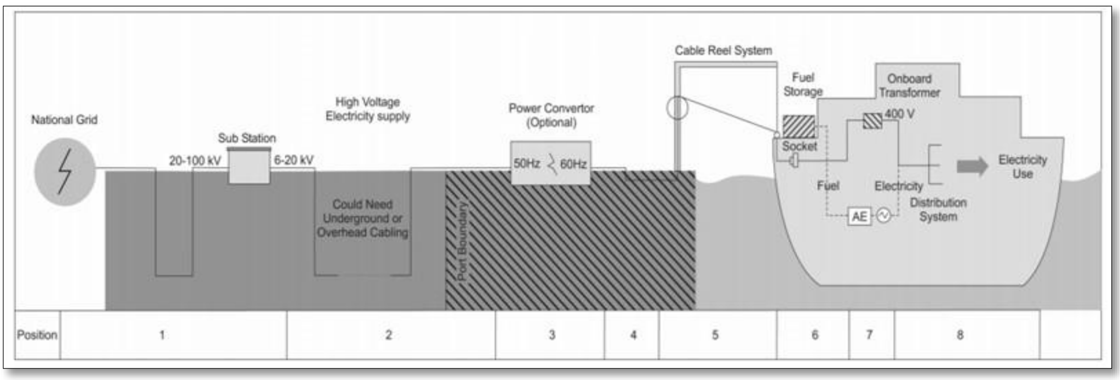


Figure 2.3 Overview of CI connection according to EU recommendation [3]

There are currently no existing standards for shore-side electricity, but a schematic diagram outlining the typical technical requirements and elements can be seen in Figure 2.3.

Elements of the system include as numbered in the figure:

1. A connection to the national grid is needed carrying 20-100 kV electricity from a local sub-station where it is transformed to 6-20 kV.

2. Cables are then required to deliver the 6-20 kV power from the sub-station to the port terminal.

3. The electricity may then require power conversion from the grid standard of 50Hz to 60Hz, depending upon whether the ship runs at 50 Hz or 60 Hz.

4. Electricity is then distributed to the terminal. Cables need to be installed underground within existing conduits or this may require new canalization. Electricity is metered.

5. To avoid handling of high voltage cables, a cable reel system is suggested. A cable reel tower could be built on the berth supporting a cable reel, davit and frame. The davit and frame would be used to raise and lower the cables to the vessel. The cable reel and frame would be electro-mechanically powered and controlled.

6. Onboard the vessel a socket is needed for the connecting cable.

7. The ship then needs to transform the high voltage electricity to 400 V to be used onboard. This transformer is preferably located near the main switch board in the engine room.

8. The electricity is then distributed around the ship, and the auxiliary engines are switched off.[3]

2.3 Port side equipment

2.3.1 Frequency Converter

Ships can operate at frequencies of 50 or 60 Hz. In the second case, frequency conversion equipment is needed. More specifically, a frequency converter is required onshore, with which the national network is converted from 50 Hz to 60 Hz, depending on the requirements of the ship.

Figure 2.4 3-Phase Frequency converter [19]

2.3.2 Transformer

Most vessels operate with 3-phase on 6.6kV or 11 kV. Thus, a transformer is required, to step down the voltage of the national grid (20 kV). Usually, the voltage of 6.6kV is preferred to reduce the size and quantity of copper cables to be installed, because those kinds of cables are more expensive and more difficult to manage. The transformer capacity needs to consider carefully the current and future requirements of the ships. For instance container ships with reefers need a significant portion of load, and the tendency shows that reefer capacities are rising in the most recent built ships. [4]

Figure 2.5 Voltage Transformer [20]

2.3.3 Switchgear

Between the Transformer output and the cables going to the dock face a switchgear cell is required. Switchgear is a mechanism which combines electrical switches and disconnection safety points, which are used to supervise, protect and isolate the electrical equipment. This equipment is directly connected to installation's reliability. It is used as a switch-off mechanism and helps to define breakdowns. Protective relaying is required at the switchgear cell to protect the transformer and the feeder cables. [4]

Figure 2.6 Switchgear box [5]

2.3.4 Cables and Conduits

Cables and conduits usually are similar to those of the rest of the terminal. In order to keep cables to a manageable size, they are typically sized to provide 4MVA of power each. Therefore, two cables can provide 8 MVA etc. The preferred mean for the control circuitry is fiber optic rather than copper. Conduits are sized to meet code fill requirements. One conduit is typically used for each power cable with a separate conduit for communications and controls.

Multiple switchgear units have to be installed near the berth face in order to switch off each receptacle when not being used. [4]

Figure 2.7 Cables for Cold Ironing Connection [6]

2.3.5 Connection Boxes

In the ports where CI is already applied, Cavotec boxes are mostly used, the design of which has become a standard for other companies as well.

These boxes are placed along the port usually near the stern of the ship. To provide flexibility not knowing both where the ship will berth along the dock and where the ship's cables are located, boxes are placed per specific meters.The boxes are key interlocked with the nearby switchgear using Kirk Keys.

This procedure is typically as follows:

- When the plug from the ship is inserted into the receptacle the key is removed. This locks the plug to the receptacle preventing it from being removed. The same is done for all the plugs.

- The keys are then brought to the nearby switchgear which is usually powered continuously from the transformer switchgear. Keys then are inserted into the locks at the breaker and turned. The breaker can then be closed to hold the keys captive.

- The ship's onboard power is then synchronized to the shore power. When synchronization is done, the breaker on the ship is closed to receive power. After that point, the engine can be shut down at any time. [4]

Figure 2.8 Connection box with one connector on the left and with two connectors on the right.

2.3.6 Cable Connection

The most common way to connect the cables to the ships is the lifting cable crane, the cables come from the installation and are lifted so that they are placed properly.

Figure 2.9 AMP Dispenser of CAVOTEC [7]

Another way to lift the cables, which is not used so often, is that of the crane truck. Before the ship arrives at the port the vehicle is connected to the cables of the connection box and after the mooring of the ship transports the cables through the integrated lifting system.

Figure 2.10 AMP Mobile Truck of CAVOTEC [7]

In recent years, many ships have been equipped with roller equipment, which includes a motorized cable management system that allows the cables themselves to be carried from the receptacles to the ship without having to depend on the lifting crane.

Figure 2.11 AMP Reel of CAVOTEC [7]

2.4 Onboard equipment

The equipment onboard is not very different from that on the port. Most ships have a transformer, cables and a switchgear.

Currently, there are two methods in use to make the switchover from ship's power to shore power. The ship's power can be turned off and then connected to shore power or the ship can remain energized and synchronized to the shore power for a continuous transfer power. With cruise ships this is critical because of the impact to the onboard systems when power is lost. On the contrary it is less important for the containers because even reefers can tolerate a brief interruption in power. However, power interruptions are detrimental to equipment reliability. Therefore most ships prefer the incorporation of synchronizing equipment with their CI implementation. [4]

2.5 Current Installed applications

In recent years, the application of Cold Ironing concerns many ports around the world as there is great interest in environmental protection. As a result, more and more ports and shipping companies are seeking to install CI equipment, with the aim of reducing air pollution.

2.5.1 Princess Cruise Ships

The first program of its kind in the world, Princess shore power program made history when it first began operations in the Alaska capital in the summer of 2001. This ground-breaking technology has now grown to include systems in Seattle, Vancouver, Los Angeles, San Diego, San Francisco and Halifax, and is planned to roll out in other ports that have made commitments to shore power programs, including New York.

Princess has outfitted 14 of its ships, many of which visit the port of Souda, with a custom-built electrical connection cabinet that automatically connects the ship's electrical network to the local electrical network onshore. [8]

Figure 2.12 Princess Cruise Ship [9]

2.5.2 Los Angeles Port

The port of Los Angeles is located in San Pedro and in 2004 announced the opening of the West Basin Container Terminal at Berth 100, the first container terminal in the world to use Alternative Maritime Power.

It can provide up to 40 MW of grid power to two cruise ships simultaneously at both 6,6 kV and 11kV, as well as three container terminals, reducing pollution from ship engines.

Each dock that has an CI application has its own dome which has two connections to supply the ships with a voltage of 6.6 kV at 60Hz.

In 2018 there were 75 such domes in the port of LA, which is more than any other port in the world. [1]

Figure 2.13 Port of Los Angeles [10]

3 Port of Souda

3.1 General Information

3.1.1 Chronology

Souda is etymologically derived from the Latin word “Suda” which means trenches, ruler, narrow passage. The port of Souda, due to its geographical location, has played an important historical, national and political role over time.

Information about the port during the Arab occupation and the second Byzantine period of Crete is limited. The wider area was ceded at the end of the **12th century** to the monastery of Patmos, which founded its most important monastery there. With the concession of Crete to the Venetians and its attempts to prevail during the **13th century**, the Gulf of Souda is mentioned as the place where the warring fleets transported.

Later, **during the Turkish rule**, the port of Souda became a naval base, anchorage and refueling station for the Ottoman fleet.

During the years of the Cretan State, the port of Souda was the permanent anchorage of the fleets of the Great Powers, under whose domination was the semi-autonomous state. There was the welcoming of the Commissioner of the Cretan State, Prince George, in 1898. Finally, on the islet of Souda on February 14, 1913, the Greek flag was raised.

During World War II, the port pf Souda was of great strategic importance and was used by both the Germans and allied forces.

Shortly after the German occupation, the Greek Naval Station was reestablished and where it is still today. There are also US and NATO military installations using the strategically important bay for their current activities. [11]

3.1.2 Geographical Data

The port of Souda is the largest natural port in Crete. Due to its geographical location it is one of the safest natural ports in the Mediterranean as it is formed by the White Mountains in the south and Akrotiri in the north. The bay is located on the northwest coast of Chania and is about 15 km long and 2 to 4 km wide, while the port has two piers 1.37 km long and has a depth of 9-12 meters.

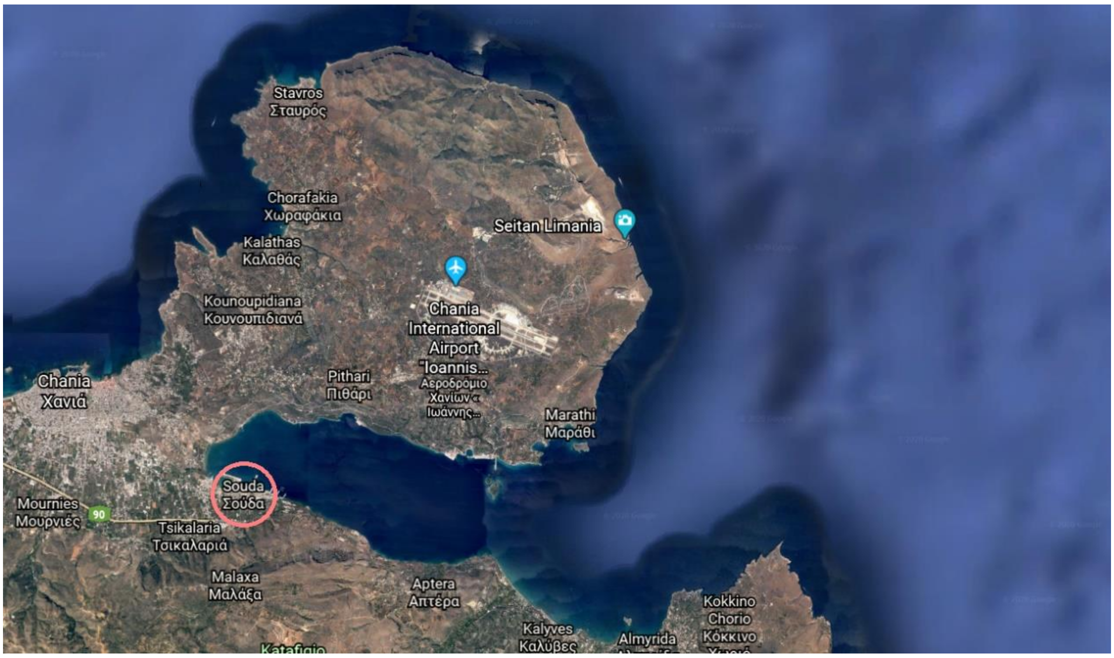


Figure 3.1 Geographical location of Souda via Google Earth

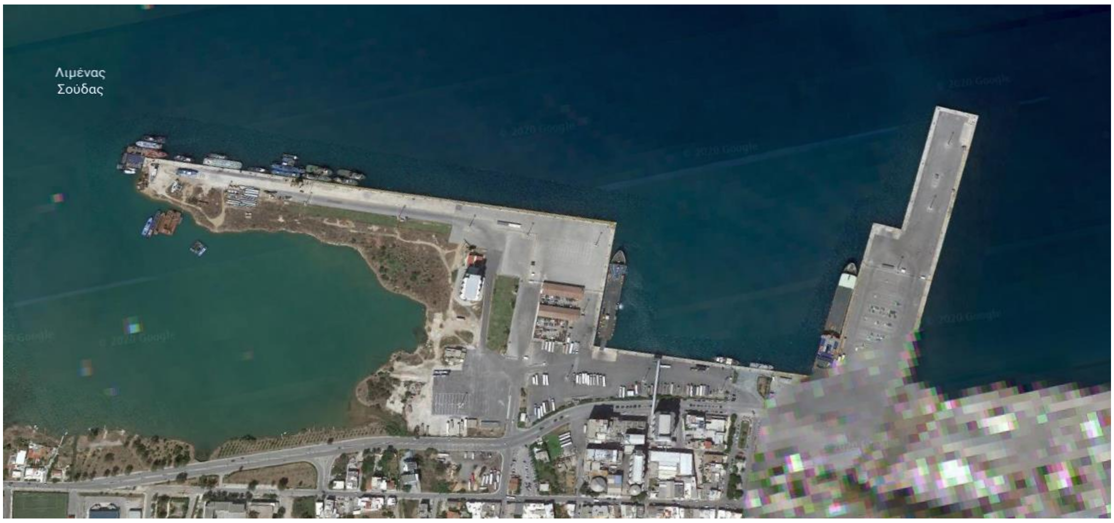


Figure 3.2 Port of Souda via Google Earth

It is a multi-purpose port, which is a crossroad of the most important sea routes, contributing decisively to the commercial, tourism and economic development of Chania.

There are two daily itineraries to Piraeus through which thousands of passengers, vehicles and goods are transferred. Also, lately, it has been included as a destination in the itineraries of international cruise companies. More specifically, it is estimated that 130 cruise ships with around 267,000 passengers visit the port of Souda every year.

In the coming years, the construction of a modern passenger station is expected, which will be able to serve even more passengers, so there is expected to be an increase in both the number of ships and the passengers.

Figure 3.3 Port of Souda [12]

3.2 Regulations Applying to Ships

International Marine Organization (IMO) ship pollution rules are contained in the "International Convention on the Prevention of Pollution from Ships", known also as MARPOL, which is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.

The convention includes regulations aimed at preventing and minimizing pollution from ships- both accidental pollution and that from routine operation- and currently includes six technical Annexes. MARPOL Annex VI is the one which refers to preventing air pollution from ships. [13]

Although air pollution from ships does not have the direct cause and effect associated with, for example an oil spill incident, it causes a cumulative effect that contributes to the overall air quality problems encountered by populations in many areas, and also affects the natural environment, such as tough acid rain.

MARPOL Annex VI, first adopted in 1997, limits the main air pollutants contained in ships exhaust gas, including sulfur oxides (SOx) and nitrous oxides (NOx), and prohibits deliberate emissions of ozone depleting substances (ODS). MARPOL Annex VI also regulates shipboard incineration and the emissions of volatile organice compounds (VOC) from tankers.

Following entry into force of MARPOL Annex VI on 19 May 2005, the Marine Environment Protection Committee (MEPC), agreed to revise MARPOL Annex VI with aim of significantly strengthening emission limits in light of technological improvements and implementation experience. As a result of three-year examination, MEPC 58 (October 2008) adopted the revised MARPOL Annex VI and the associated NOx Technical Code 2008, which entered into force on 1 July 2010.

MARPOL Annex VI has been revised throughout the years. The main changes are a progressive reduction globally in emissions of SOx, NOx and particulate matter and the introduction of emission control areas (ECAs) to reduce emissions of those air pollutants further in designated sea areas.

Under the revised MARPOL Annex VI, the global sulfur limit will be reduced from current 3.5% to 0.5 % effective from January 1, 2020. The fuel oil standard (0.5% sulfur limit) shall become effective on January 1, 2020. The limits applicable in ECAs for SOx and particulate matter were reduces to 0.10% from 1 January 2015.

The revised NOx Technical Code 2008 includes a new chapter based on the agreed approach for regulation of existing (pre-2000) engines established in MARPOL Annex VI, provisions for a direct measurement and monitoring method, a certification procedure for existing engines and test cycles to be applied to Tier II and Tier III standards.

Revisions to the regulations for ozone-depleting substances, volatile organic compounds, shipboard incineration, reception facilities and fuel oil quality were also made with regulations on fuel oil availability added.

The revised measures are expected to have a significant beneficial impact on the atmospheric environment and on human health, particularly for those people living in port cities and coastal communities. [14]

3.3 Environmental Impact

Shipping, undoubtedly, has a great impact on air pollution as the energy requirements of ships are high and there is extensive use of low-quality fuels. Combustion of oil releases harmful gases such as sulfur oxides (SOx), nitric oxides (NOx) and suspended oil particles (PM).

3.3.1 Pollutants from Ships

- Sulfur Oxides (SOx)
  SOx are produced from the burning of sulfur-containing fuels such as diesel and particularly from high sulfur marine fuels (bunker fuel). These compounds include sulfur dioxide and a range of related chemical air pollutants. SOx react with water vapor in the air to create acidic aerosols that irritate the airways, sometimes causing discomfort and coughing in healthy people, and often causing severe respiratory symptoms in asthmatics.

- Nitrogen Oxides (NOx)
  Due to the high temperatures prevailing in combustion engines, air nitrogen (N2) reacts with oxygen and oxidizes to nitric oxide (NO) and nitrogen dioxide (NO2), known as nitrogen oxides, NOx. The main effects of NOx on the ecosystem are the destruction of the ozone zone and acid rain. As a result, it causes significant respiratory problems in humans.

- Particulate matter (PM)
  PM pollution ranges from a coarse dust to very tiny sooty particles formed when gasoline or diesel are burned. It is the tiniest PM that cause the greatest health hazards (Bagley, 1996). Dozens of studies link fine PM concentrations to increased hospital admissions for asthma attacks, chronic obstructive lung disease, bronchitis, pneumonia, heart disease, and premature deaths.

- Carbon dioxide (CO_2)
  Carbon dioxide is the most significant long-lived greenhouse gas (GHG) in Earth's atmosphere. Since the Industrial Revolution anthropogenic emissions - primarily from use of fossil fuels and deforestation - have rapidly increased its concentration

in the atmosphere, leading to global warming. Carbon dioxide also causes ocean acidification because it dissolves in water to form carbonic acid.

3.3.2 Calculation of emissions in the port of Souda

Calculating fuel consumption and subsequent ship emissions is a complex process, as there are many parameters, such as engines, their different modes of operation depending on the ribbed are, the type of ship with the cargo it carries and the configuration of power supply systems. Fuel consumption from one (FCK) is calculated by combining the required energy of the engine, expressed in kilowatt hours (kWh) and its typical consumption (SFOC) in units of fuel mass per unit of energy. The calculation equation is:

$$FC_K = E_{ENERGY,K}\ SFOC_K$$

Where the energy term is a combination of the maximum rated power expressed in kW, the operating load factor (which expresses the operating load of the motor, depending on the operating phase and its duration). The energy term is given by the relation:

$$E_{ENERGY.K.P} = MCR_K LF_K T_p$$

Where: MCR= maximum rated power (kW)

K= the engine for which the calculations are made

LF= Load Factor

P = operating phase

T= operating time (hr)

This method calculates the emissions for a voyage, summing the individual emissions resulting from the different phases of the operation of the ship. Therefore, for a trip, emissions can be put forward as equ:

$$E_{trip} = E_{hotelling} + E_{maneuvering} + E_{travelling}$$

In our case, calculations are related to the phases of Maneuvering and Hoteling. Hoteling time begins when the ship lands and at the port pier and ends when it departs.

Load Factor

It is important to mention the use of load factor, which expresses the ratio of the energy generated by the motor for the given high-speed motor that has the specified maximum rated power. The determination of the cargo coefficients of the main (ME) and auxiliary engines, according to the activity of the ships in the port, involves great uncertainty.

Table 3.1 Load factors of the engines for the maneuvering and hoteling

	Main Engine (ME)		Auxiliary Engine (AE)	
	Summer	The rest of the Year	Summer	The rest of the year
Maneuvering	0,20	0,20	0,75	0,60
Hoteling	0	0	0,45	0,30

For the cruising speeds the load factor of the cruising system for the main engines is 80-85%. For lower speeds, the determination of the load factor for the propulsion system is based on the assumption that the load on the propulsion system is proportional to the speed of the ship. The coefficient of inclination is calculated from the following formula

$LF = (\text{Actual speed}/ \text{Max speed})^3$

For the auxiliary engines the load factor differs depending on the operating condition of the ship and the type of auxiliary engines of each ship. Although, load factors are approximated by various studies, both for the main and the auxiliary engines, it is obvious that this is very uncertain due to the heterogeneous auxiliary engines (kW,SFOC) but also the different hours and operating loads per engine, during a full trip.

Emission Factors

Considering the partial load capacity of the main and auxiliary engines, we lead to the introduction of correction factors, as proposed by the extensive work of restoring the transmissions, which were originally prepared for the ENTEC (ENTEC,2002) and were included in the final report on the emissions of ship-Mediterranean Sea.

The emission factors for the main engines during maneuvers and docking (operating at about 20% MCR) due to lack of data, rely heavily on the professional or empirical critical assessment of each designer. It is worth noting that the emission factors, during the maneuvering and the mooring phase, have increased uncertainty compared to those during travelling phase, mainly for two reasons:

1. The main engines are being started with a cold engine, having significant different emitters (especially HC and PM), compared to when starting with relatively hot engines,
2. The load of the motor changes during maneuvers, resulting in its increase emission variability.

In addition, the average emission rates from the main engines operating at steady state with low loads (<40% MCR) were evaluated by the IVL/Lloyds database and the approach adopted was to multiply the emission rates by the main engines (coming from state loads 70-100%) by 0.8 for NOx, 3.0 for HC and 3.0 for PM.

Emission factors are used in conjunction with energy consumption or fuel for estimating emissions and vary depending on the pollutant, the type of the engine, the operating cycle and fuel. Given that SFOC for each motor, it is understandable that emission factors depend on the type of the engine (main, auxiliary, boilers). The emission factors are further adjusted with fuel consumption (HFO, LSFO, MDO, MGO) and sulfur content. Finally, the load of the engine, the variability, is integrated to the factors used to estimate emissions. To calculate the emission factors a specific methodology is being used in which all these variables are considered:

1) We determine the basic emission factors given by IMO. Emission factors are given in two categories: based on energy in g pollution/ kWh and on fuel in g pollutants/ g fuel consumption.
2) We convert the basic emission factors based on energy (g pollutants / kWh) at emission factors based on fuel (g pollutants / g fuel) consumed, depending on the situation using the following ration:
$$EF_{baseline(g\ pollutant/\ g\ fuel)} = \frac{EF_{baseline\left(\frac{g\ pollutants}{kWh}\right)}}{SFOC_{baseline\left(\frac{g\ fuel}{KWh}\right)}}$$
3) We use correction factors (FCF) on a case-by-case basis to adjust emission factors for the specific fuel that is used:
$$EF_{actual(\frac{g\ pollutant}{g\ fuel})} = EF_{baseline\ (\frac{g\ pollutant}{g\ fuel})} \text{ x FCF}$$

Depending on the type we want to calculate the ratios are as follows:

$$CO_{2(\frac{g}{kWh})} = (3.114\ or\ 3.206) \text{ x } CO_{2(\frac{g}{fuel})} SFOC_{(\frac{g\ fuel}{kWh})}$$

Where 3.114 and 3.206 are the emission factor CO_2 based on the type of the fuel (HFO, LSFO, MGO).

$$NO_{x(\frac{g}{kWh})} = 45 \text{ x } n^{-0,20}$$

Where n: the engine speed

$$SOx_{(g/kWh)} = SFOC_{(g\ fuel/kWh)} \text{ x } 2 \text{ x } 0.97753\ \%\ \text{Fuel Sulfur}$$

Where 0.97753 is the conversion factor of Sulfur, S to SOx, 2 is the ratio molecular weight of SOx and S.

$$PM_{HFO\left(\frac{g}{kWh}\right)} = 1.35 + SFOC_{\left(\frac{gfuel}{kWh}\right)} \text{ x 7 x 0,02247 x (\% Fuel Sulfur – 0.0246)}$$

$$PM_{MGO\left(\frac{g}{kWh}\right)} = 0{,}23 + SFOC_{\left(\frac{gfuel}{kWh}\right)} \text{ x 7 x 0,02247 x (\% Fuel Sulfur – 0.024)}$$

Based on all the above information and specific methodologies the pollutants for the port of Souda have been calculated for the years 2018-2019 and are presented in the table below.

Table 3.2 Pollutants for the port of Souda for the years 2018-2019

Year	Type	CO_2 (t)	SOx (t)	NOx (t)	PM (t)
2018	Cruises	4,581.057	19.504	80.448	4.090
2018	Ferries	9,991.168	34.686	181.453	7.372
2019	Cruise	6,005.236	29.397	112.526	5.935
2019	Ferries	21,792.848	132.228	382.774	25.922

4 Photovoltaic Park

4.1 General Information

Photovoltaics are very important today as they meet the need of energy and the need to protect the environment. Every kilowatt hour of electricity supplied by network and is produced from fossil fuels, burdens the atmosphere with an at least one-kilogram carbon dioxide. Using solar energy means less emissions from others hazardous pollutants that cause serious damage to health and environment.

A PV panel consists of one or more PV modules which is the basic structural unit of the photovoltaic generator. PV modules consist of PV cells which are the electronic devices that generate electricity when they receive radiation.[15]

The most important elements of a solar cell are two layers of conductive material which generally consist of silicon crystals. Crystalline silicon itself is not a very good conductor of electricity, but when impurities are added to it, the conditions are created to produce electricity. Boron is usually added to the bottom layer of the solar cell, which forms bonds with silicon leading to the development of a positive charge (p). Phosphorus is usually added to the top of the solar cell, which forms bonds with silicon leading to the development of a negative charge (n). The surface between the type p and type n semiconductors that are created is called the p-n junction.

When sunlight enters the cell, its energy releases electrons into both layers. These electrons, also known as free electrons try, due to the different charges of the two layers, to move from the type-n layer to the type-p layer, but are blocked by the electric field at the p-n contact. However, the presence of an external circuit creates the necessary path for the transfer of electrons from the type-n to the type-p layer.

In practice, a set of PV elements connected in series (to show a specific open circuit) voltage and at the same time, are placed, in a flat glass plate, high transparency, adapted to a metal frame, high strength, usually made of anodized aluminum. The back is covered with a special plastic material, for protection from moisture. The final construction meets special specifications, in order to have the necessary mechanical strength, the appropriate support sockets and in addition the increased tightness for protection from moisture. This device is the standard industrial unit (module) and is called photovoltaic panel. Typical peak power values of a commercial PV panel: from a few watts peak (Wp) to 310 Wp.

4.2 Main Types of Solar Cells

The main types of the solar cells are the following:

A. Monocrystalline Silicon

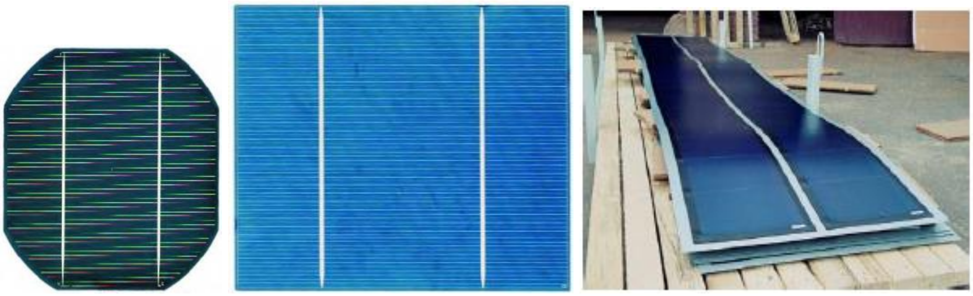
Monocrystalline silicon cells are made from a large crystalline silicon wafer. These cells are made by process known as the "Czochralski" method. They are characterized by a high efficiency of 15-19% but also higher costs. Their color is usually deep blue to black when they have an anti-reflective (AR) coating or gray (without ante-reflective coating).

B. Polycrystalline Silicon

Polycrystalline silicon cells are cheaper than those of monocrystalline silicon but also less efficient. Their ranges from 13 to 16%. The method of making a polycrystalline cell requires much less precision and cost than single crystal cells. Their color usually blue (with anti-reflective coating) or gray-silver (without anti-reflective coating).

C. Thin Film

The photovoltaic panels of this technology consist of semiconductor cells just a few micrometers thick. These cells have lower efficiency than crystalline silicon cells but also lower cost. They are usually characterized by their intensely dark (almost black) color.



(a) (b) (c)

Figure 4.1 Example of typical photovoltaic panels (a) Monocrystalline Silicon (b) Polycrystalline Silicon (c) Thin-fim

4.3 Factors affecting the performance of PV

The outdoor performance of a PV module is influenced by many factors. Some of these issues are related to the module itself and others are related to the location and environment. Few of these major factors are material degradation, solar irradiance, module temperature, parasitic resistances, fill-factor, shading, soiling, PID, tilt-angle etc.

a. <u>Degradation of PV Module</u>
Manufacturers of solar PV systems usually guarantee the performance life of 25 years for the modules. Solar PV panels usually degrade at a faster rate in the first few years of their life. In general, their rated power output degrades at about 0.5 % per year.
These degradation processes may be chemical, electrical, thermal or mechanical in nature. Early degradation of PV modules may be due to design flaws, poor quality materials or manufacturing issues. In most cases, module failures and performance losses are due to gradual accumulated damages resulting from long-term outdoor exposure in harsh environments.

b. <u>Variation in Solar Radiation</u>
The performance of PV modules under varying light conditions will differ significantly, which in turn has a severe impact on the yield of PV systems. Variations in the intensity of solar radiation falling on a PV module affect many of its parameters, including I, V, power, FF and efficiency.
To reduce the temperature related issues on PV modules, the following aspects could be considered:

i. Keep sufficient gap between the modules and the roof (or ground) to allow convective air flow to cool them.

ii. Ensure that panels and supporting structure are of light-colored so that heat absorption will be less.
iii. Use perforated base structure to increase cooling.
iv. Do not keep inverters below and close to the modules.
v. Use cooling fans.

c. Module Temperature

Figure 4.2 shows the effect of cell temperature on the current-voltage characteristic (I-V) of a cell. It follows from the figure that temperature mainly affects the voltage of the solar cell. In particular, the open circuit voltage increases significantly as the temperature decreases, which must be taken into account when designing a system, while the short-circuit current decreases slightly. Overall, the power of the solar cell decreases with increasing temperature. Usually, the manufacturers of solar cells and panels report indicative coefficients of variation of the following sizes with temperature.

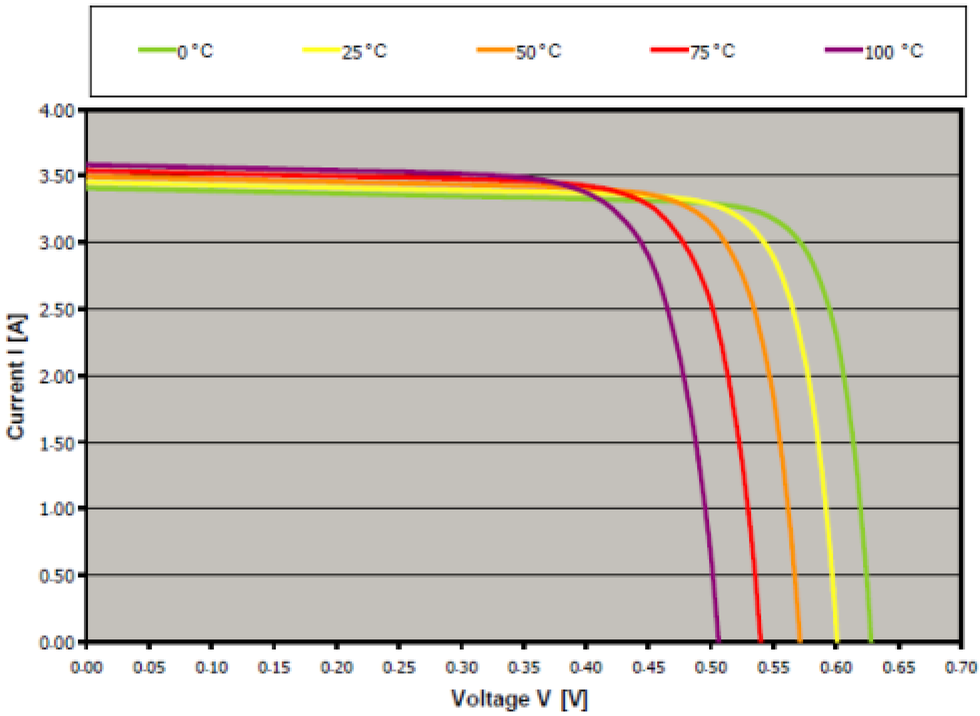


Figure 4.2 The effect of temperature on the I-V characteristic of a cell

d. Fill Factor

The fill-factor of a PV cell is defined as the ratio of the maximum power to the product of V_{oc} & I_{sc}. A good quality PV Module is expected to have fill-factor above 70%. A lesser fill-factor indicates larger value of R_s , or lesser value of R_{ah}, increased recombination current in the space charge region and increased reverse saturation current of the junction I, all these conditions represent increased losses.

e. Parasitic Resistances

The series and shunt resistances of a PV cell, called Parasitic Resistances, results in increased I^2R losses, which eventually results in reduced module efficiency. The series resistor (R_s) represents the internal resistance of the PV cell. It comprises of the resistance of metal contacts, fingers, impurities and resistance of the semiconductor itself. The shunt resistor (R_{sh}) represents the leakage resistance and is responsible for the leakage current. The impacts of R_s and R_{sh} on the I-V curve of a PV cell are shown in Figure 4.3. The resulting reductions in area of the I-V curve leads to a reduction in fill-factor and thereby drip in cell efficiency.

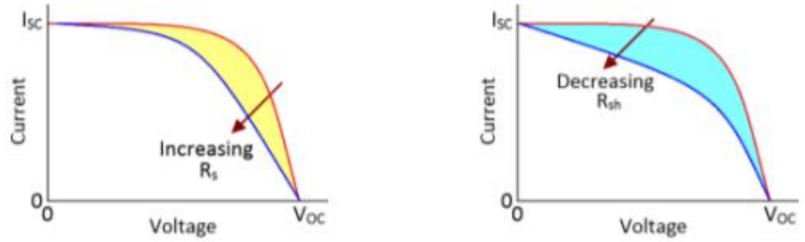


Figure 4.3 Impacts of parasitic resistances on I-V characteristic.

For optimum performance of a PV module, R_s must be as low as possible and R_{sh} must be as high as possible. The knowledge of these resistance values is important for monitoring the quality and evaluating the performance of a PV system.

f. Shading

Shading results in mismatches in the generated currents of individual cells of a module. Even partial shading on a single cell can significantly reduce the power output of the entire module as id all the cells were shaded. Since cells in a module are connected in series, am currents has to flow through all the cells. If more current than the shaded capability is forced through a shaded cell, it will be over-heated and might be damaged.

g. Soiling

Soiling is the accumulation of dust, dirt and other contaminants on a PV module. It leads to the formation of a thin screen over a module and thus reduces the light falling on one or many cells. Dust represents minute solid particles of diameter less than 500 µm. Dust settlement depends on factors such as dust properties (shape, size, weight), weather conditions (rain, humidity, snow), location (coastal or dusty area), module tilt angle, surface finish and wind speed.

Soiling in PV system may result into an annual power loss of 5-17% or more.

Power losses duo to soiling can be greatly reduced by regular cleaning. Many methods are available for PV cleaning while the frequency of cleaning will vary depending up on the location, season and module mounting.

h. Potential Induced Degradation

PID (Potential Induced Degradation) is a performance degradation mechanism in PV systems due to stray currents, leading to gradual loss of power up to 30% or more. It generally occurs in PV systems with ungrounded inverters. There are two issues with PID: i) loss of useful generated power and ii) degradation of the front surface passivation, leading to increased recombination and cell damages. PID occurs only a few years after installation of the PV system.

i. PV Module Orientation and Tit Angle
For capturing optimum solar energy, a PV module must always point to the direction of the sun so that the incident light will be perpendicular to the module. However, this will not be always possible due to the daily and seasonal variations in the sun's position. By using single axis trackers, PV performance can be optimized against daily variations in sun's position from morning to evening and by using dual axis trackers, performance can be optimized against both daily and seasonal variations. Module tilt angle is the angle between a PV module and o horizontal surface. For small scale PV systems, modules are usually fixed at some inclination. [16]

5 Case Study

5.1 Traffic Analysis

In order to determine the power demand and the number of CI berthing places an analysis of ship call had to be made. This analysis concerns two ship categories that approach the port, cruise ship and passenger ships RoRo. Firstly, for each category, the number of different ships was detected, and their berthing time was calculated for the years 2018 and 2019. The results can be seen in the table below:

Table 5.1 Traffic analysis in 2018

2018				
Category	No. of different ships	No. of Calls	Total time at port	Average time at port
RoRo Passenger	7	564	5408	9:30
Cruises	23	80	817:30	10:13

Table 5.2 Traffic analysis in 2019

2019				
Category	No. of different ships	No. of Calls	Total time at port	Average time at port

RoRo Passenger	6	748	6918:30	9:15
Cruises	31	148	1339:30	9

To continue the analysis, the maximum, minimum and average number of each ship category simultaneously at berth were calculated for every month.

Table 5.3 Min, average, max arrivals per month per type for 2018 and 2019

		2018		2019	
Month		Ferries	Cruises	Ferries	Cruises
January	min	1	0	1	0
	mean	1	0	2	0
	max	1	0	2	0
February	min	1	0	1	1
	mean	1	0	2	1
	max	1	0	2	1
March	min	1	1	1	1
	mean	1	1	2	1
	max	1	1	2	1
April	min	1	1	1	1
	mean	1	1	2	1
	max	2	1	3	2
May	min	1	1	1	1
	mean	1	1	2	2
	max	1	2	2	6
June	min	1	1	2	1
	mean	1	1	2	1
	max	2	1	2	2
July	min	1	1	1	1
	mean	2	1	2	1
	max	3	1	3	3
August	min	2	1	2	1
	mean	3	1	2	1
	max	3	2	3	3
September	min	1	1	1	1
	mean	2	1	2	1
	max	2	3	3	3
October	min	2	1	1	1
	mean	2	1	2	1
	max	2	2	2	3
November	min	2	1	2	1
	mean	2	1	2	1
	max	2	1	2	1
December	min	1	1	1	1
	mean	2	1	2	1
	max	2	1	2	1

As a result of the above table, the number of berthing places will be the average monthly simultaneous arrivals of each category. This means, **one** CI output for cruises and **two** for RoRo Passenger Ships.

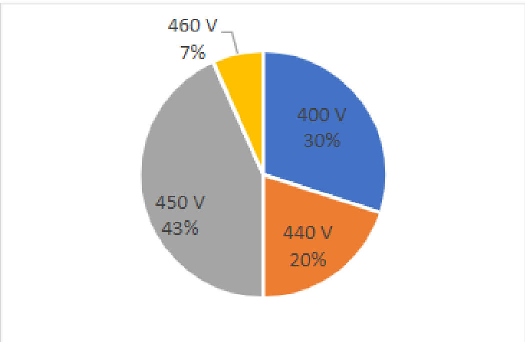
5.2 Power Demand

Determining the power demand of the vessels at berth is not an easy procedure, mainly because frequency and voltage of the vessels vary depending on the year were built, their size and their different needs.

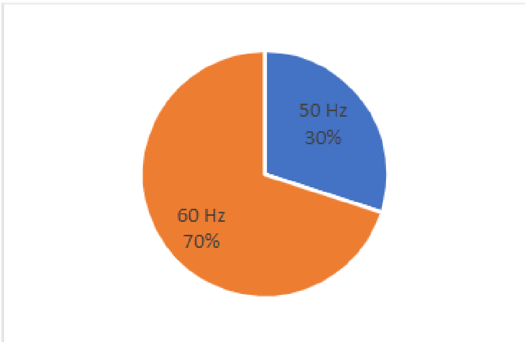
For the electrical connection and supply of each ship with the central distribution network of the respective port, it is required to know the nominal operating voltage of the current as well as the operating frequency of the ship.

5.2.1 Passenger Ships

A Passenger ship is any ship that, based on its certificates, is allowed to carry more than 12 passengers. RoRo Passenger Ferries consist of large decks on which the boarding of vehicles is done using mainly stern catapults. They are used on specific lines relatively short and regular routes as links in a wider chain of transport and communications.



(a) Voltage



(b) Frequency

Figure 5.1 Main system voltage and frequency of Ro/Ro vessels

As seen from the figure all the vessels use low voltage, from 400 V to 460 V, as a system voltage, while the majority of them operate at 60 Hz.

The total energy consumption for each month of the years 2018 and 2019 was calculated, based on the main engine power of each passenger ship that has moored in the port of Souda and the load factor.

Table 5.4 Ro/Ro that were moored in the port of Souda during 2018

Vessel name	GT	Energy Consumption (kWh/h)	No. of Calls per year
Blue Galaxy	29,992	1000	190
Elyros	33,635	1000	94
Mykonos Palace	36,894	1700	141
Knossos Palace	37,551	1700	7
Festos Palace	36,894	1700	16
El. Venizelos	38,261	1000	90
Blue Star II	29,858	1000	16

Table 5.5 Ro/Ro that were moored in the port of Souda during 2019

Vessel name	GT	Energy Consumption (kWh/h)	No. of Calls per year
Blue Galaxy	29,992	1000	194
Elyros	33,635	1000	72
Mykonos Palace	36,894	1700	163
Knossos Palace	37,551	1700	77
Festos Palace	36,894	1700	86
El. Venizelos	38,261	1000	135

Based on the timetables of Souda port for 2018 and 2019, the monthly energy consumption was calculated. November of 2018 and March of 2019 are proved to be the months with the highest energy consumption. Then the hourly energy consumption, for these two months, was calculated which is important to know in case of using renewable sources for power supply or battery storage.

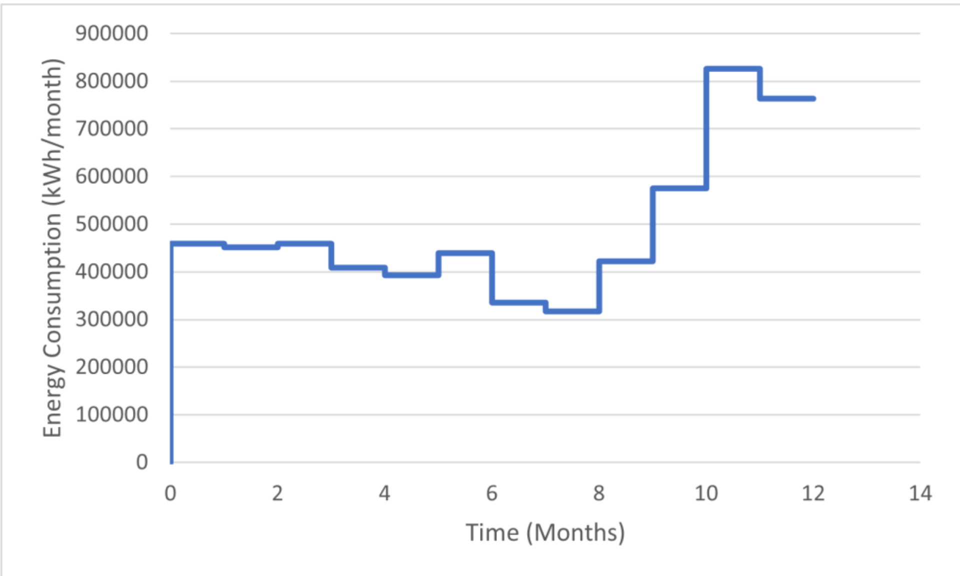


Figure 5.2 Monthly Energy Consumption (kWh/h) of Passenger Ships in 2018

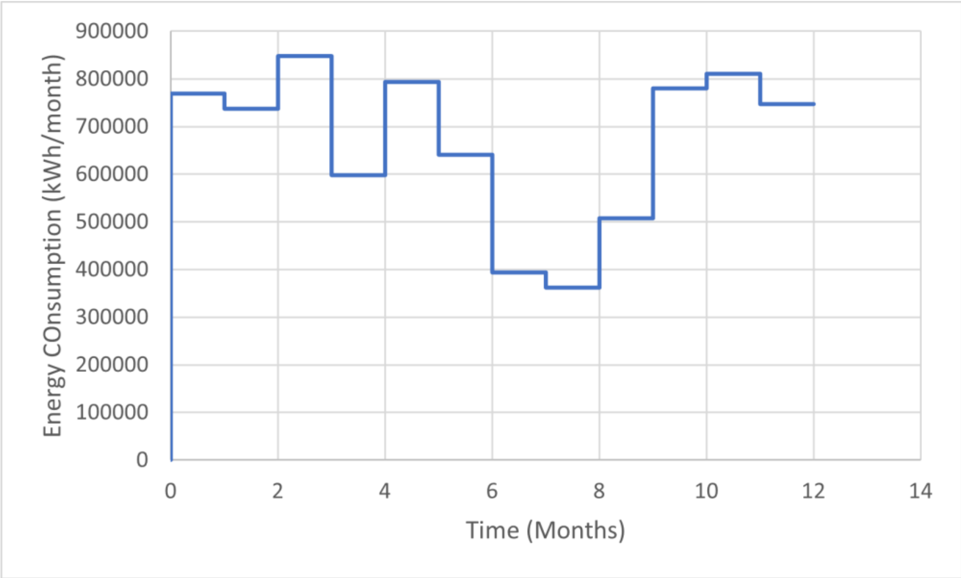


Figure 5.3 Monthly Energy Consumption (kWh/h) of Passenger Ships in 2019

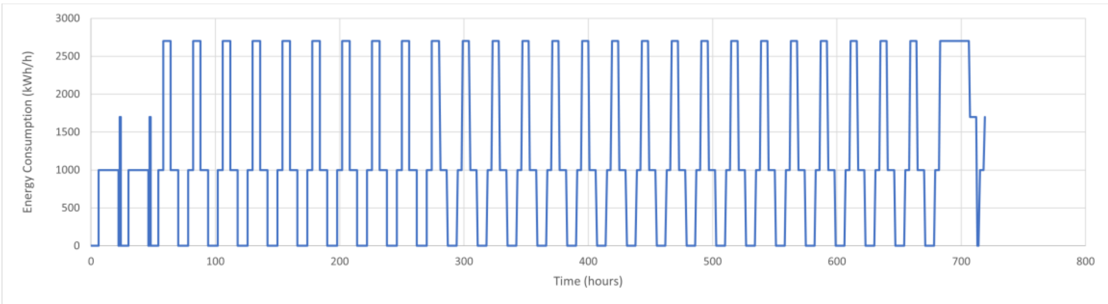


Figure 5.4 Hourly Energy Consumption (kWh/h) of Passenger Ships in November 2018

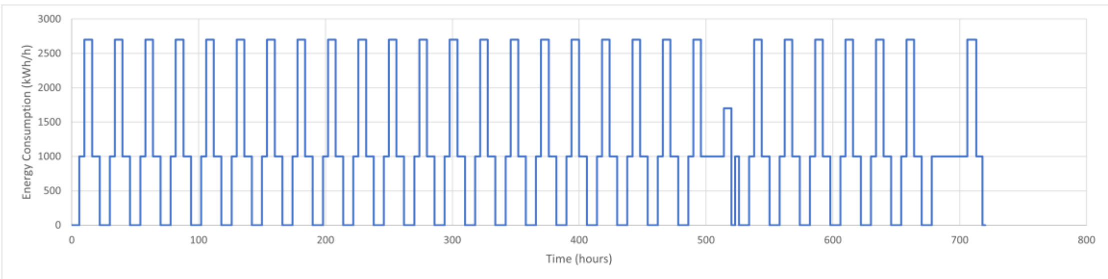
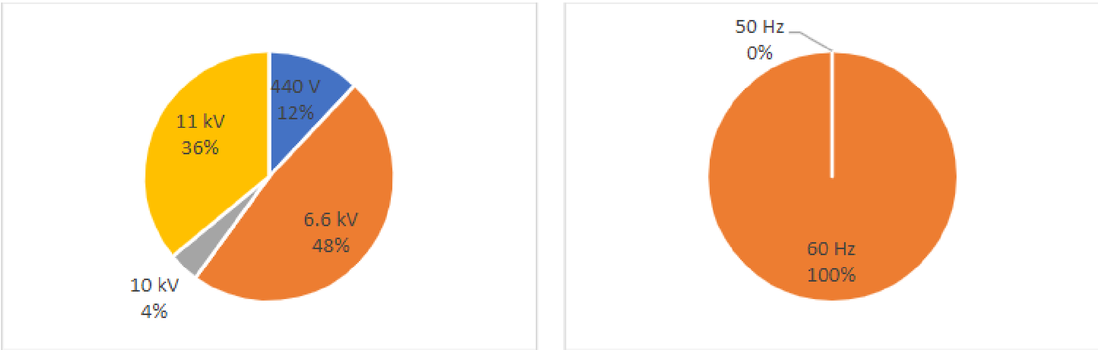


Figure 5.5 Hourly Energy Consumption (kWh/h) of Passenger Ships in March 2019

5.2.2 Cruise Ships

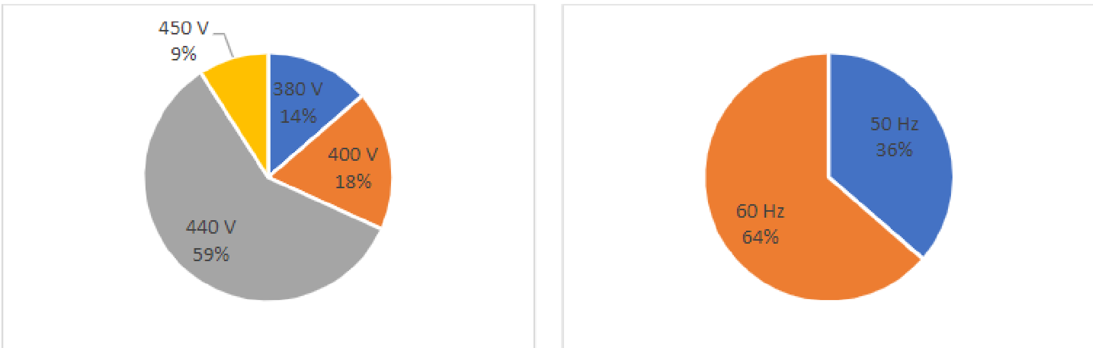
Cruise ships are a type of passenger ship used for leisure taxis with many different destinations-stops during a trip. Moving passengers from one place to another is not the main purpose of a cruise as, during such a journey, passengers usually return to the port of departure.

Cruise ships have the highest power demand, while hoteling, of any vessel type because of the large needs in heating, cooling and lighting.



(a) Voltage (b) Frequency

Figure 5.6 Main system voltage and frequency of small cruise ships (length < 200 m)



(a) Voltage (b) Frequency

Figure 5.7 Main system voltage and frequency of large cruise ships (length > 200 m)

Nowadays, large cruise vessels often use electric propulsion systems. The power needed while at sea can be up to 80 MVA. Therefore, to be able to handle this big amount of power, high voltage, 6-11kV, is used on board. On the other hand, smaller cruise vessels use low voltage system. Finally, some cruise vessels with length less than 200 m have 50 Hz operating frequency (36%), while all the larger ones have 60 Hz operating frequency.

The total energy consumption for each month of the years 2018 and 2019 was calculated, based on the main engine power of each cruise that has moored in the port of Souda and the load factor.

Table 5.6 Cruise ships that were moored in the port of Souda during 2018

Vessel Name	GT	Energy Consumption (kWh/h)	No. of Calls per year
Oceana	77,499	7,671	5
Mein Schiff 1	11,554	9,557	1
Silver Spirit	39,444	5,103	1
Golden Iris	16852	3,054	2
Horizon	47,427	5,703	16
Europa	28,890	4,229	1
Norwegian Spirit	75,904	7,575	8
Mariner of the Seas	139,863	10,954	1
Oosterdam	82,820	7,985	4
Marella Discovery 2	69,472	7,181	5
Crown Princess	113,561	9,660	6
Jewel of the Seas	90,090	8,400	1
Mein Schiff 2	111,554	9,557	6
Marella Celebration	33,933	4,660	4
Silver Muse	40,791	5,208	1
Rhapsody of the seas	78,878	7,753	2
Salamis Filoxenia	15,402	2,893	2
Celebrity Constellation	90,940	8,448	3
Azamara Pursuit	30,277	4,350	3
Azamara Quest	30,277	4,350	1
Mein Schiff 3	99,526	8,921	1
Aegean Odyssey	12,094	2,500	2
MSC Magnifica	95,128	8,681	1

Table 5.7 Cruise ships that were moored in the port of Souda during 2019

Vessel name	GT	Energy Consumption (kWh/h)	No. of Calls per year
Oceana	77,499	7,671	7
Mein Schiff 4	99,526	8,921	1
Crystal Esprit	30	67	3
Crown Iris	41,662	5,274	2
Horizon	47,427	5,703	26
Viking Jupiter	47,800	5,730	1
Norwegian Spirit	75,904	7,575	8
Crystal Serenity	68,870	7,143	3
Konningsdam	99,836	8,938	4
Marella Explorer 2	72,458	7,366	4
Emerald Princess	113,561	9,660	6
Jewel of the seas	90,090	8,400	7
Mein Schiff 6	98,811	8,882	6
Marella Celebration	33,933	4,660	4
Silver Shadow	28,258	4,173	3
Rhapsody of the seas	78,878	7,753	1
Salamis filoxenia	15,402	2,893	2
Celebrity Constellation	90,940	8,448	4

Azamara Pursuit	30,277	4,350	5
Marella Discovery	69,472	7,181	3
Norwegian Jade	93,558	8,594	16
Aegean Odyssey	12,094	2,500	1
Vision of the seas	78,717	7,743	1
Seabourn Odyssey	32,477	4,350	1
Celebrity Infinity	90,940	10,521	2
Rotterdam	61,849	8,530	1
Viking Star	47,842	5,734	2
Azamara Journey	30,277	4,350	1
Celebrity Edge	130,818	10,521	1
Msc Orchestra	92,409	8,530	1
MSc Lirica	65,591	6,936	18
Veendam	57,092	6,379	1

Based on the cruise timetables of Souda port for 2018 and 2019, the monthly energy consumption was calculated. In both cases May is proved to be the month with the highest energy consumption. Then, a load forecast was performed for each hour of the month and is presented in the following diagrams.

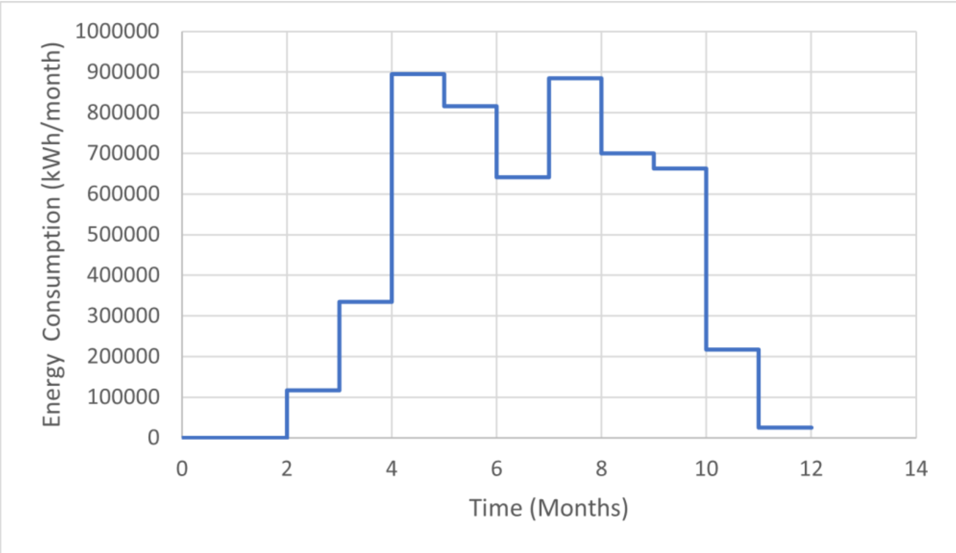


Figure 5.8 Monthly Energy Consumption (kWh/h) for Cruises in 2018

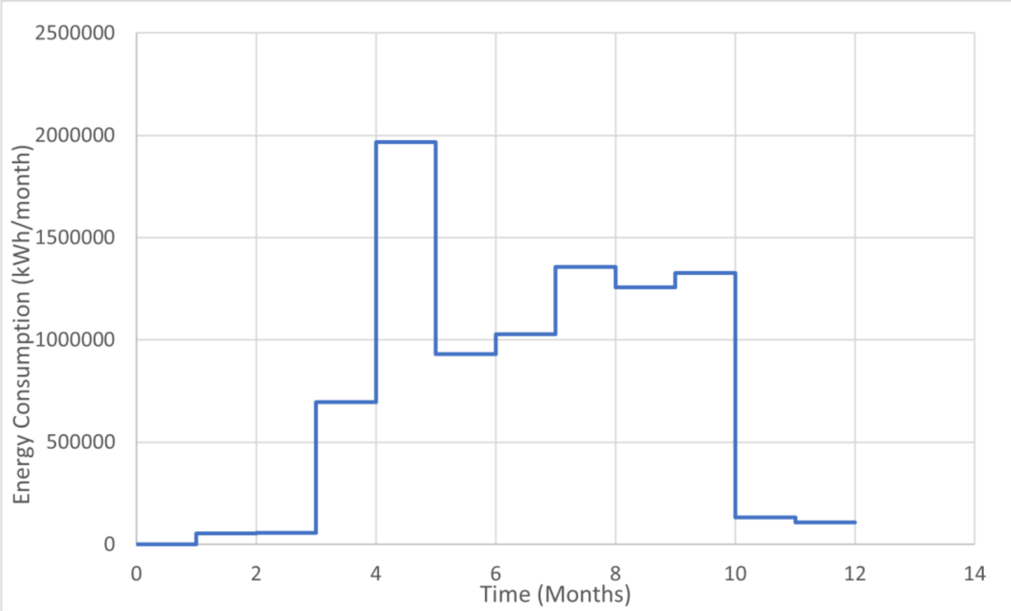


Figure 5.9 Monthly Energy Consumption (kWh/h) for Cruises in 2019

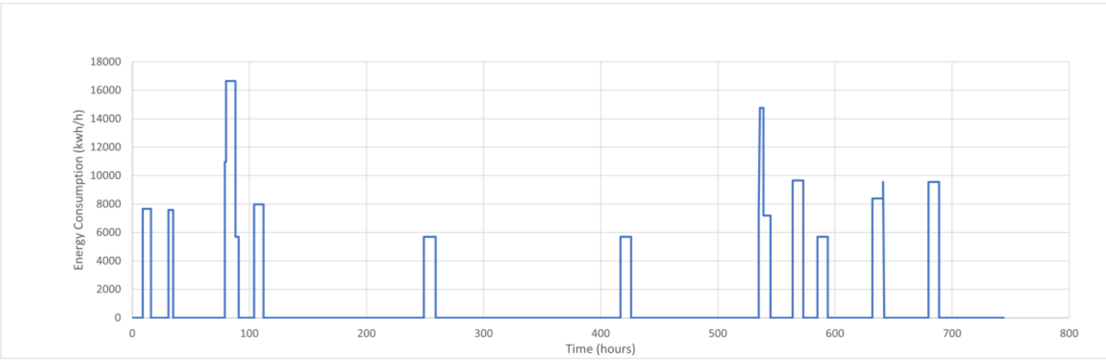


Figure 5.10 Hourly Energy Consumption (kWh/h) of Cruises in May 2018

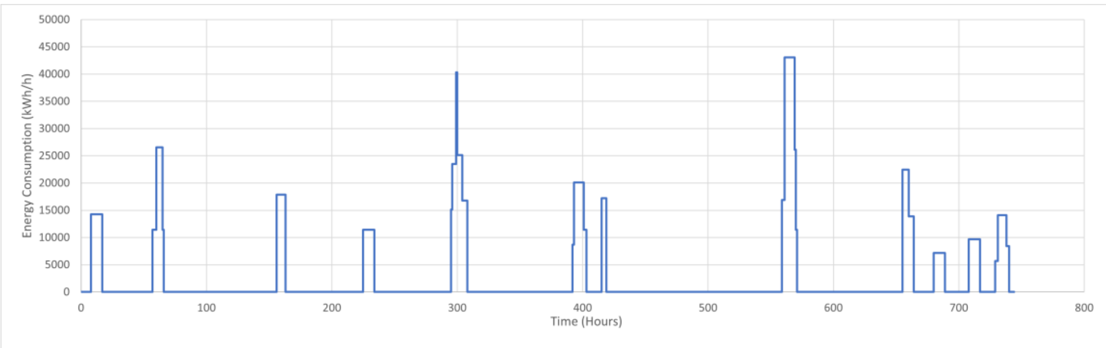


Figure 5.11 Hourly Energy Consumption (kWh/h) of Cruises in May 2019

5.2.3 Synopsis of the CI berthing places

Based on the Traffic Analysis that was made the berthing places will be three, one for cruises and two for RoRo-passengers ships. Also, based on the Energy consumption for each type of ship the maximum power for each connection point will be 15 MVA for cruise ships and 2.5 MVA for passenger ships.

Table 5.8 Connection Positions

Type of Ship	No. of berthing places	Total Power Output (MVA)	Voltage (KV)
Passenger	2	5	11
Cruise	1	15	11
Total	3	20	

The three proposed connection points can be seen in the topographic below, marked in red.

Figure 5.12 Topographic of the port of Souda.

5.3 Technical Design

As explained in chapter 2.2 the EU has proposed a system configuration for the CI. However, for the needs of the port of Souda another approach will be followed. Two alternative configurations will be studied based on the frequency converters installation, on the first one the frequency converters can be dedicated to each shore connection point (decentralized solution) whereas on the second they can be installed in a main central substation (centralized solution).

The first configuration, which is presented in Figure 5.12, forms a decentralized system where a separate frequency converter is used for each berth. Each frequency converter will be coupled to the busbar throughout a step-down and a step-up transformer.

The main advantage of this configuration is that consist of a free-standing system at each berth. If a fault takes place in one of the frequency converters, then this berth can be disconnected without any influence on the other berths. Moreover, ships with different voltage levels can be supplied simultaneously.

The main disadvantage of the decentralized solution is that the frequency converter is in use even if a 50 Hz vessel is connected, which results in slightly lower efficiency. Also, large number of transformers is required, due to the need of a step-down and a step-up transformer for each frequency converter.

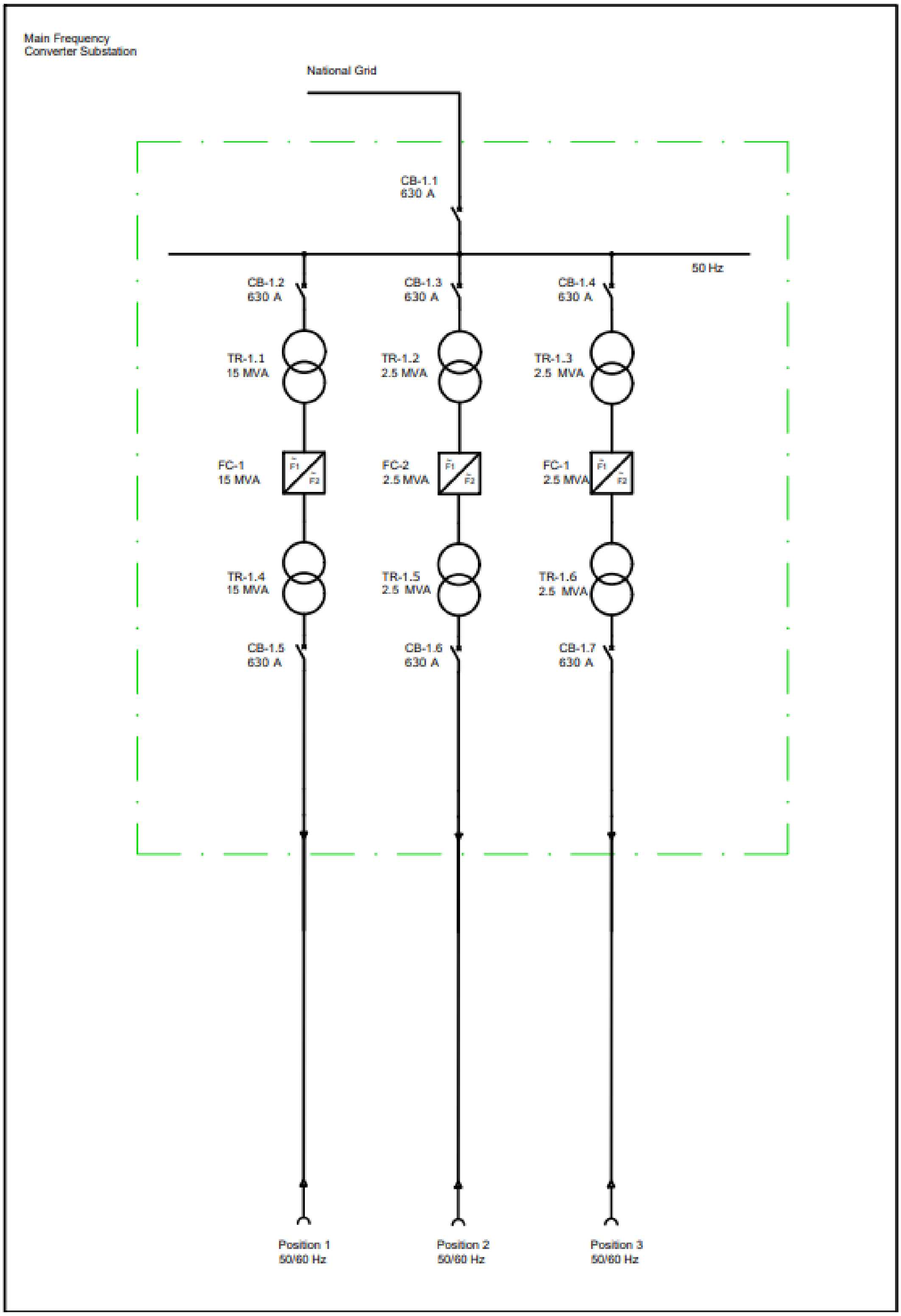


Figure 5.13 Decentralized frequency converter configuration.

As regards the second configuration, which is illustrated in Figure 5.13, a centrally placed frequency converter supplies a double busbar arrangement which can be used to selectively provide either 50 Hz or 60 Hz to the berths. The frequency converter is coupled to one of the busbars throughout a step-down and a step-up transformer. To enable the simultaneous connection of 60 Hz and 50 Hz vessels at different berths an additional busbar is integrated, which can be directly connected to utility grid or fed by a transformer when this is necessary.

Each substation at berth, which contains only the isolation transformer and the appropriate low voltage switchgear, is fed through a breaker and a change-over switch. The change-over switch makes it possible to select which busbar shall be connected to the berth on every occasion.

The frequency converter, in this configuration, can be dimension by means of the highest power demands among the ships that intend to be connected and the number of the vessels that will be supplied simultaneously. This can result in lower total installed capacity of the frequency converter system, especially in the case that many identical berths will not be supplied at the same time, which can lower the cost of the investment.

Another advantage of the centralized solution is that the frequency converter is only used when 60 Hz is needed, so a higher efficiency can be achieved with this facility. What is more, a future potential increase of power demand can be achieved by parallel installing one or more frequency converters.

On the other hand, the system is more vulnerable in the case a fault occurs in the frequency converter since the facility will not be able to supply 60 Hz to any birth. An additional disadvantage of this configuration is that there will be a higher price on the switchgear equipment since a double busbar system is used with breakers and disconnectors to allow distribution of both frequencies.

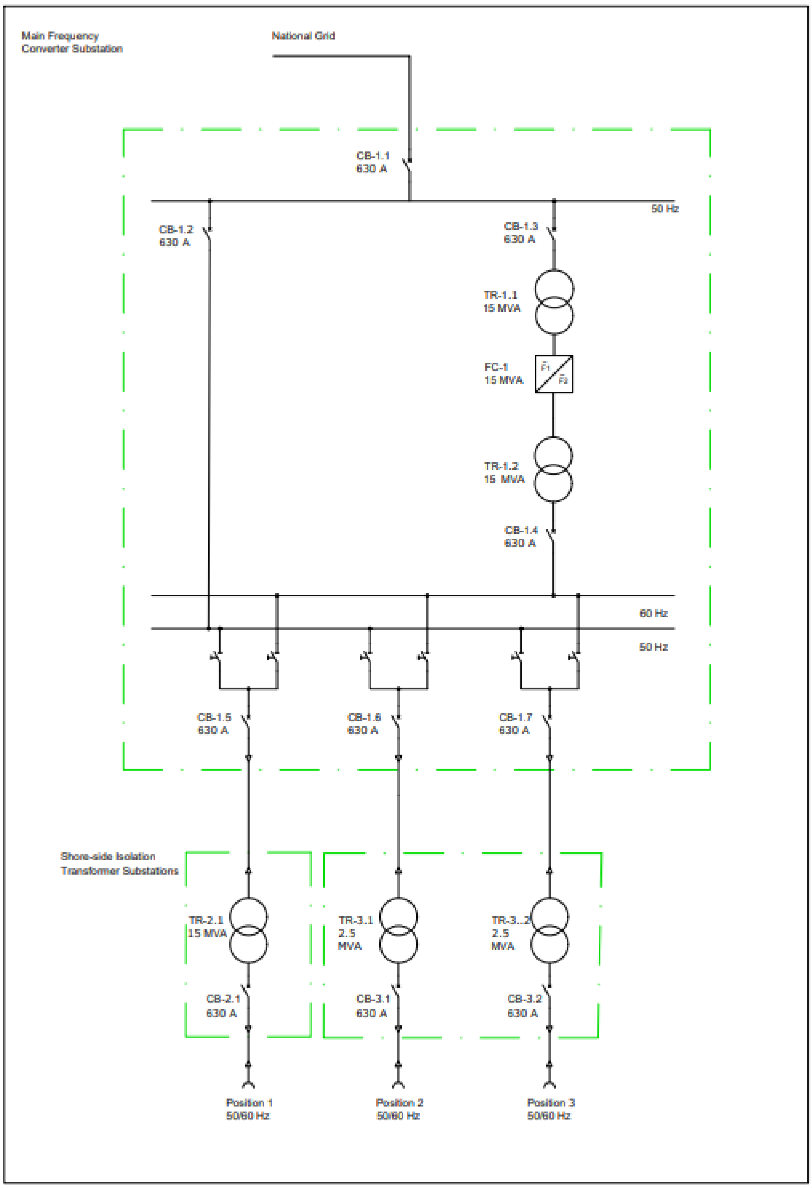


Figure 5.14 Centralized frequency converter configuration.

As already decided the connection points are 3. If they are in use at the same time, the maximum power requirement is 20 MVA. In order to determine the highest power demands among the ships that intend to be connected simultaneously, the hourly energy consumption of May (2018 & 2019), which is a month with one of the highest total energy consumptions, for both cruises and passenger ships was calculated and is presented in the following diagrams.

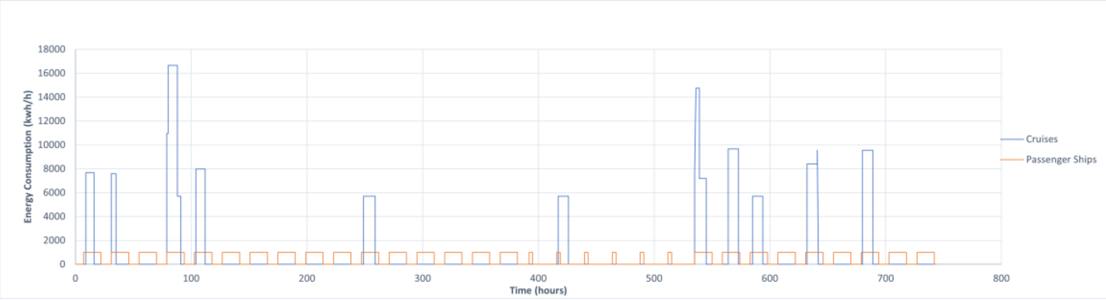


Figure 5.15 Hourly Energy Consumption (kWh/h) of Cruises and Passengers ships in May 2018

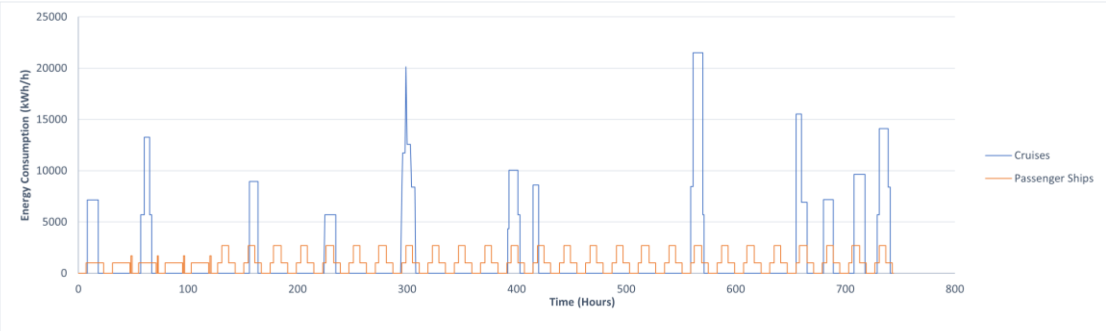


Figure 5.16 Hourly Energy Consumption (kWh/h) of Cruises and Passengers ships in May 2019

As can be seen in the graphs, the hours that the total energy consumption exceeds the limit of 15,000 KW are very few. Overall, centralized installation can be used and only for a few hours per month some ships will use their engine.

Based on all the above information, the centralized configuration with a main central transformer of 15 MVA is proved to be more suitable.

5.3.1 Main Substation building

The main equipment of the shore-side installations shall be housed inside a substation building designed specifically to house electrical equipment.

The equipment of the central substation and its size depends on the maximum energy needs of the port. As already decided, the configuration with the central frequency converter will be installed.

The main substation building will include the step-down and step- up transformers, the frequency converter, the buses and some circuit breakers.

Based on similar substations that have been built in other ports, it is estimated that the total space it will occupy will be approximately 360 m^2.

5.3.2 Cables

The electricity distribution from the main substation building to the shore side substation and then to the connection points of the ships will be carried out through underground wiring.

There will be used both cables of 20 kV and 11 kV. The former will be used to connect the main substation building with the isolating transformer, while the latter will be used to connect the shore side substation building with the berthing points.

Based on the location of the three substation buildings and the berthing places it has been calculated that there will be needed

- 276 m cable of 20kV (300 mm^2),
- 38 m of 11 kV (185 mm^2),
- 400 m of 20 kV (16 mm^2)
- and 290 m cable of 11kV (35 mm^2).

5.3.3 Shore Side Substation

In order to supply the socket outlets of the three shore supply positions two shore substations are foreseen.

There will be one substation to supply mostly cruises (15 MVA) and one substation with two transformers for passenger ships (2.5 MVA each). For each shore supply position on isolation power transformer, incoming and outgoing switchgears are foreseen, which will be installed in each Shore Substation. These substations will be approximately 35 m^2 each.

The voltage transformer that is located in this substation is also used as an isolation transformer. Thus, if, for example, a short circuit occurs during the connection, the main substation building will not be affected.

5.4 Technical Design of the PV park

5.4.1 Size of the Photovoltaic Park

The installation of photovoltaic panels on the roofs of three buildings and five parking areas is being considered.

The photovoltaic system is composed of 10,626 PV modules and 14 inverters with a total nominal power of 3187.8 kWp for an estimated annual production of energy equal to 53,856.53 kWh distributed over an area of 17,426.64 m^2 and a producibility of 1,695.57 kWh/kWp. The connection to the grid will be carried out according to a scheme Three-phase in Medium voltage. The selected areas are presented below in a satellite photo as shown by Blue Sol.

Figure 5.17 Location of the buildings and the parking areas

Table 5.9 Estimated Areas

Area	Surface	Azimuth	Tilt
K1 (x2)	104 m^2	194 °	30°
K2	375.3 m^2	199.8 °	0°
K3	856.7 m^2	195.1 °	0°
K4	814 m^2	194.3 °	0°
P1	8744 m^2	189.9 °	0°
P2	3543 m^2	187.7 °	0°
P3	1457.3 m^2	190 °	0°
P4 (x5)	478m^2	200 °	0°
P5	1167.4m^2	202.6 °	0°

For maximum energy efficiency the panels must be placed in a south orientation with a slope which depends on the latitude of the area. For the Greek data, a typical average characteristic slope is that of 30 degrees.

Regarding shading, care must be taken that the installation is located in an area where there are no obstacles. In addition, to avoid shading of rows of photovoltaic panels between them, a practical installation rule is that the distance between successive rows should be at least twice the height of the installation.

5.4.2 Technical Characteristics

As mentioned in section 5.4.1 the park will be configured to deliver approximately 3187.8 kWp. To cover the total power, 300 Wp panels were selected, from LG Electronics Inc. and more specifically the model LG330N1C-G3. In these areas, it is possible to place 10,626 panels in rows.

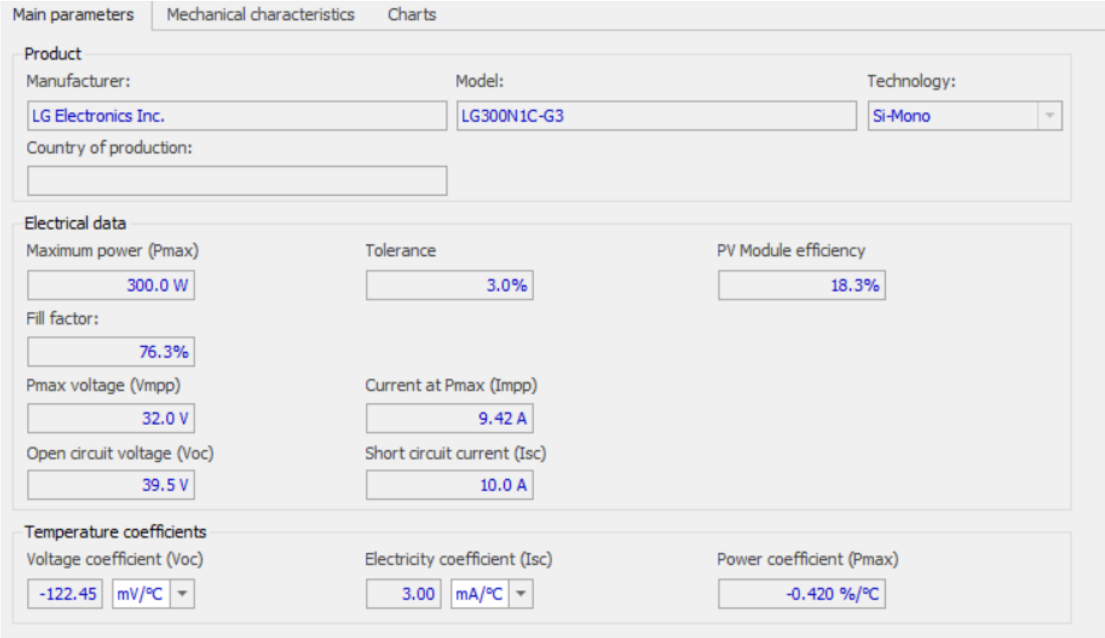


Figure 5.18 The electrical operating characteristics of photovoltaics as shown in Blue Sol.

The voltage generated by the photovoltaic generator is unsuitable for the direct connection of the station to the electricity distribution network. The role of the inverter is to convert the DC voltage generated by the panels to AC, of appropriate value and frequency- in this case 50 Hz- for connection to the mains. DC/ AC inverters can be either single-phase or three-phase. As current from the panels flows through the inverter, its characteristics substantially affect the behavior and operation of the photovoltaic system.
The KACO blueplanet 20.0 TL3 inverter is selected and its technical characteristics are shown below, as shown in Blue Sol.

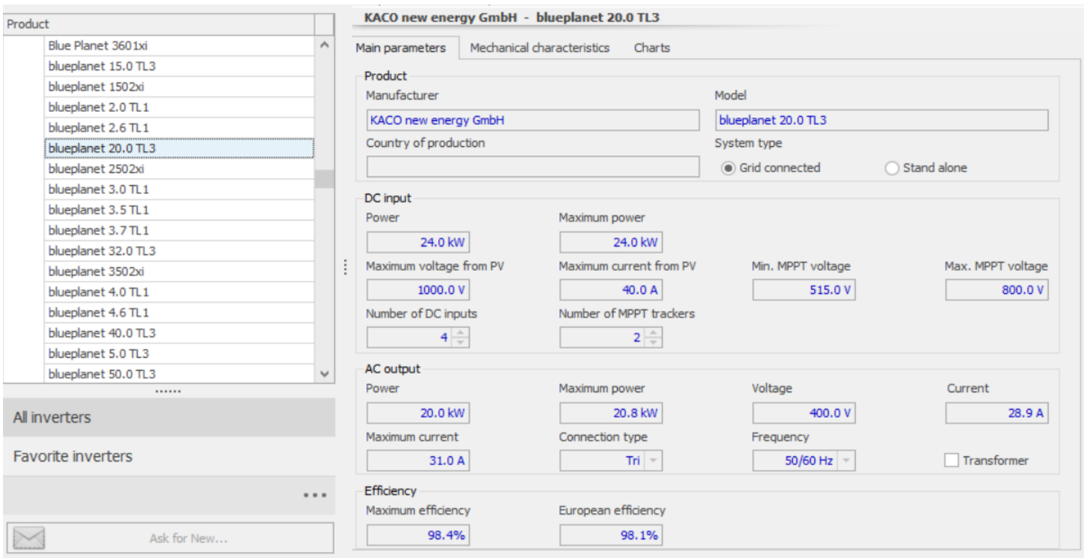


Figure 5.19 The electrical operating characteristics of the inverter.

The main technical characteristic of any PV installation is the PV generator, which consists of PV modules that join and form strings.

PV Modules

The voltage and power of a PV cell is too small to respond to power supply or to charge batteries. For this reason, the PV elements are placed in a single frame with a common electrical output. In this frame, the elements are connected in series, in groups of suitable number to obtain the desire voltage. The frames are prefabricated at the factory. The solar cells are attached with adhesive to a durable sheet of metal (usually aluminum) or reinforced plastic, which forms the back of the frame, while their front is covered by a protective sheet of glass or transparent plastic. The front and back sheets are held together, tightly and permanently, with the help of a strip of natural or synthetic rubber and tightened with a perimeter metal housing. This forms the PV module, which is the building block that is manufactured industrially and is commercially available to be used as a collector in the assembly of PV generators.

PV Strings

In a PV park that aims to produce electricity hundreds or even thousands of PV panels can be used. As expected, the PV panels must be grouped and connected properly. In order to increase the reliability of a PV system, it is advisable for the connections of the PV elements inside the frames to be not only in series but also parallel. That way, if a PV cell is shaded or damaged it will not reset the power produced by the system. Thus, the PV modules are group in PV strings and placed on a common support base, which is usually metal. The panels are connected in series or in parallel so that the output voltage of the generator acquires the desired value.

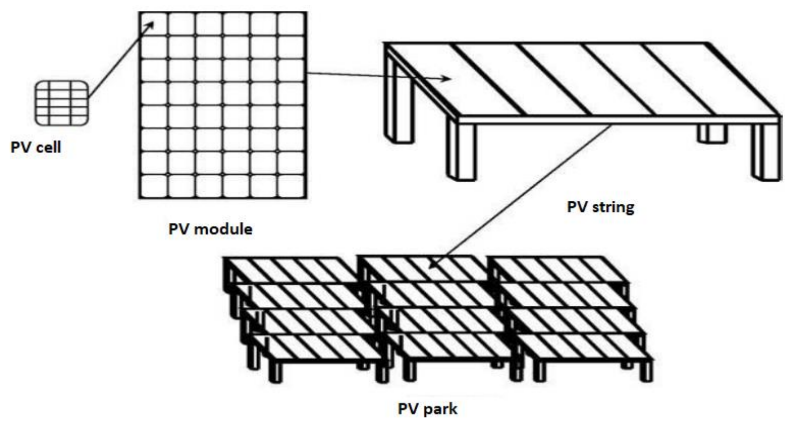


Figure 5.20 How PV module relates with the PV string and the PV park.

For calculating the number of the modules and strings Blue Sol application was used. Also, the power produced by each area was calculated as shown in figure 5.13. [17]

Table 5.10 Technical Characteristics in each area.

Area	Surface (m²)	Power (kW)	Strings	Modules
K1 (x2)	104	13.5	5	9
K2	375.3	54	20	9
K3	856.7	49	49	9
K4	814	116.1	43	9
P1	8744	1516.5	337	15
P2	3543	577.8	577.8	9
P3	1457.3	221.4	82	9
P4 (x5)	478	64.8	24	9
P5	1167.4	191,7	71	9

Based on all the above information, the nominal power and the annual energy production were calculated. Interestingly the CO2 reduction is 3243083,9 Kg per year. The following graph shows the energy produced on a monthly basis.

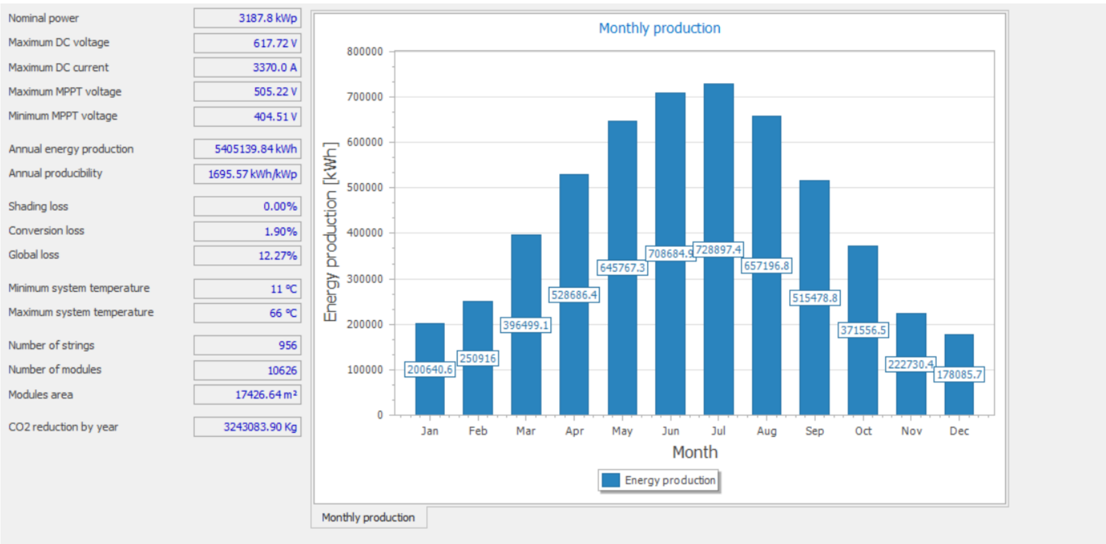


Figure 5.21 Monthly Energy Production (kWh) by Blue Sol.

6 Economic Analysis

6.1 Cold Ironing installation and operational costs

As explained in Chapter 5.3, for the case of Souda two configurations are suggested. As regards the technical characteristics, based on the power demands of the ships and the advantages and disadvantages of each configuration, the centralized solution seems to be more suitable.

However, below are presented the list of materials and the cost estimation for the cold ironing infrastructures described in the previous sections for both configurations.

Table 6.1 Decentralized Configuration.

Electrical of Main Substation					
Item	Description	Unit	Quant.	Rate (€)	Amount (€)
1.1	Main MV Switchgear ''M.MV1'' 24KV, including one incoming cubicle, one metering cubicle and 4 outgoing cubicles.	pcs	1	110,000.00	110,000.00
1.2	Main MV Switchgear ''M.MV2'' GIS type with double busbars 24KV, 5 incoming cubicles, one metering cubicle, 3 outgoing cubicles with automatic transfer.	pcs	1	110,000.00	110,000.00
1.3	Step Down Power transformer rated 15000 KVA, 20/3.3 KV.	pcs	1	170,000.00	170,000.00
1.4	Step up or up power Transformer rated 15000 KVA, 11/3.3 kV.	pcs	1	170,000.00	170,000.00
1.5	Step Down Power transformer rated 2500 KVA, 20/3.3 KV.	pcs	2	38,000.00	76,000.00
1.6	Step Up or up Power transformer rated 2500 KVA, 11/3.3 KV.	pcs	2	38,000.00	76,000.00
1.7	Step Down Power transformer rated 400 KVA, 20/0.4 KV, furnished and installed complete.	pcs	1	12,000.00	12,000.00
1.8	Static Frequency Converter rated 15000 KVA, modular type, 3.3KV/50 Hz input and 3.3KV/60 Hz output, liquid cooling,including the exterior heat exchanger, pumps, piping etc.	pcs	1	2,250,000.00	2,250,000.00
1.9	Static Frequency Converter rated 2500 KVA, modular type, 3.3KV/50 Hz input and 3.3KV/60 Hz output, liquid cooling, including the exterior heat exchanger, pumps, piping etc.	pcs	2	375,000.00	750,000.00
1.10	MV, LV & DC power and control cables, LV & DC Switchgear	pcs	1	30,000.00	30,000.00
SUBTOTAL					**3,754,000.00**

Table 6.2 Centralized Configuration.

Electrical of Main Substation					
Item	Description	Unit	Quant.	Rate (€)	Amount (€)
1.1	Main MV Switchgear ''M.MV1'' 24KV, including one incoming cubicle, one metering cubicle and 4 outgoing cubicles.	pcs	1	110,000.00	110,000.00
1.2	Main MV Switchgear ''M.MV2'' GIS type with double busbars 24KV, 5 incoming cubicles, one metering cubicle, 3 outgoing cubicles with automatic transfer.	pcs	1	220,000.00	220,000.00
1.3	Step Down Power transformer rated 15000 KVA, 20/3.3 KV.	pcs	1	170,000.00	170,000.00
1.4	Step Up or up Power transformer rated 15000 KVA, 20/3.3 KV.	pcs	1	170,000.00	170,000.00
1.5	Step Down Power transformer rated 400 KVA, 20/0.4 KV, furnished and installed complete.	pcs	1	12,000.00	12,000.00
1.6	Static Frequency Converter rated 15000 KVA, modular type, 3.3KV/50 Hz input and 3.3KV/60 Hz output, liquid cooling, including the exterior heat exchanger, pumps, piping etc.	pcs	1	2,250,000.00	2,250,000.00
1.7	MV, LV & DC power and control cables, LV & DC Switchgear	pcs	1	30,000.00	30,000.00
SUBTOTAL 1					**2,962,000.00**
Electrical of Shore Substations					
2.1	Typical incoming MV Switchgear 24KV, GIS Ring Main Unit type including one incoming cubicle and one outgoing cubicle.	pcs	3	8,000.00	24,000.00
2.2	Typical outgoing MV Switchgear 12KV, GIS Ring Main Unit type including one cubicle for incoming cable, one metering cubicle and one outgoing cubicle.	pcs	3	22,000.00	66,000.00
2.3	Isolation Step Down Power transformer rated 15000 KVA, 20/11 KV, furnished and installed complete.	Pcs	1	170,000.00	170,000.00
2.4	Isolation Step Down Power transformer rated 2500 KVA, 20/11	pcs	2	38,000.00	76,000.00

	KV, furnished and installed complete.				
SUBTOTAL 2					**336,000.00**
TOTAL					**3,858,000.00**

As can be seen the centralized is a bit more expensive than the decentralized solution. This makes sense as a double busbar system is used with breakers and disconnectors to allow distribution of both frequencies. However, the technical advantages of the centralized configuration can overcome the small financial difference. Therefore, the centralized solution is still preferable.

To continue with the overall cost estimation of implementing CI in the port of Souda, at the following tables the rest of the equipment is presented, divided in the categories of equipment in need that were explained in the previous chapters.

In addition, 15% of the total cost has been added for unexpected expenses. The annual maintenance cost is assumed at 3% of the total installation cost, the contractor general expenses are assumed 18% and finally a VAT 24% has been added.

Table 6.3 Installation Cost

1. Substation buildings					
Item	Description	Unit	Quant.	Rate (€)	Amount (€)
1.1	Main substation building construction including concrete foundation and floor, steel frame, exterior wall and roof insulated panels, internal partition panels, louvers, raised false floor, trenches, exterior and internal doors, windows, finishes, sanitary fixtures, all required auxiliary installations, lightning and earthing protection system.	m^2	269	950.00	255,550.00
1.2	Ditto but substation building S/S1	m^2	59	800.00	47,200.00
1.3	Ditto but substation building S/S2	m^2	34	800.00	27,200.00
1.4	Crane Truck		1	212,000.00	212,000.00
SUBTOTAL 1					**541,950.00**
2. Outdoor Civil Works					
SUBTOTAL 2					**48,649.60**
3. Electrical Utilities					
Item	Description	Unit	Quant.	Rate (€)	Amount (€)
3.1	Corrugated HDPE duct normal type 750N, min 600mm and max 130mm below grade with nominal diameter DN125	m	352	7.20	2,534.40
3.2	Ditto but DN70	m	1090	3.50	3,815.00
3.3	20 kV Cu / XLPE multi-core cable 3x300mm^2	m	276	292.00	80,592.00
3.4	20 kV Cu / XLPE multi-core cable 3x70mm^2	m	800	52.00	41,600.00
3.5	11 kV Cu / XLPE multi-core cable 3x300mm^2	m	76	292.00	22,192.00

3.6	11 kV Cu / XLPE multi-core cable 3x70mm^2	m	290	52.00	15,080.00
SUBTOTAL 3					**165,813.40**
4. **Electrical of Main Substation**					
4.1	Main MV Switchgear ''M.MV1'' 24KV, including one incoming cubicle, one metering cubicle and 4 outgoing cubicles.	pcs	1	110,000.00	110,000.00
4.2	Main MV Switchgear ''M.MV2'' GIS type with double busbars 24KV, 5 incoming cubicles, one metering cubicle, 3 outgoing cubicles with automatic transfer.	pcs	1	220,000.00	220,000.00
4.3	Step Down Power transformer rated 15000 KVA, 20/3.3 KV.	pcs	1	170,000.00	170,000.00
4.4	Step Up or up Power transformer rated 15000 KVA, 20/3.3 KV.	pcs	1	170,000.00	170,000.00
4.5	Step Down Power transformer rated 400 KVA, 20/0.4 KV, furnished and installed complete.	pcs	1	12,000.00	12,000.00
4.6	Static Frequency Converter rated 15000 KVA, modular type, 3.3KV/50 Hz input and 3.3KV/60 Hz output, liquid cooling, including the exterior heat exchanger, pumps, piping etc.	pcs	1	2,250,000.00	2,250,000.00
4.7	MV, LV & DC power and control cables, LV & DC Switchgear	pcs	1	30,000.00	30,000.00
SUBTOTAL 4					**2,962,000.00**
5. **Electrical of Shore Substations**					
5.1	Typical incoming MV Switchgear 24KV, GIS Ring Main Unit type including one incoming cubicle and one outgoing cubicle.	pcs	3	8,000.00	24,000.00
5.2	Typical outgoing MV Switchgear 12KV, GIS Ring Main Unit type including one cubicle for incoming cable, one metering cubicle and one outgoing cubicle.	pcs	3	22,000.00	66,000.00
5.3	Isolation Step Down Power transformer rated 15000 KVA, 20/11 KV, furnished and installed complete.	Pcs	1	170,000.00	170,000.00
5.4		pcs	2	38,000.00	76,000.00

	Isolation Step Down Power transformer rated 2500 KVA, 20/11 KV, furnished and installed complete.				
SUBTOTAL 5					**336,000.00**
6. Socket Outlets and Plugs					
SUBTOTAL 6					**16,000.00**

TOTAL S1	**4,070,413.00**
Contractor General Expenses 18%	732,674.34
SUBTOTAL COST S2	**4,803,087.34**
Unexpected Expenses 15%	720,463.10
SUBTOTAL COST S3	**5,523,550.44**
Prediction Review 1%	55,235.50
SUBTOTAL COST S4	**5,578,785.95**
VAT 24%	1,338,908.63
TOTAL COST OF PROJECT	**6,917,684.57**

Table 6.4 Operational Cost

Maintenance and Operational Costs		
	Number of employees	Annual Wage/person (€)
Electrician-Engineers	4	24.000
Technicians	9	16.000
Total annual operating cost	**240,000 €**	
Maintenance cost	**3% of total installation cost**	207,530
Total annual costs	**447,530€**	

6.2 Electricity cost

The following tables present PPCs electricity charges for businesses and industries.

Table 6.5 On shore generated electricity cost, source: www.dei.gr

DEI Cost		
High Usage Factor		
Time Zone	Power Fee (€/kW/month)	Energy Cost (€/kWh)
7:00-23:00 on working days	8.88	
7:00-23:00 on working days		0.06470
23:00-7:00 on working days		0.05057
weekends		0.05057
Average		0.057635

Table 6.6 Additional charges, source:www.dei.gr

Transmission System	Distribution Network					
Power fee (€/kW/month)	Power fee (€/kW/month)	Energy cost (€/kWh)	Other charges (€/kWh)	ETMEAP (€/kWh)	YKΩ (€/kWh)	CO_2 fee (€/kWh)
1.197	1.097	0.0028	0.00007	0.00878	0.00691	0.00356

Table 6.6 Overall onshore generated electricity cost.

	Power fee (€/kW/month)	Energy & other costs without any tax exceptions (€/kWh)	Energy & other costs with tax exceptions (€/kWh)
Overall cost	**11.174**	**0.07975**	**0.060505**

6.3 Cost of the Photovoltaic Park

As mentioned before a PV park of 3 MW is proposed to be installed and in the following tables its total cost is presented.

Table 6.7 Cost of the Photovoltaic Park (3MW).

Cost of the PV Park (3MW)				
Item	Description	Cost/Power (€/kW)	Power (kW)	Cost (€)
1	PV Modules - LG Electronics Inc. LG3001C-G3	550	3187.8	1,753,290.00
2	KACO new energy GmbH blueplanet 20.0 TL3	30	3187.8	95,634.00
3	Full System installation & connection	40	3187.8	127,512.00
4	Electrical Accessories	60	3187.8	191,268.00
5	Converter	20	3187.8	63,756.00
6	Licensing			100,000.00
Total				**2,331,460.00**

Table 6.8 Maintenance cost of the Photovoltaic Park (3MW).

Annual Costs in €	3 MW
Maintenance and labor	10,000
Insurance	25,000
Unexpected	5,000
Total	**40,000**

6.4 External costs of ship emissions for the environment and human health

The health problems occurring from ship emissions pose a significant economic burden for Greeks. Thus, every possible solution to improve this issue should be considered thoroughly.

Table 6.9 External cost factors (in Euro, year 2000) per ton of pollutant.

Pollutant	Human Health	Ecosystem Quality	Climate Change	Total
CO_2	0	0	21	21
SO_2	6300	200	0	6500
NOx	5700	1000	0	6700
PM	35000	0	0	35000

It must be mentioned that the above table refers to the value of Euro in 2000 in order to evaluate all data from all member countries. Therefore, when these figures are required to make any calculation, then the current money values of Euro should be calculated by using inflation rates. Euro experienced an average inflation rate of 1.75% per year between 2000 and 2019. That means that 1€ in the year 2000 is worth 1.46 in 2019. The following table results after taking under consideration this inflation.

Table 6.10 External cost factors (in Euro, year 2019) per ton of pollutant.

Pollutant	Human Health	Ecosystem Quality	Climate Change	Total
CO_2	0	0	30.66	30.66
SO_2	9,198	292	0	9,490
NOx	8,322	1,460	0	9,782
PM	51,100	0	0	51,100

The following table presents the external cost of all the emissions in Souda.

Table 6.11 Maximum external cost of the emissions in port per year.

Pollutant	**CO_2**	**SO_2**	**NOx**	**PM**	**Total**
Tons	27,798.08	161.63	495.30	31.89	
Cost	852,289.26	1,533,821.25	4,845,024.6	1,629,527.9	8,860,663.01

6.5 Net Present Value Model

Net Present Value (NPV) is the total benefit (profit) that the investor has from the implementation of the project throughout its life n.

NPV is expressed in the formula below:

$$NPV = \sum_{i=1}^{n} \frac{A_i}{(1+r)^i} - C$$

Where,

n is project life,

A_i is net cash flow at the end of the year i,

r is discount rate,

C is initial capital expenditure.

Based on the formula, the present value of each cash flow is found, including the cost, discounted at the project's cost of capital, the sum of these discounted cash flows is defined as the project's NPV.

Investments that have a positive NPV are accepted, on the contrary if the NPV is negative the investment must be rejected. The financial goal of the managers is to maximize the NPV, as it is associated with maximizing the benefit.

6.6 Assumptions and Scenarios for Cold Ironing Installation

6.6.1 Assumptions for NPV

In order to create a NPV model, a number of assumptions had to be made.

1. **Time period of the investment:**
    - Year of starting: 2022
    - Year of data: 2019
    - Life of investment: 30 years
    - All components have the same lifetime (including the PV park)
2. **Financial estimations**
    - No Electricity price growing rate has been considered.
    - No Euro inflation rate has been considered.
    - Discount rate (Greek inflation rate): 2%
3. **Ship calls are considered same with 2019 figures and fix for the next years.**
4. **Ships' energy consumption is considered same with 2019 figures and fix for the next years.**
5. **Ship emissions are considered same with 2019 figures and fix for the next years.**
6. **Calculation of cash flow at system usage rate 100%:**
    - Cost of on-shore generated electricity as reference value without any tax exceptions: 1,610,483.54 €
    - Cost of on-shore generated electricity as reference value tax exceptions included: 1,285,156.19 €
7. **Initial capital cost of the investment**
    - Initial capital cost of the Cold Ironing installation: 6,917,694.57 €
    - Initial capital cost of the Photovoltaic park installation: 2,331,460 €

8. **Annual costs:**
    - Cold Ironing total annual cost reference value (2019): 447,530 €
    - PV park total annual cost reference value (2019): 40,000 €
9. **PV unit's efficiency decreases by 1% every year.**
10. **No loans for the initial investment have been considered in this study.**
11. **Mediterranean continues to be out of ECAs zones.**

6.6.2 Explanation of the different scenarios

As mentioned before, three different scenarios of the CI facilities use have been examined:

1. The 100% use of the CI facilities from the beginning of its operation.
2. The 15% use of the CI facilities the first year of operation and an increase of 15% each following year until it reaches the max.
3. The 25% use of the CI facilities the first year of operation and an increase of 20% each following year until it reaches the max.

For every of the above scenarios, four different funding possibilities were considered:

1. The total initial investment is covered by Souda Port.
2. 70% of the initial investment is covered by Souda Port and 30% by EU funding.
3. 50% of the initial investment is covered by Souda Port and 50% by EU funding.
4. 30% of the initial investment is covered by Souda Port and &0% by EU funding.

For each scenario and every funding possibility we calculated the NPV of two different occasions:

1. On-shore electricity price is calculated according to DEI without any tax exceptions:
   Cost in € = 0.0.07975 * kWh + 11.174 * kW/month
2. On-shore electricity price is calculated according to DEI including tax exceptions:
   Cost in € = 0.060505* kWh + 11.174 * kW/month

Finally, for each occasion, funding possibility and scenario, four different NPV have been calculated:

1. Installation only of the CI (without PV park).
2. Installation of the CI and a 3 MW park with a fixed price per MWh of 39 € /MWh.
3. Installation of the CI and a 3 MW park which will grant an exception to operate as Net Metering Instalment.
4. The environmental benefits in monetary values.

6.7 Results of the Net Present Value method

6.7.1 Scenario 1: 100% use of the CI facilities

Table 6.12 Results of the NPV method for the 1st scenario.

100% use from the first year				
NPV in kilo Euros				
	Without EU funding	30% EU funding	50% EU funding	70% EU funding
Without tax exceptions				
Without PV park	-7,578	-5,502	-4,119	-2,735
PV scenario 1	-9,284	-7,209	-5,825	-4,442
PV scenario 2	-650	1,426	2,810	4,193
With environmental benefits	253,030	255,105	256,489	257,872
With tax exceptions				
Without PV park	-292	1,784	3,167	4,551
PV scenario 1	-4,049	-1,974	-590	793
PV scenario 2	4,585	6,660	8,044	9,427
With environmental benefits	260,316	262,391	263,775	265,159

This table describes the ideal scenario of all ships approaching Souda using CI instead of the auxiliary engines. However, it seems impossible because of the lack of necessary electrical modifications in all the vessels.

Nevertheless, it is obvious that without a tax exception only the scenario with the PV park and the Net Metering exception would be a profitable installment and this only if the EU made a funding. Moreover, even with exceptions, without an EU funding, the scenario with the PV park and the Net Metering exception, of course poses as the ideal scenario for Souda port in financial perspective.

However, if one considers the environmental benefits presented in monetary values on the table, it is more than clear that the investment should be materialized.

6.7.2 Scenario 2: 15% initial use of the CI and 15% increase every year

Table 6.13 Results of the NPV method for the 2nd scenario.

15% initial use and 15% increase every year				
NPV in kilo Euros				
	Without EU funding	30% EU funding	50% EU funding	70% EU funding
Without tax exceptions				
Without PV park	-10,535	-8,459	-7,076	-5,692
PV scenario 1	-12,241	-10,165	-8,782	-7,398
PV scenario 2	-3,607	-1,531	-148	1,236
With environmental benefits	150,881	152,957	154,340	155,724
With tax exceptions				
Without PV park	-5,549	-3,474	-2,090	-707
PV scenario 1	-9,307	-7,232	-5,848	-4,465

PV scenario 2	-673	1,403	2,786	4,170
With environmental benefits	145,868	147,943	149,327	150,710

The percentage value into the model of usage rate of the CI was inserted to make more rational approach of the market. The following table presents the pessimistic scenario of only 15% of the ships approaching Souda's port having the appropriate equipment to use the CI facilities, and an increase of 15% each year.

In that case the results show that again without a tax exception the loss for the port will be huge, with the only exception of a 70% EU funding and a PV park with a Net Metering exception. What is more, even with tax exceptions only with an EU funding and a PV park with a Net Metering exception would be profitable.

Noteworthy, is the fall of the environmental benefits for Souda and the fact that the maximum usage of the CI system will be reached 15 years after the installation.

6.7.3 Scenario 3: 25% initial use of the CI and 20% increase every year

Table 6.14 Results of the NPV method for the 3rd scenario.

25% initial use and 20% increase every year				
NPV in kilo Euros				
	Without EU funding	30% EU funding	50% EU funding	70% EU funding
Without tax exceptions				
Without PV park	-9,449	-7,374	-5,990`	-4,607
PV scenario 1	-11	-9,080	-7,696	-6,313
PV scenario 2	-2,521	-446	938	2,321
With environmental benefits	234,048	236,123	237,507	238,890
With tax exceptions				
Without PV park	-3,619	-1,544	-160	1,223
PV scenario 1	-7,377	-5,301	-3,918	-2,534
PV scenario 2	1,257	3,333	4,716	6,100
With environmental benefits	234,112	236,1867	237,570	238,954

This is a more optimistic scenario, while the initial usage ratio is 25% and increases 20% every year. As a result, the usage will be reached 10 years after the installation. The profitable cases for Souda are again, those of having a PV park and a Net Metering exception and granting a reduction on the energy fee.

The analytical calculations of the above tables can be found in Appendix.

7.Conclusions

In the modern world, the need to respect and protect the environment is constantly growing. For this reason, there is a significant number of different authorities, committed to protect and preserve the ecosystem. Thus, as regards ports and ship owners, alternative ways of reducing the emission from ships have experienced a technological revolution. However, such technological improvements come with a high price. In the present Diploma Thesis, the possibility of a Cold Ironing installation in Chania's port, Souda, was considered, from a cost-benefit perspective.

In the port of Souda there are approximately 700 calls per year, from both passenger RoRo ships and cruises, with an average time at the port of 9 hours. This has as a result 28,487 tons of air pollutants to be discharged into the atmosphere from the ships while hoteling at berth. That noxious exhaust gases have been spread out over the city of Souda during 2019. With the installation of the cold ironing system in port of Souda, emissions from ships will be cut sharply because of the non-use of fuels oils in auxiliary engine to generate electricity. Therefore, air pollution will decrease while air quality will increase.

Taking into account the type of ships that berth in the port, the frequency of their visit, the duration of their stay as well as the topographic configuration of the port, a three-point Cold Ironing system is proposed. The two connection points are addressed to passenger ferries and one to cruise ships. The total power of the facility is 20 MVA and the total investment is estimated at 6,917,694.57 euros with an annual maintenance cost of 447,530 euros.

From the perspective of energy prices, the price of on-shore generated electricity according to DEI's invoice is approximately 0.0953 €/kWh. On the other hand, ship owners will buy the energy with a fixed price of 0.12 €/kWh.

The significant higher price of the CI is a negative factor for installing it. That is because ship owners will not be willing to use it instead of MGO. If one considers the cost of retrofitting the vessels that are not already equipped with CI connection system which may reach even a million euros depending on the ship category and size, the scenario of using CI becomes more distant.

Since this problem was realized, a number of alternatives have been examined. That includes tax exception or photovoltaic park installations in order to make the CI a competitive solution for the ship-owners. The ideal solution would be that of the Greek government reducing the fee to make it competitive and give a motivation to the port authority to make the investment.

The installation of a photovoltaic park has also been considered. Ideally the size of it should be enough to cover the power demand of the CI in order to have a zero-emission harbor. However, the available space as well as the cost of such an investment makes it unreasonable. Nevertheless, the implementation of 3 MW photovoltaic park in order to cover a portion of energy demand and expenses is a reasonable size. This investment is estimated at 2,331,460 euros with an annual maintenance of 40,000 euros.

In the case study, investment cost for the cold ironing system and the photovoltaic park has been analyzed by using the Net Present Value method in respect of three different scenarios differing on the usage (%) of the Cold ironing system per year.

In all three scenarios, independently of the EU's participation on funding the investment, the Net Present Value method presented negative values. However, some of the scenarios, where tax exception for the electricity was granted, presented positive outcomes, for example the scenario with 3 MW park with a net metering exception.

However even if the ideal scenario of an investment with positive Net Present Value is not achieved, the investment should still be considered because of the great environmental profit arise. Especially, in the pessimistic scenario where negative NPVs occur in some cases, the materialization of the project should move forward, considering the external benefits.

As the European Union has proved in recent years that it supports similar environmental initiatives, it is more than likely that a proportion of the investment would be funded from EU. Especially if the photovoltaic park is installed, the whole investment will comply with many of EU's criteria to grand a fund.

For the purposes of this study, Greek inflation and electricity's price growth rate have been calculated, yet several assumptions had to be made. What is more, all the economic calculations in this thesis are unstable and may differ from different point of view. Thus, a further analysis regarding these factors is proposed.

To conclude, Cold Ironing is a drastic environmental protection solution. Both the efficacy and the advantages of the project have been proved. However, these benefits come with a high price. Thus, countries should be obligated to support part of the cost by introducing special exceptions regarding the energy fee and the taxation. Moreover, even though in short-term such a project may appear unprofitable, in a long-term perspective is quite the contrary. Finally, if such a policy is followed, the investment for port authorities could be at least at a break-even level, if not profitable, as this kind of projects have the potential to become a benchmark for other ports, resulting in a globally faster spreading of the port electrification and Cold Ironing.

8 Appendix

8.1 Ship Data

8.1.1 Cruise Data 2018-2019

Ship	Arrival	Departure	hours
SILVER SPIRIT	2/3/18 22:00	3/3/18 21:00	23:00:00
MEIN SCHIFF I	3/4/18 8:00	3/4/18 18:00	10:00:00
OCEANA	8/4/18 8:00	8/4/18 18:00	10:00:00
GOLDEN IRIS	10/4/18 8:00	10/4/18 13:30	5:30:00
HORIZON	21/4/18 8:30	21/4/18 18:30	10:00:00
EUROPA	25/4/18 8:00	25/4/18 18:00	10:00:00
HORIZON	27/4/18 9:00	27/4/18 17:00	8:00:00
OCEANA	1/5/18 9:00	1/5/18 17:00	8:00:00

NORWEGIAN SPIRIT	2/5/18 7:00	2/5/18 12:00	5:00:00
MARINER OF THE SEAS	4/5/18 7:00	4/5/18 17:00	10:00:00
HORIZON	4/5/18 9:00	4/5/18 19:00	10:00:00
OOSTERDAM	5/5/18 8:00	5/5/18 17:00	9:00:00
HORIZON	11/5/18 9:00	11/5/18 19:00	10:00:00
HORIZON	18/5/18 9:00	18/5/18 19:00	10:00:00
NORWEGIAN SPIRIT	23/5/18 7:00	23/5/18 12:00	5:00:00
MARELLA DISCOVERY 2	23/5/18 8:00	23/5/18 18:00	10:00:00
CROWN PRINCESS	24/5/18 12:00	24/5/18 22:00	10:00:00
HORIZON	25/5/18 9:00	25/5/18 19:00	10:00:00
JEWEL OF THE SEAS	27/5/18 8:00	27/5/18 18:00	10:00:00
MEIN SCHIFF 2	29/5/18 8:00	29/5/18 18:00	10:00:00
HORIZON	1/6/18 9:00	1/6/18 19:00	10:00:00
HORIZON	8/6/18 9:00	8/6/18 19:00	10:00:00
MARELLA CELEBRATION	9/6/18 9:00	9/6/18 20:00	11:00:00
SILVER MUSE	11/6/18 8:00	11/6/18 22:00	14:00:00
OCEANA	12/6/18 9:00	12/6/18 18:00	9:00:00
NORWEGIAN SPIRIT	13/6/18 7:00	13/6/18 12:00	5:00:00
CROWN PRINCESS	14/6/18 12:00	14/6/18 22:00	10:00:00
RHAPSODY OF THE SEAS	19/6/18 7:00	19/6/18 17:00	10:00:00
MARELLA DISCOVERY 2	20/6/18 8:00	20/6/18 18:00	10:00:00
OOSTERDAM	22/6/18 8:00	22/6/18 17:00	9:00:00
MEIN SCHIFF 2	26/6/18 8:00	26/6/18 18:00	10:00:00
HORIZON	29/6/18 9:00	29/6/18 19:00	10:00:00
CROWN PRINCESS	5/7/18 12:00	5/7/18 22:00	10:00:00
HORIZON	6/7/18 9:00	6/7/18 19:00	10:00:00
MARELLA CELEBRATION	7/7/18 9:00	7/7/18 20:00	11:00:00
HORIZON	13/7/18 9:00	13/7/18 19:00	10:00:00
RHAPSODY OF THE SEAS	17/7/18 7:00	17/7/18 17:00	10:00:00
MARELLA DISCOVERY 2	18/7/18 8:00	18/7/18 18:00	10:00:00
MEIN SCHIFF 2	24/7/18 8:00	24/7/18 18:00	10:00:00
NORWEGIAN SPIRIT	25/7/18 7:00	25/7/18 12:00	5:00:00
CROWN PRINCESS	26/7/18 12:00	26/7/18 22:00	10:00:00
HORIZON	3/8/18 9:00	3/8/18 19:00	10:00:00
MARELLA CELEBRATION	4/8/18 9:00	4/8/18 20:00	11:00:00
OCEANA	7/8/18 8:00	7/8/18 18:00	10:00:00
OOSTERDAM	9/8/18 8:00	9/8/18 17:00	9:00:00
SALAMIS FILOXENIA	9/8/18 11:00	11/8/18 20:00	57:00:00
CROWN PRINCESS	16/8/18 12:00	16/8/18 22:00	10:00:00
MEIN SCHIFF 2	21/8/18 8:00	21/8/18 18:00	10:00:00
CELEBRITY CONSTELLATION	24/8/18 7:00	24/8/18 17:00	10:00:00
HORIZON	24/8/18 9:00	24/8/18 19:00	10:00:00

MARELLA DISCOVERY 2	29/8/18 8:00	29/8/18 18:00	10:00:00
HORIZON	31/8/18 9:00	31/8/18 19:00	10:00:00
OCEANA	4/9/18 9:00	4/9/18 17:00	8:00:00
NORWEGIAN SPIRIT	5/9/18 7:00	5/9/18 12:00	5:00:00
CROWN PRINCESS	6/9/18 12:00	6/9/18 22:00	10:00:00
MEIN SCHIFF 2	18/9/18 8:00	18/9/18 18:00	10:00:00
HORIZON	21/9/18 9:00	21/9/18 19:00	10:00:00
NORWEGIAN SPIRIT	26/9/18 7:00	26/9/18 12:00	5:00:00
MARELLA DISCOVERY 2	26/9/18 8:00	26/9/18 18:00	10:00:00
OOSTERDAM	26/9/18 8:00	26/9/18 17:00	9:00:00
AZAMARA PURSUIT	27/9/18 8:00	27/9/18 22:00	14:00:00
HORIZON	28/9/18 9:00	28/9/18 19:00	10:00:00
MARELLA CELEBRATION	29/9/18 9:00	29/9/18 20:00	11:00:00
GOLDEN IRIS	4/10/18 8:00	4/10/18 13:00	5:00:00
AZAMARA PURSUIT	5/10/18 8:00	5/10/18 18:00	10:00:00
HORIZON	5/10/18 9:00	5/10/18 19:00	10:00:00
CELEBRITY CONSTELLATION	9/10/18 12:00	9/10/18 19:00	7:00:00
AZAMARA QUEST	10/10/18 9:00	10/10/18 23:00	14:00:00
HORIZON	12/10/18 9:00	12/10/18 19:00	10:00:00
MEIN SCHIFF 2	16/10/18 8:00	16/10/18 18:00	10:00:00
NORWEGIAN SPIRIT	17/10/18 7:00	17/10/18 12:00	5:00:00
SALAMIS FILOXENIA	17/10/18 9:00	17/10/18 19:00	10:00:00
Mein Schiff 3	21/10/18 7:00	21/10/18 19:00	12:00:00
AZAMARA PURSUIT	21/10/18 8:00	21/10/18 18:00	10:00:00
HORIZON	30/10/18 10:00	30/10/18 20:00	10:00:00
CELEBRITY CONSTELLATION	1/11/18 12:00	1/11/18 19:00	7:00:00
AEGEAN ODYSSEY	2/11/18 7:00	2/11/18 23:59	16:59:00
NORWEGIAN SPIRIT	7/11/18 7:00	7/11/18 12:00	5:00:00
MSC MAGNIFICA	11/11/18 7:45	11/11/18 17:00	9:15:00
AEGEAN ODYSSEY	3/12/18 8:00	3/12/18 18:00	10:00:00
VIKING JUPITER	18/2/19 7:00	18/2/19 16:30	9:30:00
HORIZON	25/3/19 10:00	25/3/19 20:00	10:00:00
NORWEGIAN SPIRIT	13/4/19 7:00	13/4/19 12:00	5:00:00
OCEANA	14/4/19 8:00	14/4/19 18:00	10:00:00
MEIN SCHIFF 4	20/4/19 8:00	20/4/19 18:00	10:00:00
HORIZON	20/4/19 9:00	20/4/19 19:00	10:00:00
AEGEAN ODYSSEY	21/4/19 9:00	22/4/19 23:00	38:00:00
NORWEGIAN SPIRIT	23/4/19 7:00	23/4/19 12:00	5:00:00
JEWEL OF THE SEAS	25/4/19 11:00	25/4/19 20:00	9:00:00
HORIZON	26/4/19 9:00	26/4/19 19:00	10:00:00
CRYSTAL SERENITY	1/5/19 8:00	1/5/19 18:00	10:00:00
CRYSTAL SERENITY	1/5/19 8:00	1/5/19 18:00	10:00:00

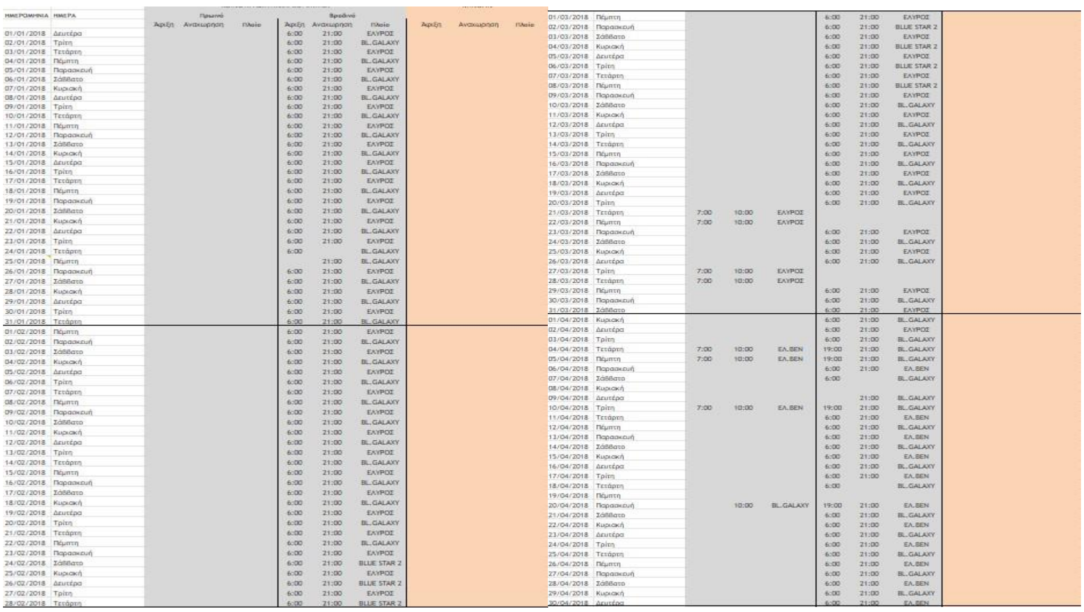
NORWEGIAN SPIRIT	3/5/19 7:00	3/5/19 12:00	5:00:00
NORWEGIAN SPIRIT	3/5/19 7:00	3/5/19 12:00	5:00:00
HORIZON	3/5/19 9:00	3/5/19 19:00	10:00:00
HORIZON	3/5/19 9:00	3/5/19 19:00	10:00:00
KONINGSDAM	7/5/19 12:00	7/5/19 20:00	8:00:00
KONINGSDAM	7/5/19 12:00	7/5/19 20:00	8:00:00
HORIZON	10/5/19 9:00	10/5/19 19:00	10:00:00
HORIZON	10/5/19 9:00	10/5/19 19:00	10:00:00
NORWEGIAN SPIRIT	13/5/19 7:00	13/5/19 12:00	5:00:00
NORWEGIAN SPIRIT	13/5/19 7:00	13/5/19 12:00	5:00:00
SILVER SHADOW	13/5/19 8:00	13/5/19 16:00	8:00:00
SILVER SHADOW	13/5/19 8:00	13/5/19 16:00	8:00:00
JEWEL OF THE SEAS	13/5/19 11:00	13/5/19 20:00	9:00:00
JEWEL OF THE SEAS	13/5/19 11:00	13/5/19 20:00	9:00:00
AZAMARA PURSUIT	17/5/19 8:00	17/5/19 17:00	9:00:00
AZAMARA PURSUIT	17/5/19 8:00	17/5/19 17:00	9:00:00
HORIZON	17/5/19 9:00	17/5/19 19:00	10:00:00
HORIZON	17/5/19 9:00	17/5/19 19:00	10:00:00
NORWEGIAN JADE	18/5/19 7:00	18/5/19 12:00	5:00:00
NORWEGIAN JADE	18/5/19 7:00	18/5/19 12:00	5:00:00
CELEBRITY CONSTELLATION	24/5/19 7:00	24/5/19 17:00	10:00:00
CELEBRITY CONSTELLATION	24/5/19 7:00	24/5/19 17:00	10:00:00
MARELLA EXPLORER 2	24/5/19 9:00	24/5/19 18:00	9:00:00
HORIZON	24/5/19 9:00	24/5/19 19:00	10:00:00
HORIZON	24/5/19 9:00	24/5/19 19:00	10:00:00
MARELLA EXPLORER 2	24/5/19 9:00	24/5/19 18:00	9:00:00
MSC LIRICA	28/5/19 7:00	28/5/19 17:00	10:00:00
MSC LIRICA	28/5/19 7:00	28/5/19 17:00	10:00:00
NORWEGIAN JADE	28/5/19 7:00	28/5/19 12:00	5:00:00
MARELLA DISCOVERY	29/5/19 8:00	29/5/19 17:00	9:00:00
Emerald Princess	30/5/19 12:00	30/5/19 22:00	10:00:00
HORIZON	31/5/19 9:00	31/5/19 19:00	10:00:00
JEWEL OF THE SEAS	31/5/19 11:00	31/5/19 20:00	9:00:00
MARELLA CELEBRATION	1/6/19 9:00	1/6/19 18:00	9:00:00
OCEANA	3/6/19 8:00	3/6/19 18:00	10:00:00
MSC LIRICA	4/6/19 7:00	4/6/19 17:00	10:00:00
MEIN SCHIFF 6	4/6/19 8:00	4/6/19 18:00	10:00:00
MSC LIRICA	11/6/19 7:00	11/6/19 17:00	10:00:00
CROWN IRIS	13/6/19 8:00	13/6/19 15:00	7:00:00
NORWEGIAN JADE	15/6/19 7:00	15/6/19 12:00	5:00:00
SEABOURN ODYSSEY	17/6/19 8:00	17/6/19 17:00	9:00:00
MSC LIRICA	18/6/19 7:00	18/6/19 17:00	10:00:00

Emerald Princess	20/6/19 12:00	20/6/19 22:00	10:00:00
HORIZON	21/6/19 9:00	21/6/19 19:00	10:00:00
OCEANA	23/6/19 8:00	23/6/19 18:00	10:00:00
AZAMARA PURSUIT	24/6/19 8:00	24/6/19 17:00	9:00:00
NORWEGIAN JADE	25/6/19 7:00	25/6/19 12:00	5:00:00
VEENDAM	25/6/19 8:00	25/6/19 17:00	9:00:00
SALAMIS FILOXENIA	27/6/19 10:00	27/6/19 17:00	7:00:00
CRYSTAL ESPRIT	28/6/19 8:00	28/6/19 21:00	13:00:00
HORIZON	28/6/19 9:00	28/6/19 19:00	10:00:00
MEIN SCHIFF 6	2/7/19 8:00	2/7/19 18:00	10:00:00
SILVER SHADOW	4/7/19 8:00	4/7/19 16:00	8:00:00
NORWEGIAN JADE	6/7/19 7:00	6/7/19 12:00	5:00:00
MARELLA CELEBRATION	6/7/19 9:00	6/7/19 18:00	9:00:00
RIVIERA	10/7/19 8:00	10/7/19 18:00	10:00:00
Emerald Princess	11/7/19 12:00	11/7/19 22:00	10:00:00
NORWEGIAN JADE	16/7/19 7:00	16/7/19 12:00	5:00:00
OCEANA	16/7/19 8:00	16/7/19 18:00	10:00:00
KONINGSDAM	16/7/19 8:00	16/7/19 17:00	9:00:00
MARELLA EXPLORER 2	19/7/19 9:00	19/7/19 18:00	9:00:00
HORIZON	19/7/19 9:00	19/7/19 19:00	10:00:00
RHAPSODY OF THE SEAS	23/7/19 7:00	23/7/19 17:00	10:00:00
MARELLA DISCOVERY	24/7/19 8:00	24/7/19 17:00	9:00:00
HORIZON	26/7/19 9:00	26/7/19 19:00	10:00:00
NORWEGIAN JADE	27/7/19 7:00	27/7/19 12:00	5:00:00
MSC LIRICA	30/7/19 7:00	30/7/19 17:00	10:00:00
MEIN SCHIFF 6	30/7/19 8:00	30/7/19 18:00	10:00:00
Emerald Princess	1/8/19 12:00	1/8/19 22:00	10:00:00
HORIZON	2/8/19 9:00	2/8/19 19:00	10:00:00
MSC LIRICA	6/8/19 7:00	6/8/19 17:00	10:00:00
NORWEGIAN JADE	6/8/19 7:00	6/8/19 12:00	5:00:00
HORIZON	9/8/19 9:00	9/8/19 19:00	10:00:00
VEENDAM	12/8/19 8:00	12/8/19 17:00	9:00:00
MSC LIRICA	13/8/19 7:00	13/8/19 17:00	10:00:00
CRYSTAL ESPRIT	16/8/19 8:00	16/8/19 21:00	13:00:00
HORIZON	16/8/19 9:00	16/8/19 19:00	10:00:00
NORWEGIAN JADE	17/8/19 7:00	17/8/19 12:00	5:00:00
MARELLA CELEBRATION	17/8/19 9:00	17/8/19 18:00	9:00:00
CELEBRITY CONSTELLATION	18/8/19 8:00	18/8/19 18:00	10:00:00
MSC LIRICA	20/8/19 7:00	20/8/19 17:00	10:00:00
AZAMARA PURSUIT	20/8/19 8:00	20/8/19 22:00	14:00:00
Emerald Princess	22/8/19 12:00	22/8/19 22:00	10:00:00
MARELLA EXPLORER 2	23/8/19 9:00	23/8/19 18:00	9:00:00

HORIZON	23/8/19 9:00	23/8/19 19:00	10:00:00
OCEANA	25/8/19 8:00	25/8/19 18:00	10:00:00
MSC LIRICA	27/8/19 7:00	27/8/19 17:00	10:00:00
NORWEGIAN JADE	27/8/19 7:00	27/8/19 12:00	5:00:00
MEIN SCHIFF 6	27/8/19 8:00	27/8/19 18:00	10:00:00
HORIZON	30/8/19 9:00	30/8/19 19:00	10:00:00
MSC LIRICA	3/9/19 7:00	3/9/19 17:00	10:00:00
NORWEGIAN JADE	7/9/19 7:00	7/9/19 12:00	5:00:00
MSC LIRICA	10/9/19 7:00	10/9/19 17:00	10:00:00
Emerald Princess	12/9/19 12:00	12/9/19 22:00	10:00:00
HORIZON	13/9/19 9:00	13/9/19 19:00	10:00:00
AZAMARA PURSUIT	15/9/19 8:00	15/9/19 20:00	12:00:00
OCEANA	15/9/19 8:00	15/9/19 17:00	9:00:00
MSC LIRICA	17/9/19 7:00	17/9/19 17:00	10:00:00
NORWEGIAN JADE	17/9/19 7:00	17/9/19 12:00	5:00:00
JEWEL OF THE SEAS	17/9/19 11:00	17/9/19 20:00	9:00:00
MARELLA DISCOVERY	18/9/19 8:00	18/9/19 17:00	9:00:00
HORIZON	20/9/19 9:00	20/9/19 19:00	10:00:00
MARELLA CELEBRATION	21/9/19 9:00	21/9/19 18:00	9:00:00
MSC LIRICA	24/9/19 7:00	24/9/19 17:00	10:00:00
VISION OF THE SEAS	24/9/19 7:00	24/9/19 17:00	10:00:00
MEIN SCHIFF 6	24/9/19 8:00	24/9/19 18:00	10:00:00
SALAMIS FILOXENIA	27/9/19 8:00	27/9/19 15:00	7:00:00
HORIZON	27/9/19 9:00	27/9/19 19:00	10:00:00
CELEBRITY INFINITY	28/9/19 7:00	28/9/19 17:00	10:00:00
NORWEGIAN JADE	28/9/19 7:00	28/9/19 12:00	5:00:00
MSC LIRICA	1/10/19 7:00	1/10/19 17:00	10:00:00
CRYSTAL ESPRIT	4/10/19 8:00	4/10/19 21:00	13:00:00
MARELLA EXPLORER 2	4/10/19 9:00	4/10/19 18:00	9:00:00
JEWEL OF THE SEAS	5/10/19 11:00	5/10/19 20:00	9:00:00
CELEBRITY INFINITY	7/10/19 7:00	7/10/19 18:00	11:00:00
MSC LIRICA	8/10/19 7:00	8/10/19 17:00	10:00:00
NORWEGIAN JADE	8/10/19 7:00	8/10/19 12:00	5:00:00
OCEANA	8/10/19 8:00	8/10/19 18:00	10:00:00
CRYSTAL SERENITY	13/10/19 12:00	13/10/19 21:00	9:00:00
HORIZON	14/10/19 9:00	14/10/19 19:00	10:00:00
JEWEL OF THE SEAS	14/10/19 11:00	14/10/19 20:00	9:00:00
MSC LIRICA	15/10/19 7:00	15/10/19 17:00	10:00:00
KONINGSDAM	15/10/19 8:00	15/10/19 17:00	9:00:00
NORWEGIAN JADE	19/10/19 7:00	19/10/19 12:00	5:00:00
MSC ORCHESTRA	21/10/19 10:00	21/10/19 16:00	6:00:00
MSC LIRICA	22/10/19 7:00	22/10/19 17:00	10:00:00

MEIN SCHIFF 6	22/10/19 8:00	22/10/19 18:00	10:00:00
CELEBRITY EDGE	23/10/19 12:00	23/10/19 20:00	8:00:00
CROWN IRIS	24/10/19 8:00	24/10/19 15:00	7:00:00
AZAMARA JOURNEY	25/10/19 8:00	25/10/19 22:00	14:00:00
ROTTERDAM	29/10/19 8:00	29/10/19 17:00	9:00:00
NORWEGIAN SPIRIT	2/11/19 7:00	2/11/19 12:00	5:00:00
NORWEGIAN SPIRIT	26/11/19 7:00	26/11/19 12:00	5:00:00
HORIZON	27/11/19 9:00	27/11/19 19:00	10:00:00
VIKING STAR	17/12/19 8:00	17/12/19 17:30	9:30:00
VIKING STAR	23/12/19 7:00	23/12/19 16:30	9:30:00

8.1.2 Passenger RoRo Data 2018-2019



ΗΜΕΡΟΜΗΝΙΑ	ΗΜΕΡΑ	Πρωινό Αρχή	Αναχώρηση	Πλοίο	Βραδινό Αρχή	Αναχώρηση	Πλοίο	Αρχή	Αναχώρηση	Πλοίο
01/01/2018	Δευτέρα				6:00	21:00	ΕΛΥΡΟΣ			
02/01/2018	Τρίτη				6:00	21:00	BL.GALAXY			
03/01/2018	Τετάρτη				6:00	21:00	ΕΛΥΡΟΣ			
04/01/2018	Πέμπτη				6:00	21:00	BL.GALAXY			
05/01/2018	Παρασκευή				6:00	21:00	ΕΛΥΡΟΣ			
06/01/2018	Σάββατο				6:00	21:00	BL.GALAXY			
07/01/2018	Κυριακή				6:00	21:00	ΕΛΥΡΟΣ			
08/01/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
09/01/2018	Τρίτη				6:00	21:00	ΕΛΥΡΟΣ			
10/01/2018	Τετάρτη				6:00	21:00	BL.GALAXY			
11/01/2018	Πέμπτη				6:00	21:00	ΕΛΥΡΟΣ			
12/01/2018	Παρασκευή				6:00	21:00	BL.GALAXY			
13/01/2018	Σάββατο				6:00	21:00	ΕΛΥΡΟΣ			
14/01/2018	Κυριακή				6:00	21:00	BL.GALAXY			
15/01/2018	Δευτέρα				6:00	21:00	ΕΛΥΡΟΣ			
16/01/2018	Τρίτη				6:00	21:00	BL.GALAXY			
17/01/2018	Τετάρτη				6:00	21:00	ΕΛΥΡΟΣ			
18/01/2018	Πέμπτη				6:00	21:00	BL.GALAXY			
19/01/2018	Παρασκευή				6:00	21:00	ΕΛΥΡΟΣ			
20/01/2018	Σάββατο				6:00	21:00	BL.GALAXY			
21/01/2018	Κυριακή				6:00	21:00	ΕΛΥΡΟΣ			
22/01/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
23/01/2018	Τρίτη				6:00	21:00	ΕΛΥΡΟΣ			
24/01/2018	Τετάρτη				6:00		BL.GALAXY			
25/01/2018	Πέμπτη					21:00	BL.GALAXY			
26/01/2018	Παρασκευή				6:00	21:00	ΕΛΥΡΟΣ			
27/01/2018	Σάββατο				6:00	21:00	BL.GALAXY			
28/01/2018	Κυριακή				6:00	21:00	ΕΛΥΡΟΣ			
29/01/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
30/01/2018	Τρίτη				6:00	21:00	ΕΛΥΡΟΣ			
31/01/2018	Τετάρτη				6:00	21:00	BL.GALAXY			
01/02/2018	Πέμπτη				6:00	21:00	ΕΛΥΡΟΣ			
02/02/2018	Παρασκευή				6:00	21:00	BL.GALAXY			
03/02/2018	Σάββατο				6:00	21:00	ΕΛΥΡΟΣ			
04/02/2018	Κυριακή				6:00	21:00	BL.GALAXY			
05/02/2018	Δευτέρα				6:00	21:00	ΕΛΥΡΟΣ			
06/02/2018	Τρίτη				6:00	21:00	BL.GALAXY			
07/02/2018	Τετάρτη				6:00	21:00	ΕΛΥΡΟΣ			
08/02/2018	Πέμπτη				6:00	21:00	BL.GALAXY			
09/02/2018	Παρασκευή				6:00	21:00	ΕΛΥΡΟΣ			
10/02/2018	Σάββατο				6:00	21:00	BL.GALAXY			
11/02/2018	Κυριακή				6:00	21:00	ΕΛΥΡΟΣ			
12/02/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
13/02/2018	Τρίτη				6:00	21:00	ΕΛΥΡΟΣ			
14/02/2018	Τετάρτη				6:00	21:00	BL.GALAXY			
15/02/2018	Πέμπτη				6:00	21:00	ΕΛΥΡΟΣ			
16/02/2018	Παρασκευή				6:00	21:00	BL.GALAXY			
17/02/2018	Σάββατο				6:00	21:00	ΕΛΥΡΟΣ			
18/02/2018	Κυριακή				6:00	21:00	BL.GALAXY			
19/02/2018	Δευτέρα				6:00	21:00	ΕΛΥΡΟΣ			
20/02/2018	Τρίτη				6:00	21:00	BL.GALAXY			
21/02/2018	Τετάρτη				6:00	21:00	ΕΛΥΡΟΣ			
22/02/2018	Πέμπτη				6:00	21:00	BL.GALAXY			
23/02/2018	Παρασκευή				6:00	21:00	ΕΛΥΡΟΣ			
24/02/2018	Σάββατο				6:00	21:00	BLUE STAR 2			
25/02/2018	Κυριακή				6:00	21:00	ΕΛΥΡΟΣ			
26/02/2018	Δευτέρα				6:00	21:00	BLUE STAR 2			
27/02/2018	Τρίτη				6:00	21:00	ΕΛΥΡΟΣ			
28/02/2018	Τετάρτη				6:00	21:00	BLUE STAR 2			
01/03/2018	Πέμπτη				6:00	21:00	ΕΛΥΡΟΣ			
02/03/2018	Παρασκευή				6:00	21:00	BLUE STAR 2			
03/03/2018	Σάββατο				6:00	21:00	ΕΛΥΡΟΣ			
04/03/2018	Κυριακή				6:00	21:00	BLUE STAR 2			
05/03/2018	Δευτέρα				6:00	21:00	ΕΛΥΡΟΣ			
06/03/2018	Τρίτη				6:00	21:00	BLUE STAR 2			
07/03/2018	Τετάρτη				6:00	21:00	ΕΛΥΡΟΣ			
08/03/2018	Πέμπτη				6:00	21:00	BLUE STAR 2			
09/03/2018	Παρασκευή				6:00	21:00	ΕΛΥΡΟΣ			
10/03/2018	Σάββατο				6:00	21:00	BL.GALAXY			
11/03/2018	Κυριακή				6:00	21:00	ΕΛΥΡΟΣ			
12/03/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
13/03/2018	Τρίτη				6:00	21:00	ΕΛΥΡΟΣ			
14/03/2018	Τετάρτη				6:00	21:00	BL.GALAXY			
15/03/2018	Πέμπτη				6:00	21:00	ΕΛΥΡΟΣ			
16/03/2018	Παρασκευή				6:00	21:00	BL.GALAXY			
17/03/2018	Σάββατο				6:00	21:00	ΕΛΥΡΟΣ			
18/03/2018	Κυριακή				6:00	21:00	BL.GALAXY			
19/03/2018	Δευτέρα				6:00	21:00	ΕΛΥΡΟΣ			
20/03/2018	Τρίτη				6:00	21:00	BL.GALAXY			
21/03/2018	Τετάρτη	7:00	10:00	ΕΛΥΡΟΣ						
22/03/2018	Πέμπτη	7:00	10:00	ΕΛΥΡΟΣ						
23/03/2018	Παρασκευή				6:00	21:00	ΕΛΥΡΟΣ			
24/03/2018	Σάββατο				6:00	21:00	BL.GALAXY			
25/03/2018	Κυριακή				6:00	21:00	ΕΛΥΡΟΣ			
26/03/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
27/03/2018	Τρίτη	7:00	10:00	ΕΛΥΡΟΣ						
28/03/2018	Τετάρτη	7:00	10:00	ΕΛΥΡΟΣ						
29/03/2018	Πέμπτη				6:00	21:00	ΕΛΥΡΟΣ			
30/03/2018	Παρασκευή				6:00	21:00	BL.GALAXY			
31/03/2018	Σάββατο				6:00	21:00	ΕΛΥΡΟΣ			
01/04/2018	Κυριακή				6:00	21:00	BL.GALAXY			
02/04/2018	Δευτέρα				6:00	21:00	ΕΛΥΡΟΣ			
03/04/2018	Τρίτη				6:00	21:00	BL.GALAXY			
04/04/2018	Τετάρτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	21:00	BL.GALAXY			
05/04/2018	Πέμπτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	21:00	BL.GALAXY			
06/04/2018	Παρασκευή				6:00	21:00	ΕΛ.ΒΕΝ			
07/04/2018	Σάββατο				6:00		BL.GALAXY			
08/04/2018	Κυριακή									
09/04/2018	Δευτέρα					21:00	BL.GALAXY			
10/04/2018	Τρίτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	21:00	BL.GALAXY			
11/04/2018	Τετάρτη				6:00	21:00	ΕΛ.ΒΕΝ			
12/04/2018	Πέμπτη				6:00	21:00	BL.GALAXY			
13/04/2018	Παρασκευή				6:00	21:00	ΕΛ.ΒΕΝ			
14/04/2018	Σάββατο				6:00	21:00	BL.GALAXY			
15/04/2018	Κυριακή				6:00	21:00	ΕΛ.ΒΕΝ			
16/04/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
17/04/2018	Τρίτη				6:00	21:00	ΕΛ.ΒΕΝ			
18/04/2018	Τετάρτη				6:00		BL.GALAXY			
19/04/2018	Πέμπτη									
20/04/2018	Παρασκευή		10:00	BL.GALAXY	19:00	21:00	ΕΛ.ΒΕΝ			
21/04/2018	Σάββατο				6:00	21:00	BL.GALAXY			
22/04/2018	Κυριακή				6:00	21:00	ΕΛ.ΒΕΝ			
23/04/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
24/04/2018	Τρίτη				6:00	21:00	ΕΛ.ΒΕΝ			
25/04/2018	Τετάρτη				6:00	21:00	BL.GALAXY			
26/04/2018	Πέμπτη				6:00	21:00	ΕΛ.ΒΕΝ			
27/04/2018	Παρασκευή				6:00	21:00	BL.GALAXY			
28/04/2018	Σάββατο				6:00	21:00	ΕΛ.ΒΕΝ			
29/04/2018	Κυριακή				6:00	21:00	BL.GALAXY			
30/04/2018	Δευτέρα				6:00	21:00	ΕΛ.ΒΕΝ			

01/05/2018	Τρίτη				6:00	21:00	BL.GALAXY			
02/05/2018	Τετάρτη				6:00	21:00	ΕΛ.ΒΕΝ			
03/05/2018	Πέμπτη				6:00	21:00	BL.GALAXY			
04/05/2018	Παρασκευή				6:00	21:00	ΕΛ.ΒΕΝ			
05/05/2018	Σάββατο				6:00	21:00	BL.GALAXY			
06/05/2018	Κυριακή				6:00	21:00	ΕΛ.ΒΕΝ			
07/05/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
08/05/2018	Τρίτη				6:00	21:00	ΕΛ.ΒΕΝ			
09/05/2018	Τετάρτη				6:00	21:00	BL.GALAXY			
10/05/2018	Πέμπτη				6:00	21:00	ΕΛ.ΒΕΝ			
11/05/2018	Παρασκευή				6:00	21:00	BL.GALAXY			
12/05/2018	Σάββατο				6:00	21:00	ΕΛ.ΒΕΝ			
13/05/2018	Κυριακή				6:00	21:00	BL.GALAXY			
14/05/2018	Δευτέρα				6:00	21:00	ΕΛ.ΒΕΝ			
15/05/2018	Τρίτη				6:00	21:00	BL.GALAXY			
16/05/2018	Τετάρτη				6:00	21:00	ΕΛ.ΒΕΝ			
17/05/2018	Πέμπτη	7:00	10:00	BL.GALAXY						
18/05/2018	Παρασκευή	7:00	10:00	BL.GALAXY						
19/05/2018	Σάββατο	7:00	10:00	BL.GALAXY						
20/05/2018	Κυριακή	7:00	10:00	BL.GALAXY						
21/05/2018	Δευτέρα	7:00	10:00	BL.GALAXY						
22/05/2018	Τρίτη	7:00	10:00	BL.GALAXY						
23/05/2018	Τετάρτη				6:00	21:00	BL.GALAXY			
24/05/2018	Πέμπτη				6:00	21:00	ΕΛ.ΒΕΝ			
25/05/2018	Παρασκευή				6:00	21:00	BL.GALAXY			
26/05/2018	Σάββατο				6:00	21:00	ΕΛ.ΒΕΝ			
27/05/2018	Κυριακή				6:00	21:00	BL.GALAXY			
28/05/2018	Δευτέρα				6:00	21:00	ΕΛ.ΒΕΝ			
29/05/2018	Τρίτη				6:00	21:00	BL.GALAXY			
30/05/2018	Τετάρτη				6:00	21:00	ΕΛ.ΒΕΝ			
31/05/2018	Πέμπτη				6:00	21:00	BL.GALAXY			
01/06/2018	Παρασκευή				6:00	21:00	ΕΛ.ΒΕΝ			
02/06/2018	Σάββατο				6:00	21:00	BL.GALAXY			
03/06/2018	Κυριακή				6:00	21:00	ΕΛ.ΒΕΝ			
04/06/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
05/06/2018	Τρίτη				6:00	21:00	ΕΛ.ΒΕΝ			
06/06/2018	Τετάρτη				6:00	21:00	BL.GALAXY			
07/06/2018	Πέμπτη				6:00	21:00	ΕΛ.ΒΕΝ			
08/06/2018	Παρασκευή				6:00	21:00	BL.GALAXY			
09/06/2018	Σάββατο				6:00	21:00	ΕΛ.ΒΕΝ			
10/06/2018	Κυριακή				6:00	21:00	BL.GALAXY			
11/06/2018	Δευτέρα				6:00	21:00	ΕΛ.ΒΕΝ			
12/06/2018	Τρίτη				6:00	21:00	BL.GALAXY			
13/06/2018	Τετάρτη				6:00	21:00	ΕΛ.ΒΕΝ			
14/06/2018	Πέμπτη				6:00	21:00	BL.GALAXY			
15/06/2018	Παρασκευή				6:00	21:00	ΕΛ.ΒΕΝ			
16/06/2018	Σάββατο				6:00	21:00	BL.GALAXY			
17/06/2018	Κυριακή				6:00	21:00	ΕΛ.ΒΕΝ			
18/06/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
19/06/2018	Τρίτη				6:00	21:00	ΕΛ.ΒΕΝ			
20/06/2018	Τετάρτη				6:00	21:00	BL.GALAXY			
21/06/2018	Πέμπτη				6:00	21:00	ΕΛ.ΒΕΝ			
22/06/2018	Παρασκευή				6:00	21:00	BL.GALAXY			
23/06/2018	Σάββατο				6:00	21:00	ΕΛ.ΒΕΝ			
24/06/2018	Κυριακή				6:00	21:00	BL.GALAXY			
25/06/2018	Δευτέρα				6:00	21:00	ΕΛ.ΒΕΝ			
26/06/2018	Τρίτη				6:00	21:00	BL.GALAXY			
27/06/2018	Τετάρτη				6:00	21:00	ΕΛ.ΒΕΝ			
28/06/2018	Πέμπτη				6:00	21:00	BL.GALAXY			
29/06/2018	Παρασκευή				6:00	21:00	ΕΛ.ΒΕΝ			
30/06/2018	Σάββατο	7:00	10:00	BL.GALAXY	19:00	21:00	ΕΛ.ΒΕΝ			

01/07/2018	Κυριακή	7:00	10:00	BL.GALAXY	19:00	21:00	ΕΛ.ΒΕΝ			
02/07/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
03/07/2018	Τρίτη				6:00	21:00	ΕΛ.ΒΕΝ			
04/07/2018	Τετάρτη				6:00	21:00	BL.GALAXY			
05/07/2018	Πέμπτη				6:00	21:00	ΕΛ.ΒΕΝ			
06/07/2018	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	21:00	ΕΛ.ΒΕΝ			
07/07/2018	Σάββατο	7:00	10:00	BL.GALAXY	19:00	21:00	ΕΛ.ΒΕΝ			
08/07/2018	Κυριακή	7:00	10:00	BL.GALAXY	19:00	21:00	ΕΛ.ΒΕΝ			
09/07/2018	Δευτέρα				6:00	21:00	BL.GALAXY			
10/07/2018	Τρίτη				6:00	21:00	ΕΛ.ΒΕΝ			
11/07/2018	Τετάρτη	7:00	10:00	BL.GALAXY	19:00	21:00	ΕΛ.ΒΕΝ			
12/07/2018	Πέμπτη	7:00	10:00	BL.GALAXY	19:00	21:00	ΕΛ.ΒΕΝ			
13/07/2018	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	21:00	ΕΛ.ΒΕΝ			
14/07/2018	Σάββατο	7:00	10:00	BL.GALAXY	19:00	21:00	ΕΛ.ΒΕΝ			
15/07/2018	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
16/07/2018	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
17/07/2018	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
18/07/2018	Τετάρτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
19/07/2018	Πέμπτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
20/07/2018	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
21/07/2018	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
22/07/2018	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
23/07/2018	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
24/07/2018	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
25/07/2018	Τετάρτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
26/07/2018	Πέμπτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
27/07/2018	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
28/07/2018	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
29/07/2018	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
30/07/2018	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
31/07/2018	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
01/08/2018	Τετάρτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
02/08/2018	Πέμπτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
03/08/2018	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
04/08/2018	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
05/08/2018	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
06/08/2018	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
07/08/2018	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
08/08/2018	Τετάρτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
09/08/2018	Πέμπτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
10/08/2018	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
11/08/2018	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
12/08/2018	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
13/08/2018	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
14/08/2018	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
15/08/2018	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
16/08/2018	Πέμπτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
17/08/2018	Παρασκευή	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
18/08/2018	Σάββατο	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
19/08/2018	Κυριακή	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
20/08/2018	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
21/08/2018	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
22/08/2018	Τετάρτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
23/08/2018	Πέμπτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
24/08/2018	Παρασκευή	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
25/08/2018	Σάββατο	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
26/08/2018	Κυριακή	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
27/08/2018	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
28/08/2018	Τρίτη				19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
29/08/2018	Τετάρτη				19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
30/08/2018	Πέμπτη				19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
31/08/2018	Παρασκευή				19:00	22:00	BL.GALAXY	22:30	23:59	MYKON

01/09/2018	Σάββατο				19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
02/09/2018	Κυριακή				19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
03/09/2018	Δευτέρα									
04/09/2018	Τρίτη				19:00	22:00	BLUE STAR 2	22:30	23:59	MYKON
05/09/2018	Τετάρτη				19:00	22:00	BLUE STAR 2	22:30	23:59	MYKON
06/09/2018	Πέμπτη				19:00	22:00	BLUE STAR 2	22:30	23:59	MYKON
07/09/2018	Παρασκευή				19:00	22:00	BLUE STAR 2	22:30	23:59	MYKON
08/09/2018	Σάββατο				19:00	22:00	BLUE STAR 2	22:30	23:59	MYKON
09/09/2018	Κυριακή				19:00	22:00	BLUE STAR 2	22:30	23:59	MYKON
10/09/2018	Δευτέρα				19:00	22:00	BLUE STAR 2	22:30	23:59	MYKON
11/09/2018	Τρίτη				19:00	22:00	BLUE STAR 2	22:30	23:59	MYKON
12/09/2018	Τετάρτη				19:00	22:00	BLUE STAR 2	22:30	23:59	MYKON
13/09/2018	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
14/09/2018	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
15/09/2018	Σάββατο				6:00	22:00	BL.GALAXY			
16/09/2018	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
17/09/2018	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
18/09/2018	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
19/09/2018	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
20/09/2018	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
21/09/2018	Παρασκευή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
22/09/2018	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
23/09/2018	Κυριακή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
24/09/2018	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
25/09/2018	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
26/09/2018	Τετάρτη				6:00		ΕΛΥΡΟΣ			
27/09/2018	Πέμπτη					22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
28/09/2018	Παρασκευή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
29/09/2018	Σάββατο				6:00		ΕΛΥΡΟΣ			
30/09/2018	Κυριακή					22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
01/10/2018	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
02/10/2018	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
03/10/2018	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
04/10/2018	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
05/10/2018	Παρασκευή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
06/10/2018	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
07/10/2018	Κυριακή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
08/10/2018	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
09/10/2018	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
10/10/2018	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
11/10/2018	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
12/10/2018	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
13/10/2018	Σάββατο				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
14/10/2018	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
15/10/2018	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
16/10/2018	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
17/10/2018	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
18/10/2018	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
19/10/2018	Παρασκευή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
20/10/2018	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
21/10/2018	Κυριακή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
22/10/2018	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
23/10/2018	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
24/10/2018	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
25/10/2018	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
26/10/2018	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
27/10/2018	Σάββατο				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
28/10/2018	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
29/10/2018	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
30/10/2018	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
31/10/2018	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON

01/11/2018	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
02/11/2018	Παρασκευή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
03/11/2018	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
04/11/2018	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
05/11/2018	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
06/11/2018	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
07/11/2018	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
08/11/2018	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
09/11/2018	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
10/11/2018	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
11/11/2018	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
12/11/2018	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
13/11/2018	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
14/11/2018	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
15/11/2018	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
16/11/2018	Παρασκευή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
17/11/2018	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
18/11/2018	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
19/11/2018	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
20/11/2018	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
21/11/2018	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
22/11/2018	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
23/11/2018	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
24/11/2018	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
25/11/2018	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
26/11/2018	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
27/11/2018	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
28/11/2018	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
29/11/2018	Πέμπτη	6:00		ΕΛΥΡΟΣ				9:30		FEST
30/11/2018	Παρασκευή(μεσημεριανό)		10:00	ΕΛΥΡΟΣ					16:00	FEST
30/11/2018	Παρασκευή(Βραδινό)				19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
01/12/2018	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
02/12/2018	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
03/12/2018	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
04/12/2018	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
05/12/2018	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
06/12/2018	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
07/12/2018	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
08/12/2018	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
09/12/2018	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
10/12/2018	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
11/12/2018	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
12/12/2018	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
13/12/2018	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
14/12/2018	Παρασκευή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
15/12/2018	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
16/12/2018	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
17/12/2018	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
18/12/2018	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
19/12/2018	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
20/12/2018	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
21/12/2018	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
22/12/2018	Σάββατο				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
23/12/2018	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
24/12/2018	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
25/12/2018	Τρίτη				6:00		ΕΛΥΡΟΣ			
26/12/2018	Τετάρτη					22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
27/12/2018	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
28/12/2018	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
29/12/2018	Σάββατο				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
30/12/2018	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
31/12/2018	Δευτέρα				6:00		BL.GALAXY			

01/01/2019	Τρίτη					22:00	BL.GALAXY	22:30	23:59	MYKON
02/01/2019	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
03/01/2019	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
04/01/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
05/01/2019	Σάββατο				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
06/01/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
07/01/2019	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
08/01/2019	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
09/01/2019	Τετάρτη	6:00		BL.GALAXY						
10/01/2019	Πέμπτη (μεσημεριανό)		10:00	BL.GALAXY				9:30	16:00	FEST
10/01/2019	Πέμπτη (βραδινό)				19:00	22:00	BL.GALAXY	9:30		KNOSS
11/01/2019									5:30	KNOSS
11/01/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
12/01/2019	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
13/01/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
14/01/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
15/01/2019	Τρίτη	6:00		ΕΛΥΡΟΣ				9:30	16:00	FEST
16/01/2019	Τετάρτη		10:00	ΕΛΥΡΟΣ	19:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
17/01/2019	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
18/01/2019	Παρασκευή				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
19/01/2019	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
20/01/2019	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
21/01/2019	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
22/01/2019	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
23/01/2019	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
24/01/2019	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
25/01/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
26/01/2019	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
27/01/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
28/01/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
29/01/2019	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
30/01/2019	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
31/01/2019	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
01/02/2019	Παρασκευή				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
02/02/2019	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
03/02/2019	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
04/02/2019	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
05/02/2019	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
06/02/2019	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
07/02/2019	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
08/02/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
09/02/2019	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
10/02/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
11/02/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
12/02/2019	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
13/02/2019	Τετάρτη	6:00		BL.GALAXY						
14/02/2019	Πέμπτη									
15/02/2019	Παρασκευή (μεσημεριανό)		10:00	BL.GALAXY				9:30	16:00	KNOSS
15/02/2019	Παρασκευή (βραδινό)				19:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	FEST
16/02/2019	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
17/02/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
18/02/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
19/02/2019	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
20/02/2019	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
21/02/2019	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
22/02/2019	Παρασκευή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
23/02/2019	Σάββατο	6:00		ΕΛΥΡΟΣ						
24/02/2019	Κυριακή									
25/02/2019	Δευτέρα									
26/02/2019	Τρίτη (πρωινό)		10:00	ΕΛΥΡΟΣ				9:30	16:00	FEST
26/02/2019	Τρίτη (βραδινό)				19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
27/02/2019	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
28/02/2019	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON

01/03/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
02/03/2019	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
03/03/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
04/03/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
05/03/2019	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
06/03/2019	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
07/03/2019	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
08/03/2019	Παρασκευή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
09/03/2019	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
10/03/2019	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
11/03/2019	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
12/03/2019	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
13/03/2019	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
14/03/2019	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
15/03/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
16/03/2019	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
17/03/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
18/03/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
19/03/2019	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
20/03/2019	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
21/03/2019	Πέμπτη	6:00		ΕΛΥΡΟΣ				9:30	16:00	FEST
22/03/2019	Παρασκευή		10:00	ΕΛΥΡΟΣ	19:00	22:00	BL.GALAXY	9:30	16:00	MYKON
23/03/2019	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
24/03/2019	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
25/03/2019	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
26/03/2019	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
27/03/2019	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
28/03/2019	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
29/03/2019					6:00		ΕΛΥΡΟΣ			
30/03/2019	Σάββατο					22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
31/03/2019	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
01/04/2019	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
02/04/2019	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
03/04/2019	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	FEST
04/04/2019	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
05/04/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	MYKON
06/04/2019	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
07/04/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	MYKON
08/04/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
09/04/2019	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
10/04/2019	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
11/04/2019	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
12/04/2019	Παρασκευή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
13/04/2019	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
14/04/2019	Κυριακή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
15/04/2019	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
16/04/2019	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
17/04/2019	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
18/04/2019	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
19/04/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
20/04/2019	Σάββατο				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
21/04/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
22/04/2019	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
23/04/2019	Τρίτη	7:00	10:00	ΕΛΥΡΟΣ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
24/04/2019	Τετάρτη	7:00	10:00	ΕΛΥΡΟΣ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
25/04/2019	Πέμπτη	7:00	10:00	ΕΛΥΡΟΣ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
26/04/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
27/04/2019	Σάββατο				6:00		BL.GALAXY			
28/04/2019	Κυριακή							22:30	23:59	MYKON
29/04/2019	Δευτέρα					22:00	BL.GALAXY	22:30	23:59	MYKON
30/04/2019	Τρίτη	7:00	10:00	ΕΛΥΡΟΣ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON

01/05/2019	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ			
02/05/2019	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
03/05/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
04/05/2019	Σάββατο				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
05/05/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	22:30	23:59	MYKON
06/05/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
07/05/2019	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	MYKON
08/05/2019	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
09/05/2019	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
10/05/2019	Παρασκευή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
11/05/2019	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
12/05/2019	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	MYKON
13/05/2019	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
14/05/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
15/05/2019	Τετάρτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	MYKON
16/05/2019	Πέμπτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
17/05/2019	Παρασκευή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	MYKON
18/05/2019	Σάββατο				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
19/05/2019	Κυριακή				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	MYKON
20/05/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
21/05/2019	Τρίτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	MYKON
22/05/2019	Τετάρτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
23/05/2019	Πέμπτη				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
24/05/2019	Παρασκευή				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
25/05/2019	Σάββατο				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
26/05/2019	Κυριακή				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
27/05/2019	Δευτέρα				6:00	22:00	ΕΛΥΡΟΣ	9:30	16:00	KNOSS
28/05/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
29/05/2019	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
30/05/2019	Πέμπτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
31/05/2019	Παρασκευή				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
01/06/2019	Σάββατο				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
02/06/2019	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
03/06/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
04/06/2019	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
05/06/2019	Τετάρτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
06/06/2019	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
07/06/2019	Παρασκευή				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
08/06/2019	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
09/06/2019	Κυριακή				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	MYKON
10/06/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	KNOSS
11/06/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
12/06/2019	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
13/06/2019	Πέμπτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
14/06/2019	Παρασκευή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
15/06/2019	Σάββατο				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
16/06/2019	Κυριακή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
17/06/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
18/06/2019	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
19/06/2019	Τετάρτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
20/06/2019	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
21/06/2019	Παρασκευή				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
22/06/2019	Σάββατο				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
23/06/2019	Κυριακή				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
24/06/2019	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
25/06/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
26/06/2019	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
27/06/2019	Πέμπτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
28/06/2019	Παρασκευή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
29/06/2019	Σάββατο				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
30/06/2019	Κυριακή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON

01/07/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
02/07/2019	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
03/07/2019	Τετάρτη				6:00	22:00	ΕΛ.ΒΕΝ			
04/07/2019	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
05/07/2019	Παρασκευή	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
06/07/2019	Σάββατο	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
07/07/2019	Κυριακή	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
08/07/2019	Δευτέρα	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
09/07/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
10/07/2019	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
11/07/2019	Πέμπτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
12/07/2019	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
13/07/2019	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
14/07/2019	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
15/07/2019	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
16/07/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
17/07/2019	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
18/07/2019	Πέμπτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
19/07/2019	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
20/07/2019	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
21/07/2019	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
22/07/2019	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
23/07/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
24/07/2019	Τετάρτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
25/07/2019	Πέμπτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
26/07/2019	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
27/07/2019	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
28/07/2019	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
29/07/2019	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
30/07/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
31/07/2019	Τετάρτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
01/08/2019	Πέμπτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
02/08/2019	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
03/08/2019	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
04/08/2019	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
05/08/2019	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
06/08/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
07/08/2019	Τετάρτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
08/08/2019	Πέμπτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
09/08/2019	Παρασκευή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
10/08/2019	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
11/08/2019	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
12/08/2019	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
13/08/2019	Τρίτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
14/08/2019	Τετάρτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
15/08/2019	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
16/08/2019	Παρασκευή	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
17/08/2019	Σάββατο	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
18/08/2019	Κυριακή	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
19/08/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
20/08/2019	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
21/08/2019	Τετάρτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
22/08/2019	Πέμπτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
23/08/2019	Παρασκευή	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
24/08/2019	Σάββατο	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
25/08/2019	Κυριακή	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
26/08/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
27/08/2019	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
28/08/2019	Τετάρτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
29/08/2019	Πέμπτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY	22:30	23:59	MYKON
30/08/2019	Παρασκευή				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
31/08/2019	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON

01/09/2019	Κυριακή	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
02/09/2019	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
03/09/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
04/09/2019	Τετάρτη	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
05/09/2019	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
06/09/2019	Παρασκευή				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
07/09/2019	Σάββατο	7:00	10:00	BL.GALAXY	19:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	MYKON
08/09/2019	Κυριακή				6:00	22:00	BL.GALAXY	22:30	23:59	MYKON
09/09/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
10/09/2019	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
11/09/2019	Τετάρτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
12/09/2019	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
13/09/2019	Παρασκευή				6:00		ΕΛ.ΒΕΝ			
14/09/2019	Σάββατο					22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
15/09/2019	Κυριακή				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
16/09/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
17/09/2019	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
18/09/2019	Τετάρτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
19/09/2019	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
20/09/2019	Παρασκευή				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
21/09/2019	Σάββατο				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
22/09/2019	Κυριακή				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
23/09/2019	Δευτέρα				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
24/09/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ			
25/09/2019	Τετάρτη				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
26/09/2019	Πέμπτη				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
27/09/2019	Παρασκευή				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
28/09/2019	Σάββατο				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
29/09/2019	Κυριακή				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
30/09/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
01/10/2019	Τρίτη				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
02/10/2019	Τετάρτη				6:00	22:00	ΕΛ.ΒΕΝ			
03/10/2019	Πέμπτη				6:00	22:00	BL.GALAXY	22:30	23:59	FEST
04/10/2019	Παρασκευή				6:00	22:00	ΕΛ.ΒΕΝ	22:30	23:59	FEST
05/10/2019	Σάββατο				6:00	22:00	BL.GALAXY			
06/10/2019	Κυριακή				6:00	22:00	ΕΛ.ΒΕΝ			
07/10/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
08/10/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
09/10/2019	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
10/10/2019	Πέμπτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
11/10/2019	Παρασκευή				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
12/10/2019	Σάββατο				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
13/10/2019	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
14/10/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
15/10/2019	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
16/10/2019	Τετάρτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
17/10/2019	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
18/10/2019	Παρασκευή				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
19/10/2019	Σάββατο				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
20/10/2019	Κυριακή				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
21/10/2019	Δευτέρα				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
22/10/2019	Τρίτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
23/10/2019	Τετάρτη				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
24/10/2019	Πέμπτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
25/10/2019	Παρασκευή				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
26/10/2019	Σάββατο				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
27/10/2019	Κυριακή				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
28/10/2019	Δευτέρα				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
29/10/2019	Τρίτη				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
30/10/2019	Τετάρτη				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
31/10/2019	Πέμπτη				6:00	22:00	BL.GALAXY	9:30	16:00	FEST

01/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
02/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
03/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
04/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
05/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
06/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
07/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
08/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
09/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
10/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
11/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
12/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
13/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
14/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
15/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
16/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
17/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
18/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
19/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
20/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
21/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
22/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
23/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
24/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
25/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
26/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
27/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
28/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
29/11/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
30/11/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
01/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
02/12/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
03/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
04/12/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
05/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
06/12/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
07/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
08/12/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
09/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
10/12/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
11/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
12/12/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
13/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
14/12/2019	#ERROR!				6:00	22:00	BL.GALAXY			
15/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
16/12/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
17/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
18/12/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
19/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
20/12/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
21/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
22/12/2019	#ERROR!				6:00		BL.GALAXY	9:30	16:00	FEST
23/12/2019	#ERROR!					22:00	BL.GALAXY			
24/12/2019	Τρίτη	7:00	10:00	ΕΛ.ΒΕΝ	19:00	22:00	BL.GALAXY			
25/12/2019										
26/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
27/12/2019	#ERROR!				6:00	22:00	BL.GALAXY	9:30	16:00	FEST
28/12/2019	#ERROR!				6:00	22:00	ΕΛ.ΒΕΝ	9:30	16:00	KNOSS
29/12/2019					6:00		BL.GALAXY			
30/12/2019										
31/12/2019	Τρίτη					10:00	BL.GALAXY			

8.2 Case Study, NPV calculation

8.2.1 NPV without a PV park

								100% use of the facilities						
A/A	Year	kWh	Revenue	onshore cost	dif1	NPV values with Annual costs	onshore with exception	dif2	NPV values with Annual costs & tax exception	Environmental Benefits	dif3	dif4	NPV3	NPV4
0				6,917,694.57	-6,917,694.57	-6,917,694.57	6,917,694.57	-6,917,694.57	-6,917,694.57		-6,917,694.57	-6,917,694.57	-6,917,694.57	-6,917,694.57
1	2022	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-28,894.12	1,285,156.19	743,385.34	290,054.26	8,860,663.01	9,278,721.00	9,604,048.35	8,658,030.39	8,976,978.77
2	2023	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-28,327.57	1,285,156.19	743,385.34	284,366.92	9,037,876.27	9,455,934.26	9,781,261.61	8,658,596.94	8,971,291.43
3	2024	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-27,772.13	1,285,156.19	743,385.34	278,791.10	9,218,633.79	9,636,691.78	9,962,019.13	8,659,152.38	8,965,715.61
4	2025	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-27,227.58	1,285,156.19	743,385.34	273,324.60	9,403,006.47	9,821,064.46	10,146,391.81	8,659,696.94	8,960,249.12
5	2026	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-26,693.70	1,285,156.19	743,385.34	267,965.30	9,591,066.60	10,009,124.59	10,334,451.94	8,660,230.81	8,954,889.81
6	2027	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-26,170.30	1,285,156.19	743,385.34	262,711.08	9,782,887.93	10,200,945.92	10,526,273.27	8,660,754.22	8,949,635.59
7	2028	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-25,657.16	1,285,156.19	743,385.34	257,559.88	9,978,545.69	10,396,603.68	10,721,931.03	8,661,267.36	8,944,484.39
8	2029	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-25,154.07	1,285,156.19	743,385.34	252,509.69	10,178,116.60	10,596,174.59	10,921,501.94	8,661,770.44	8,939,434.20
9	2030	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-24,660.86	1,285,156.19	743,385.34	247,558.52	10,381,678.93	10,799,736.93	11,125,064.27	8,662,263.66	8,934,483.03
10	2031	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-24,177.31	1,285,156.19	743,385.34	242,704.43	10,589,312.51	11,007,370.50	11,332,697.85	8,662,747.20	8,929,628.94
11	2032	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-23,703.25	1,285,156.19	743,385.34	237,945.52	10,801,098.76	11,219,156.75	11,544,484.10	8,663,221.27	8,924,870.03
12	2033	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-23,238.48	1,285,156.19	743,385.34	233,279.92	11,017,120.74	11,435,178.73	11,760,506.08	8,663,686.04	8,920,204.43
13	2034	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-22,782.82	1,285,156.19	743,385.34	228,705.80	11,237,463.15	11,655,521.14	11,980,848.49	8,664,141.70	8,915,630.32
14	2035	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-22,336.10	1,285,156.19	743,385.34	224,221.37	11,462,212.41	11,880,270.41	12,205,597.76	8,664,588.42	8,911,145.89
15	2036	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-21,898.14	1,285,156.19	743,385.34	219,824.88	11,691,456.66	12,109,514.66	12,434,842.00	8,665,026.38	8,906,749.39
16	2037	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-21,468.76	1,285,156.19	743,385.34	215,514.59	11,925,285.80	12,343,343.79	12,668,671.14	8,665,455.76	8,902,439.10
17	2038	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-21,047.80	1,285,156.19	743,385.34	211,288.81	12,163,791.51	12,581,849.50	12,907,176.85	8,665,876.71	8,898,213.32
18	2039	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-20,635.10	1,285,156.19	743,385.34	207,145.89	12,407,067.34	12,825,125.33	13,150,452.68	8,666,289.41	8,894,070.41
19	2040	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-20,230.49	1,285,156.19	743,385.34	203,084.21	12,655,208.69	13,073,266.68	13,398,594.03	8,666,694.02	8,890,008.72
20	2041	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-19,833.82	1,285,156.19	743,385.34	199,102.16	12,908,312.86	13,326,370.86	13,651,698.20	8,667,090.70	8,886,026.68
21	2042	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-19,444.92	1,285,156.19	743,385.34	195,198.20	13,166,479.12	13,584,537.11	13,909,864.46	8,667,479.60	8,882,122.72
22	2043	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-19,063.64	1,285,156.19	743,385.34	191,370.78	13,429,808.70	13,847,866.70	14,173,194.04	8,667,860.87	8,878,295.30
23	2044	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-18,689.85	1,285,156.19	743,385.34	187,618.42	13,698,404.88	14,116,462.87	14,441,790.22	8,668,234.67	8,874,542.93
24	2045	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-18,323.38	1,285,156.19	743,385.34	183,939.62	13,972,372.97	14,390,430.97	14,715,758.32	8,668,601.14	8,870,864.14
25	2046	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-17,964.10	1,285,156.19	743,385.34	180,332.96	14,251,820.43	14,669,878.43	14,995,205.77	8,668,960.42	8,867,257.48
26	2047	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-17,611.86	1,285,156.19	743,385.34	176,797.02	14,536,856.84	14,954,914.83	15,280,242.18	8,669,312.65	8,863,721.54
27	2048	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-17,266.53	1,285,156.19	743,385.34	173,330.42	14,827,593.98	15,245,651.97	15,570,979.32	8,669,657.98	8,860,254.93
28	2049	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-16,927.97	1,285,156.19	743,385.34	169,931.78	15,124,145.86	15,542,203.85	15,867,531.20	8,669,996.54	8,856,856.29
29	2050	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-16,596.05	1,285,156.19	743,385.34	166,599.78	15,426,628.78	15,844,686.77	16,170,014.12	8,670,328.47	8,853,524.30
30	2051	16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-16,270.64	1,285,156.19	743,385.34	163,333.12	15,735,161.35	16,153,219.34	16,478,546.69	8,670,653.88	8,850,257.64
						-7,577,763.07			**-291,583.56**				**253,029,972.39**	**260,316,151.90**

15% the first year and 15% increase every year												
kWh	Revenue	onshore cost	dif1	NPV values with Annual costs	onshore with exception	dif2	NPV values with Annual costs & tax exception	Environmental Benefits	dif3	dif4	NPV3	NPV4
0.00	0.00	6,917,694.57	-6,917,694.57	-6,917,694.57	6,917,694.57	-6,917,694.57	-6,917,694.57	0.00	-6,917,694.57	-6,917,694.57	-6,917,694.57	-6,917,694.57
2,535,676.92	304,281.23	241,572.53	62,708.70	-377,275.79	192,773.43	111,507.80	-329,433.53	1,329,099.45	1,391,808.15	1,440,607.25	1,001,852.35	925,762.89
2,916,028.46	349,923.42	277,808.41	72,115.00	-360,837.17	221,689.44	128,233.97	-306,897.37	1,528,464.37	1,600,579.37	1,656,698.34	1,162,214.86	1,108,275.06
3,353,432.73	402,411.93	319,479.67	82,932.25	-343,568.60	254,942.86	147,469.07	-282,754.12	1,757,734.02	1,840,666.28	1,905,203.09	1,373,597.91	1,312,783.43
3,856,447.64	462,773.72	367,401.62	95,372.09	-325,339.47	293,184.29	169,589.43	-256,774.13	2,021,394.13	2,116,766.22	2,190,983.55	1,610,681.59	1,542,116.25
4,434,914.78	532,189.77	422,511.87	109,677.91	-306,003.05	337,161.93	195,027.84	-228,698.98	2,324,603.25	2,434,281.15	2,519,631.09	1,876,765.80	1,799,461.73
5,100,152.00	612,018.24	485,888.65	126,129.59	-285,394.36	387,736.22	224,282.02	-198,237.82	2,673,293.73	2,799,423.33	2,897,575.75	2,175,570.51	2,088,413.97
5,865,174.80	703,820.98	558,771.94	145,049.03	-263,327.89	445,896.66	257,924.32	-165,063.15	3,074,287.79	3,219,336.82	3,332,212.11	2,511,289.38	2,413,024.64
6,744,951.02	809,394.12	642,587.74	166,806.39	-239,594.90	512,781.15	296,612.97	-128,806.23	3,535,430.96	3,702,237.35	3,832,043.93	2,888,650.05	2,777,861.38
7,756,693.67	930,803.24	738,975.90	191,827.34	-213,960.54	589,698.33	341,104.91	-89,051.75	4,065,745.61	4,257,572.95	4,406,850.52	3,312,982.29	3,188,073.50
8,920,197.72	1,070,423.73	849,822.28	220,601.45	-186,160.45	678,153.08	392,270.65	-45,331.91	4,675,607.45	4,896,208.89	5,067,878.10	3,790,294.71	3,649,466.17
10,258,227.38	1,230,987.29	977,295.62	253,691.66	-155,897.01	779,876.04	451,111.25	2,880.27	5,376,948.56	5,630,640.23	5,828,059.81	4,327,361.26	4,168,583.98
11,796,961.49	1,415,635.38	1,123,889.97	291,745.41	-122,835.08	896,857.44	518,777.94	56,178.51	6,183,490.85	6,475,236.26	6,702,268.78	4,931,818.85	4,752,805.25
13,566,505.71	1,627,980.69	1,292,473.46	335,507.22	-86,597.25	1,031,386.06	596,594.63	115,231.80	7,111,014.48	7,446,521.70	7,707,609.10	5,612,277.28	5,410,448.23
15,601,481.57	1,872,177.79	1,486,344.48	385,833.31	-46,758.38	1,186,093.97	686,083.82	180,793.98	8,177,666.65	8,563,499.96	8,863,750.47	6,378,443.29	6,150,890.93
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-21,898.14	1,285,156.19	743,385.34	219,824.88	9,404,316.65	9,822,374.64	10,147,701.99	7,207,370.67	6,965,647.66
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-21,468.76	1,285,156.19	743,385.34	215,514.59	9,592,402.98	10,010,460.97	10,335,788.32	7,203,060.38	6,966,077.03
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-21,047.80	1,285,156.19	743,385.34	211,288.81	9,784,251.04	10,202,309.03	10,527,636.38	7,198,834.60	6,966,497.99
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-20,635.10	1,285,156.19	743,385.34	207,145.89	9,979,936.06	10,397,994.05	10,723,321.40	7,194,691.68	6,966,910.69
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-20,230.49	1,285,156.19	743,385.34	203,084.21	10,179,534.78	10,597,592.77	10,922,920.12	7,190,630.00	6,967,315.30
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-19,833.82	1,285,156.19	743,385.34	199,102.16	10,383,125.48	10,801,183.47	11,126,510.82	7,186,647.96	6,967,711.98
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-19,444.92	1,285,156.19	743,385.34	195,198.20	10,590,787.99	11,008,845.98	11,334,173.33	7,182,743.99	6,968,100.88
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-19,063.64	1,285,156.19	743,385.34	191,370.78	10,802,603.74	11,220,661.74	11,545,989.09	7,178,916.58	6,968,482.15
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-18,689.85	1,285,156.19	743,385.34	187,618.42	11,018,655.82	11,436,713.81	11,762,041.16	7,175,164.21	6,968,855.95
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-18,323.38	1,285,156.19	743,385.34	183,939.62	11,239,028.94	11,657,086.93	11,982,414.28	7,171,485.42	6,969,222.41
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-17,964.10	1,285,156.19	743,385.34	180,332.96	11,463,809.51	11,881,867.51	12,207,194.86	7,167,878.76	6,969,581.70
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-17,611.86	1,285,156.19	743,385.34	176,797.02	11,693,085.71	12,111,143.70	12,436,471.05	7,164,342.82	6,969,933.93
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-17,266.53	1,285,156.19	743,385.34	173,330.42	11,926,947.42	12,345,005.41	12,670,332.76	7,160,876.21	6,970,279.26
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-16,927.97	1,285,156.19	743,385.34	169,931.78	12,165,486.37	12,583,544.36	12,908,871.71	7,157,477.57	6,970,617.82
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-16,596.05	1,285,156.19	743,385.34	166,599.78	12,408,796.10	12,826,854.09	13,152,181.44	7,154,145.58	6,970,949.74
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-16,270.64	1,285,156.19	743,385.34	163,333.12	12,656,972.02	13,075,030.01	13,400,357.36	7,150,878.91	6,971,275.16
				-10,534,517.58			**-5,549,246.37**				**150,881,250.90**	**145,867,732.49**

25% the first year and 20% increase every year												
kWh	Revenue	onshore cost	dif1	NPV values with Annual costs	onshore with exception	dif2	NPV values with Annual costs & tax exception	Environmental Benefits	dif3	dif4	NPV3	NPV4
0.00	0.00	6,917,694.57	-6,917,694.57	-6,917,694.57	6,917,694.57	-6,917,694.57	-6,917,694.57	0.00	-6,917,694.57	-6,917,694.57	-6,917,694.57	-6,917,694.57
3,380,902.56	405,708.31	322,096.71	83,611.60	-356,782.75	257,031.24	148,677.07	-292,993.07	2,215,165.75	2,298,777.35	2,363,842.82	1,814,948.38	1,878,738.06
4,057,083.07	486,849.97	386,516.05	100,333.92	-333,714.03	308,437.49	178,412.48	-258,667.36	2,658,198.90	2,758,532.82	2,836,611.38	2,296,310.44	2,296,310.44
4,868,499.69	584,219.96	463,819.26	120,400.70	-308,261.24	370,124.98	214,094.98	-219,971.03	3,189,838.68	3,310,239.38	3,403,933.66	2,785,885.20	2,785,885.20
5,842,199.63	701,063.96	556,583.11	144,480.84	-279,970.58	444,149.98	256,913.97	-176,099.74	3,827,806.42	3,972,287.26	4,084,720.39	3,360,201.71	3,360,201.71
7,010,639.55	841,276.75	667,899.74	173,377.01	-248,308.81	532,979.98	308,296.77	-126,107.83	4,593,367.70	4,766,744.71	4,901,664.47	4,034,246.82	4,034,246.82
8,412,767.46	1,009,532.10	801,479.68	208,052.41	-212,649.24	639,575.97	369,956.12	-68,883.38	5,512,041.24	5,720,093.66	5,881,997.37	4,825,651.50	4,825,651.50
10,095,320.95	1,211,438.51	961,775.62	249,662.90	-172,255.22	767,491.17	443,947.35	-3,118.91	6,614,449.49	6,864,112.39	7,058,396.84	5,755,157.42	5,755,157.42
12,114,385.14	1,453,726.22	1,154,130.74	299,595.47	-126,260.69	920,989.40	532,736.82	72,723.20	7,937,339.39	8,236,934.86	8,470,076.21	6,847,165.94	6,847,165.94
14,537,262.17	1,744,471.46	1,384,956.89	359,514.57	-73,647.37	1,105,187.28	639,284.18	160,451.32	9,524,807.27	9,884,321.84	10,164,091.45	8,130,383.96	8,130,383.96
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-24,177.31	1,285,156.19	743,385.34	242,704.43	11,429,768.72	11,847,826.71	12,173,154.06	9,619,095.76	9,619,095.76
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-23,703.25	1,285,156.19	743,385.34	237,945.52	11,658,364.09	12,076,422.09	12,401,749.44	9,614,336.85	9,614,336.85
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-23,238.48	1,285,156.19	743,385.34	233,279.92	11,891,531.38	12,309,589.37	12,634,916.72	9,609,671.26	9,609,671.26
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-22,782.82	1,285,156.19	743,385.34	228,705.80	12,129,362.00	12,547,420.00	12,872,747.35	9,605,097.14	9,605,097.14
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-22,336.10	1,285,156.19	743,385.34	224,221.37	12,371,949.24	12,790,007.24	13,115,334.59	9,600,612.71	9,600,612.71
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-21,898.14	1,285,156.19	743,385.34	219,824.88	12,619,388.23	13,037,446.22	13,362,773.57	9,596,216.21	9,596,216.21
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-21,468.76	1,285,156.19	743,385.34	215,514.59	12,871,775.99	13,289,833.99	13,615,161.34	9,591,905.92	9,591,905.92
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-21,047.80	1,285,156.19	743,385.34	211,288.81	13,129,211.51	13,547,269.51	13,872,596.86	9,587,680.15	9,587,680.15
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-20,635.10	1,285,156.19	743,385.34	207,145.89	13,391,795.74	13,809,853.74	14,135,181.09	9,583,537.23	9,583,537.23
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-20,230.49	1,285,156.19	743,385.34	203,084.21	13,659,631.66	14,077,689.65	14,403,017.00	9,579,475.54	9,579,475.54
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-19,833.82	1,285,156.19	743,385.34	199,102.16	13,932,824.29	14,350,882.28	14,676,209.63	9,575,493.50	9,575,493.50
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-19,444.92	1,285,156.19	743,385.34	195,198.20	14,211,480.78	14,629,538.77	14,954,866.12	9,571,589.54	9,571,589.54
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-19,063.64	1,285,156.19	743,385.34	191,370.78	14,495,710.39	14,913,768.39	15,239,095.74	9,567,762.12	9,567,762.12
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-18,689.85	1,285,156.19	743,385.34	187,618.42	14,785,624.60	15,203,682.59	15,529,009.94	9,564,009.75	9,564,009.75
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-18,323.38	1,285,156.19	743,385.34	183,939.62	15,081,337.09	15,499,395.09	15,824,722.44	9,560,330.96	9,560,330.96
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-17,964.10	1,285,156.19	743,385.34	180,332.96	15,382,963.84	15,801,021.83	16,126,349.18	9,556,724.30	9,556,724.30
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-17,611.86	1,285,156.19	743,385.34	176,797.02	15,690,623.11	16,108,681.10	16,434,008.45	9,553,188.36	9,553,188.36
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-17,266.53	1,285,156.19	743,385.34	173,330.42	16,004,435.57	16,422,493.57	16,747,820.92	9,549,721.75	9,549,721.75
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-16,927.97	1,285,156.19	743,385.34	169,931.78	16,324,524.29	16,742,582.28	17,067,909.63	9,546,323.12	9,546,323.12
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-16,596.05	1,285,156.19	743,385.34	166,599.78	16,651,014.77	17,069,072.76	17,394,400.11	9,542,991.12	9,542,991.12
16,904,512.81	2,028,541.54	1,610,483.54	418,057.99	-16,270.64	1,285,156.19	743,385.34	163,333.12	16,984,035.07	17,402,093.06	17,727,420.41	9,539,724.46	9,539,724.46
				-9,449,055.51			**-3,619,091.70**				**234,047,744.57**	**234,111,534.24**

8.2.2 NPV with a 3 MW park with a fixed price per MWh of 39 € /MWh.

100% use of the facilities									
year	kWh	kW- PV	Revenue	onshore cost	dif1	NPV values with Annual costs	onshore with exception	dif2	NPV values with Annual costs & tax exception
0				9,249,154.57	-9,249,154.57	-9,249,154.57	9,249,154.57	-9,249,154.57	-9,249,154.57
1	16,904,512.81	5,405,140.00	1,590,725.20	1,095,538.86	495,186.34	7,506.21	874,233.43	716,491.77	224,472.32
2	16,904,512.81	5,351,088.60	1,595,103.36	1,100,688.31	494,415.05	6,617.70	878,342.66	716,760.70	220,329.40
3	16,904,512.81	5,297,577.71	1,599,437.74	1,105,786.26	493,651.48	5,768.41	882,410.79	717,026.95	216,260.10
4	16,904,512.81	5,244,601.94	1,603,728.78	1,110,833.23	492,895.55	4,956.94	886,438.25	717,290.53	212,263.22
5	16,904,512.81	5,192,155.92	1,607,976.91	1,115,829.73	492,147.17	4,181.92	890,425.43	717,551.48	208,337.54
6	16,904,512.81	5,140,234.36	1,612,182.55	1,120,776.27	491,406.28	3,442.03	894,372.73	717,809.82	204,481.89
7	16,904,512.81	5,088,832.01	1,616,346.14	1,125,673.34	490,672.80	2,736.00	898,280.57	718,065.58	200,695.09
8	16,904,512.81	5,037,943.69	1,620,468.10	1,130,521.45	489,946.65	2,062.59	902,149.32	718,318.77	196,976.00
9	16,904,512.81	4,987,564.26	1,624,548.83	1,135,321.07	489,227.76	1,420.61	905,979.39	718,569.44	193,323.47
10	16,904,512.81	4,937,688.62	1,628,588.76	1,140,072.69	488,516.07	808.92	909,771.16	718,817.60	189,736.39
11	16,904,512.81	4,888,311.73	1,632,588.29	1,144,776.80	487,811.49	226.39	913,525.01	719,063.28	186,213.66
12	16,904,512.81	4,839,428.61	1,636,547.82	1,149,433.87	487,113.95	-328.05	917,241.32	719,306.50	182,754.19
13	16,904,512.81	4,791,034.33	1,640,467.76	1,154,044.37	486,423.39	-855.44	920,920.47	719,547.28	179,356.91
14	16,904,512.81	4,743,123.98	1,644,348.49	1,158,608.76	485,739.74	-1,356.80	924,562.83	719,785.67	176,020.77
15	16,904,512.81	4,695,692.74	1,648,190.42	1,163,127.50	485,062.92	-1,833.08	928,168.76	720,021.66	172,744.73
16	16,904,512.81	4,648,735.82	1,651,993.94	1,167,601.07	484,392.87	-2,285.23	931,738.64	720,255.30	169,527.77
17	16,904,512.81	4,602,248.46	1,655,759.41	1,172,029.89	483,729.52	-2,714.16	935,272.81	720,486.60	166,368.88
18	16,904,512.81	4,556,225.97	1,659,487.23	1,176,414.43	483,072.81	-3,120.75	938,771.65	720,715.59	163,267.07
19	16,904,512.81	4,510,663.71	1,663,177.78	1,180,755.12	482,422.66	-3,505.84	942,235.49	720,942.28	160,221.37
20	16,904,512.81	4,465,557.08	1,666,831.41	1,185,052.40	481,779.01	-3,870.25	945,664.70	721,166.71	157,230.81
21	16,904,512.81	4,420,901.50	1,670,448.51	1,189,306.71	481,141.80	-4,214.78	949,059.61	721,388.90	154,294.45
22	16,904,512.81	4,376,692.49	1,674,029.44	1,193,518.48	480,510.96	-4,540.19	952,420.58	721,608.87	151,411.35
23	16,904,512.81	4,332,925.56	1,677,574.57	1,197,688.13	479,886.43	-4,847.21	955,747.94	721,826.63	148,580.59
24	16,904,512.81	4,289,596.31	1,681,084.24	1,201,816.09	479,268.15	-5,136.57	959,042.02	722,042.22	145,801.28
25	16,904,512.81	4,246,700.35	1,684,558.81	1,205,902.76	478,656.05	-5,408.95	962,303.16	722,255.65	143,072.53
26	16,904,512.81	4,204,233.34	1,687,998.64	1,209,948.57	478,050.07	-5,665.01	965,531.69	722,466.95	140,393.45
27	16,904,512.81	4,162,191.01	1,691,404.06	1,213,953.92	477,450.15	-5,905.40	968,727.94	722,676.13	137,763.19
28	16,904,512.81	4,120,569.10	1,694,775.44	1,217,919.21	476,856.22	-6,130.74	971,892.22	722,883.22	135,180.90
29	16,904,512.81	4,079,363.41	1,698,113.10	1,221,844.86	476,268.24	-6,341.63	975,024.86	723,088.24	132,645.75
30	16,904,512.81	4,038,569.77	1,701,417.38	1,225,731.24	475,686.14	-6,538.65	978,126.17	723,291.21	130,156.90
						-9,284,025.59			**-4,049,272.61**

15% the first year and 15% increase every year								
kWh	kW- PV	Revenue	onshore cost	dif1	NPV values with Annual costs	onshore with exception	dif2	NPV values with Annual costs & tax exception
0.00			9,249,154.57	-9,249,154.57	-9,249,154.57	9,249,154.57	-9,249,154.57	-9,249,154.57
2,535,676.92	5,405,140.00	-133,535.11	-273,372.15	139,837.04	-340,875.45	-218,149.34	84,614.23	-395,015.46
2,916,028.46	5,351,088.60	-83,514.76	-231,986.83	148,472.07	-325,891.90	-185,124.09	101,609.33	-370,934.90
3,353,432.73	5,297,577.71	-26,691.87	-185,217.61	158,525.75	-310,028.06	-147,802.54	121,110.67	-345,285.11
3,856,447.64	5,244,601.94	37,960.96	-132,248.69	170,209.65	-293,154.96	-105,533.66	143,494.62	-317,835.51
4,434,914.78	5,192,155.92	111,625.14	-72,141.94	183,767.09	-275,127.43	-57,568.84	169,193.98	-288,326.74
5,100,152.00	5,140,234.36	195,659.26	-3,818.62	199,477.88	-255,782.04	-3,047.24	198,706.50	-256,467.01
5,865,174.80	5,088,832.01	291,625.58	73,961.75	217,663.84	-234,934.74	59,021.03	232,604.55	-221,927.94
6,744,951.02	5,037,943.69	401,320.68	162,625.64	238,695.04	-212,378.24	129,774.28	271,546.40	-184,339.92
7,756,693.67	4,987,564.26	526,810.54	263,813.42	262,997.11	-187,879.07	210,521.53	316,289.01	-143,286.80
8,920,197.72	4,937,688.62	670,470.95	379,411.43	291,059.52	-161,174.23	302,768.04	367,702.91	-98,299.95
10,258,227.38	4,888,311.73	835,034.04	511,588.88	323,445.15	-131,967.38	408,244.85	426,789.18	-48,851.60
11,796,961.49	4,839,428.61	1,023,641.66	662,840.29	360,801.37	-99,924.66	528,942.57	494,699.09	5,652.78
13,566,505.71	4,791,034.33	1,239,906.91	836,034.28	403,872.62	-64,669.87	667,150.34	572,756.57	65,882.91
15,601,481.57	4,743,123.98	1,487,984.75	1,034,469.69	453,515.05	-25,779.08	825,500.60	662,484.14	132,593.38
16,904,512.81	4,695,692.74	1,648,190.42	1,163,127.50	485,062.92	-1,833.08	928,168.76	720,021.66	172,744.73
16,904,512.81	4,648,735.82	1,651,993.94	1,167,601.07	484,392.87	-2,285.23	931,738.64	720,255.30	169,527.77
16,904,512.81	4,602,248.46	1,655,759.41	1,172,029.89	483,729.52	-2,714.16	935,272.81	720,486.60	166,368.88
16,904,512.81	4,556,225.97	1,659,487.23	1,176,414.43	483,072.81	-3,120.75	938,771.65	720,715.59	163,267.07
16,904,512.81	4,510,663.71	1,663,177.78	1,180,755.12	482,422.66	-3,505.84	942,235.49	720,942.28	160,221.37
16,904,512.81	4,465,557.08	1,666,831.41	1,185,052.40	481,779.01	-3,870.25	945,664.70	721,166.71	157,230.81
16,904,512.81	4,420,901.50	1,670,448.51	1,189,306.71	481,141.80	-4,214.78	949,059.61	721,388.90	154,294.45
16,904,512.81	4,376,692.49	1,674,029.44	1,193,518.48	480,510.96	-4,540.19	952,420.58	721,608.87	151,411.35
16,904,512.81	4,332,925.56	1,677,574.57	1,197,688.13	479,886.43	-4,847.21	955,747.94	721,826.63	148,580.59
16,904,512.81	4,289,596.31	1,681,084.24	1,201,816.09	479,268.15	-5,136.57	959,042.02	722,042.22	145,801.28
16,904,512.81	4,246,700.35	1,684,558.81	1,205,902.76	478,656.05	-5,408.95	962,303.16	722,255.65	143,072.53
16,904,512.81	4,204,233.34	1,687,998.64	1,209,948.57	478,050.07	-5,665.01	965,531.69	722,466.95	140,393.45
16,904,512.81	4,162,191.01	1,691,404.06	1,213,953.92	477,450.15	-5,905.40	968,727.94	722,676.13	137,763.19
16,904,512.81	4,120,569.10	1,694,775.44	1,217,919.21	476,856.22	-6,130.74	971,892.22	722,883.22	135,180.90
16,904,512.81	4,079,363.41	1,698,113.10	1,221,844.86	476,268.24	-6,341.63	975,024.86	723,088.24	132,645.75
16,904,512.81	4,038,569.77	1,701,417.38	1,225,731.24	475,686.14	-6,538.65	978,126.17	723,291.21	130,156.90
					-12,240,780.11			**-9,306,935.42**

					25% the first year and 20% increase every year			
kWh	kW- PV	Revenue	onshore cost	dif1	NPV values with Annual costs	onshore with exception	dif2	NPV values with Annual costs & tax exception
0.00	0.00	0.00	9,249,154.57	-9,249,154.57	-9,249,154.57	9,249,154.57	-9,249,154.57	-9,249,154.57
3,380,902.56	5,405,140.00	-32,108.03	-192,847.98	160,739.94	-320,382.41	-153,891.53	121,783.49	-358,575.01
4,057,083.07	5,351,088.60	53,411.79	-123,279.19	176,690.98	-298,768.76	-98,376.05	151,787.84	-322,704.88
4,868,499.69	5,297,577.71	155,116.17	-40,878.03	195,994.19	-274,720.70	-32,620.42	187,736.59	-282,502.03
5,842,199.63	5,244,601.94	276,251.20	56,932.80	219,318.40	-247,786.06	45,432.03	230,819.17	-237,161.13
7,010,639.55	5,192,155.92	420,712.12	173,245.93	247,466.19	-217,433.19	138,249.21	282,462.91	-185,735.58
8,412,767.46	5,140,234.36	593,173.11	311,772.41	281,400.70	-183,036.92	248,792.51	344,380.60	-127,112.57
10,095,320.95	5,088,832.01	799,243.12	476,965.42	322,277.70	-143,862.07	380,615.54	418,627.58	-59,983.70
12,114,385.14	5,037,943.69	1,045,652.78	674,168.65	371,484.13	-99,044.03	537,982.53	507,670.25	17,189.51
14,537,262.17	4,987,564.26	1,340,478.76	909,794.41	430,684.34	-47,565.90	726,010.48	614,468.28	106,216.27
16,904,512.81	4,937,688.62	1,628,588.76	1,140,072.69	488,516.07	808.92	909,771.16	718,817.60	189,736.39
16,904,512.81	4,888,311.73	1,632,588.29	1,144,776.80	487,811.49	226.39	913,525.01	719,063.28	186,213.66
16,904,512.81	4,839,428.61	1,636,547.82	1,149,433.87	487,113.95	-328.05	917,241.32	719,306.50	182,754.19
16,904,512.81	4,791,034.33	1,640,467.76	1,154,044.37	486,423.39	-855.44	920,920.47	719,547.28	179,356.91
16,904,512.81	4,743,123.98	1,644,348.49	1,158,608.76	485,739.74	-1,356.80	924,562.83	719,785.67	176,020.77
16,904,512.81	4,695,692.74	1,648,190.42	1,163,127.50	485,062.92	-1,833.08	928,168.76	720,021.66	172,744.73
16,904,512.81	4,648,735.82	1,651,993.94	1,167,601.07	484,392.87	-2,285.23	931,738.64	720,255.30	169,527.77
16,904,512.81	4,602,248.46	1,655,759.41	1,172,029.89	483,729.52	-2,714.16	935,272.81	720,486.60	166,368.88
16,904,512.81	4,556,225.97	1,659,487.23	1,176,414.43	483,072.81	-3,120.75	938,771.65	720,715.59	163,267.07
16,904,512.81	4,510,663.71	1,663,177.78	1,180,755.12	482,422.66	-3,505.84	942,235.49	720,942.28	160,221.37
16,904,512.81	4,465,557.08	1,666,831.41	1,185,052.40	481,779.01	-3,870.25	945,664.70	721,166.71	157,230.81
16,904,512.81	4,420,901.50	1,670,448.51	1,189,306.71	481,141.80	-4,214.78	949,059.61	721,388.90	154,294.45
16,904,512.81	4,376,692.49	1,674,029.44	1,193,518.48	480,510.96	-4,540.19	952,420.58	721,608.87	151,411.35
16,904,512.81	4,332,925.56	1,677,574.57	1,197,688.13	479,886.43	-4,847.21	955,747.94	721,826.63	148,580.59
16,904,512.81	4,289,596.31	1,681,084.24	1,201,816.09	479,268.15	-5,136.57	959,042.02	722,042.22	145,801.28
16,904,512.81	4,246,700.35	1,684,558.81	1,205,902.76	478,656.05	-5,408.95	962,303.16	722,255.65	143,072.53
16,904,512.81	4,204,233.34	1,687,998.64	1,209,948.57	478,050.07	-5,665.01	965,531.69	722,466.95	140,393.45
16,904,512.81	4,162,191.01	1,691,404.06	1,213,953.92	477,450.15	-5,905.40	968,727.94	722,676.13	137,763.19
16,904,512.81	4,120,569.10	1,694,775.44	1,217,919.21	476,856.22	-6,130.74	971,892.22	722,883.22	135,180.90
16,904,512.81	4,079,363.41	1,698,113.10	1,221,844.86	476,268.24	-6,341.63	975,024.86	723,088.24	132,645.75
16,904,512.81	4,038,569.77	1,701,417.38	1,225,731.24	475,686.14	-6,538.65	978,126.17	723,291.21	130,156.90
					-11,155,318.04			**-7,376,780.75**

8.2.3 1. NPV with a 3 MW park which will grant an exception to operate as Net Metering Instalment.

					100% use of the facilities				
year	kWh	kW- PV	Revenue	onshore cost	dif1	NPV values with Annual costs	onshore with exception	dif2	NPV values with Annual costs & tax exception
0		0.00	0.00	9,249,154.57	-9,249,154.57	-9,249,154.57	9,249,154.57	-9,249,154.57	-9,249,154.57
1	16,904,512.81	5,405,140.00	2,028,541.54	1,095,538.86	933,002.68	436,737.92	874,233.43	1,154,308.11	653,704.03
2	16,904,512.81	5,351,088.60	2,028,541.54	1,100,688.31	927,853.23	423,224.94	878,342.66	1,150,198.88	636,936.64
3	16,904,512.81	5,297,577.71	2,028,541.54	1,105,786.26	922,755.28	410,122.50	882,410.79	1,146,130.74	620,614.19
4	16,904,512.81	5,244,601.94	2,028,541.54	1,110,833.23	917,708.31	397,418.26	886,438.25	1,142,103.29	604,724.54
5	16,904,512.81	5,192,155.92	2,028,541.54	1,115,829.73	912,711.80	385,100.26	890,425.43	1,138,116.11	589,255.89
6	16,904,512.81	5,140,234.36	2,028,541.54	1,120,776.27	907,765.26	373,156.89	894,372.73	1,134,168.80	574,196.75
7	16,904,512.81	5,088,832.01	2,028,541.54	1,125,673.34	902,868.19	361,576.89	898,280.57	1,130,260.97	559,535.99
8	16,904,512.81	5,037,943.69	2,028,541.54	1,130,521.45	898,020.09	350,349.34	902,149.32	1,126,392.21	545,262.75
9	16,904,512.81	4,987,564.26	2,028,541.54	1,135,321.07	893,220.47	339,463.64	905,979.39	1,122,562.14	531,366.49
10	16,904,512.81	4,937,688.62	2,028,541.54	1,140,072.69	888,468.84	328,909.50	909,771.16	1,118,770.38	517,836.97
11	16,904,512.81	4,888,311.73	2,028,541.54	1,144,776.80	883,764.74	318,676.95	913,525.01	1,115,016.53	504,664.22
12	16,904,512.81	4,839,428.61	2,028,541.54	1,149,433.87	879,107.67	308,756.32	917,241.32	1,111,300.21	491,838.56
13	16,904,512.81	4,791,034.33	2,028,541.54	1,154,044.37	874,497.17	299,138.21	920,920.47	1,107,621.06	479,350.56
14	16,904,512.81	4,743,123.98	2,028,541.54	1,158,608.76	869,932.78	289,813.52	924,562.83	1,103,978.71	467,191.08
15	16,904,512.81	4,695,692.74	2,028,541.54	1,163,127.50	865,414.03	280,773.40	928,168.76	1,100,372.77	455,351.21
16	16,904,512.81	4,648,735.82	2,028,541.54	1,167,601.07	860,940.47	272,009.29	931,738.64	1,096,802.90	443,822.29
17	16,904,512.81	4,602,248.46	2,028,541.54	1,172,029.89	856,511.65	263,512.88	935,272.81	1,093,268.72	432,595.92
18	16,904,512.81	4,556,225.97	2,028,541.54	1,176,414.43	852,127.11	255,276.08	938,771.65	1,089,769.89	421,663.91
19	16,904,512.81	4,510,663.71	2,028,541.54	1,180,755.12	847,786.42	247,291.09	942,235.49	1,086,306.04	411,018.30
20	16,904,512.81	4,465,557.08	2,028,541.54	1,185,052.40	843,489.13	239,550.29	945,664.70	1,082,876.84	400,651.36
21	16,904,512.81	4,420,901.50	2,028,541.54	1,189,306.71	839,234.82	232,046.34	949,059.61	1,079,481.92	390,555.56
22	16,904,512.81	4,376,692.49	2,028,541.54	1,193,518.48	835,023.06	224,772.07	952,420.58	1,076,120.96	380,723.61
23	16,904,512.81	4,332,925.56	2,028,541.54	1,197,688.13	830,853.40	217,720.57	955,747.94	1,072,793.60	371,148.38
24	16,904,512.81	4,289,596.31	2,028,541.54	1,201,816.09	826,725.45	210,885.10	959,042.02	1,069,499.52	361,822.96
25	16,904,512.81	4,246,700.35	2,028,541.54	1,205,902.76	822,638.78	204,259.14	962,303.16	1,066,238.38	352,740.62
26	16,904,512.81	4,204,233.34	2,028,541.54	1,209,948.57	818,592.97	197,836.37	965,531.69	1,063,009.85	343,894.83
27	16,904,512.81	4,162,191.01	2,028,541.54	1,213,953.92	814,587.62	191,610.64	968,727.94	1,059,813.60	335,279.24
28	16,904,512.81	4,120,569.10	2,028,541.54	1,217,919.21	810,622.32	185,576.01	971,892.22	1,056,649.32	326,887.65
29	16,904,512.81	4,079,363.41	2,028,541.54	1,221,844.86	806,696.68	179,726.68	975,024.86	1,053,516.68	318,714.06
30	16,904,512.81	4,038,569.77	2,028,541.54	1,225,731.24	802,810.29	174,057.07	978,126.17	1,050,415.37	310,752.62
						-649,806.39			**4,584,946.59**

15% the first year and 15% increase every year								
kWh	kW- PV	Revenue	onshore cost	dif1	NPV values with Annual costs	onshore with exception	dif2	NPV values with Annual costs & tax exception
0.00	0.00	0.00	9,249,154.57	-9,249,154.57	-9,249,154.57	9,249,154.57	-9,249,154.57	-9,249,154.57
2,535,676.92	5,405,140.00	304,281.23	-273,372.15	577,653.38	88,356.26	-218,149.34	522,430.57	34,216.24
2,916,028.46	5,351,088.60	349,923.42	-231,986.83	581,910.24	90,715.34	-185,124.09	535,047.51	45,672.35
3,353,432.73	5,297,577.71	402,411.93	-185,217.61	587,629.54	94,326.03	-147,802.54	550,214.47	59,068.98
3,856,447.64	5,244,601.94	462,773.72	-132,248.69	595,022.41	99,306.37	-105,533.66	568,307.38	74,625.81
4,434,914.78	5,192,155.92	532,189.77	-72,141.94	604,331.72	105,790.91	-57,568.84	589,758.61	92,591.60
5,100,152.00	5,140,234.36	612,018.24	-3,818.62	615,836.86	113,932.82	-3,047.24	615,065.48	113,247.86
5,865,174.80	5,088,832.01	703,820.98	73,961.75	629,859.23	123,906.16	59,021.03	644,799.95	136,912.95
6,744,951.02	5,037,943.69	809,394.12	162,625.64	646,768.48	135,908.51	129,774.28	679,619.84	163,946.83
7,756,693.67	4,987,564.26	930,803.24	263,813.42	666,989.82	150,163.95	210,521.53	720,281.72	194,756.22
8,920,197.72	4,937,688.62	1,070,423.73	379,411.43	691,012.30	166,926.36	302,768.04	767,655.68	229,800.63
10,258,227.38	4,888,311.73	1,230,987.29	511,588.88	719,398.40	186,483.19	408,244.85	822,742.43	269,596.97
11,796,961.49	4,839,428.61	1,415,635.38	662,840.29	752,795.09	209,159.71	528,942.57	886,692.81	314,737.15
13,566,505.71	4,791,034.33	1,627,980.69	836,034.28	791,946.40	235,323.78	667,150.34	960,830.35	365,876.56
15,601,481.57	4,743,123.98	1,872,177.79	1,034,469.69	837,708.09	265,391.23	825,500.60	1,046,677.19	423,763.69
16,904,512.81	4,695,692.74	2,028,541.54	1,163,127.50	865,414.03	280,773.40	928,168.76	1,100,372.77	455,351.21
16,904,512.81	4,648,735.82	2,028,541.54	1,167,601.07	860,940.47	272,009.29	931,738.64	1,096,802.90	443,822.29
16,904,512.81	4,602,248.46	2,028,541.54	1,172,029.89	856,511.65	263,512.88	935,272.81	1,093,268.72	432,595.92
16,904,512.81	4,556,225.97	2,028,541.54	1,176,414.43	852,127.11	255,276.08	938,771.65	1,089,769.89	421,663.91
16,904,512.81	4,510,663.71	2,028,541.54	1,180,755.12	847,786.42	247,291.09	942,235.49	1,086,306.04	411,018.30
16,904,512.81	4,465,557.08	2,028,541.54	1,185,052.40	843,489.13	239,550.29	945,664.70	1,082,876.84	400,651.36
16,904,512.81	4,420,901.50	2,028,541.54	1,189,306.71	839,234.82	232,046.34	949,059.61	1,079,481.92	390,555.56
16,904,512.81	4,376,692.49	2,028,541.54	1,193,518.48	835,023.06	224,772.07	952,420.58	1,076,120.96	380,723.61
16,904,512.81	4,332,925.56	2,028,541.54	1,197,688.13	830,853.40	217,720.57	955,747.94	1,072,793.60	371,148.38
16,904,512.81	4,289,596.31	2,028,541.54	1,201,816.09	826,725.45	210,885.10	959,042.02	1,069,499.52	361,822.95
16,904,512.81	4,246,700.35	2,028,541.54	1,205,902.76	822,638.78	204,259.14	962,303.16	1,066,238.38	352,740.62
16,904,512.81	4,204,233.34	2,028,541.54	1,209,948.57	818,592.97	197,836.37	965,531.69	1,063,009.85	343,894.83
16,904,512.81	4,162,191.01	2,028,541.54	1,213,953.92	814,587.62	191,610.64	968,727.94	1,059,813.60	335,279.24
16,904,512.81	4,120,569.10	2,028,541.54	1,217,919.21	810,622.32	185,576.01	971,892.22	1,056,649.32	326,887.65
16,904,512.81	4,079,363.41	2,028,541.54	1,221,844.86	806,696.68	179,726.68	975,024.86	1,053,516.68	318,714.06
16,904,512.81	4,038,569.77	2,028,541.54	1,225,731.24	802,810.29	174,057.07	978,126.17	1,050,415.37	310,752.62
					-3,606,560.91			**-672,716.22**

25% the first year and 20% increase every year								
kWh	kW- PV	Revenue	onshore cost	dif1	NPV values with Annual costs	onshore with exception	dif2	NPV values with Annual costs & tax exception
0.00	0.00	0.00	9,249,154.57	-9,249,154.57	-9,249,154.57	9,249,154.57	-9,249,154.57	-9,249,154.57
3,380,902.56	5,405,140.00	405,708.31	-192,847.98	598,556.28	108,849.30	-153,891.53	559,599.83	70,656.70
4,057,083.07	5,351,088.60	486,849.97	-123,279.19	610,129.16	117,838.48	-98,376.05	585,226.02	93,902.36
4,868,499.69	5,297,577.71	584,219.96	-40,878.03	625,097.99	129,633.39	-32,620.42	616,840.38	121,852.06
5,842,199.63	5,244,601.94	701,063.96	56,932.80	644,131.16	144,675.26	45,432.03	655,631.92	155,300.19
7,010,639.55	5,192,155.92	841,276.75	173,245.93	668,030.82	163,485.15	138,249.21	703,027.54	195,182.76
8,412,767.46	5,140,234.36	1,009,532.10	311,772.41	697,759.68	186,677.94	248,792.51	760,739.58	242,602.29
10,095,320.95	5,088,832.01	1,211,438.51	476,965.42	734,473.09	214,978.82	380,615.54	830,822.97	298,857.19
12,114,385.14	5,037,943.69	1,453,726.22	674,168.65	779,557.57	249,242.72	537,982.53	915,743.69	365,476.26
14,537,262.17	4,987,564.26	1,744,471.46	909,794.41	834,677.05	290,477.12	726,010.48	1,018,460.98	444,259.30
16,904,512.81	4,937,688.62	2,028,541.54	1,140,072.69	888,468.84	328,909.50	909,771.16	1,118,770.38	517,836.97
16,904,512.81	4,888,311.73	2,028,541.54	1,144,776.80	883,764.74	318,676.95	913,525.01	1,115,016.53	504,664.22
16,904,512.81	4,839,428.61	2,028,541.54	1,149,433.87	879,107.67	308,756.32	917,241.32	1,111,300.21	491,838.56
16,904,512.81	4,791,034.33	2,028,541.54	1,154,044.37	874,497.17	299,138.21	920,920.47	1,107,621.06	479,350.56
16,904,512.81	4,743,123.98	2,028,541.54	1,158,608.76	869,932.78	289,813.52	924,562.83	1,103,978.71	467,191.08
16,904,512.81	4,695,692.74	2,028,541.54	1,163,127.50	865,414.03	280,773.40	928,168.76	1,100,372.77	455,351.21
16,904,512.81	4,648,735.82	2,028,541.54	1,167,601.07	860,940.47	272,009.29	931,738.64	1,096,802.90	443,822.29
16,904,512.81	4,602,248.46	2,028,541.54	1,172,029.89	856,511.65	263,512.88	935,272.81	1,093,268.72	432,595.92
16,904,512.81	4,556,225.97	2,028,541.54	1,176,414.43	852,127.11	255,276.08	938,771.65	1,089,769.89	421,663.91
16,904,512.81	4,510,663.71	2,028,541.54	1,180,755.12	847,786.42	247,291.09	942,235.49	1,086,306.04	411,018.30
16,904,512.81	4,465,557.08	2,028,541.54	1,185,052.40	843,489.13	239,550.29	945,664.70	1,082,876.84	400,651.36
16,904,512.81	4,420,901.50	2,028,541.54	1,189,306.71	839,234.82	232,046.34	949,059.61	1,079,481.92	390,555.56
16,904,512.81	4,376,692.49	2,028,541.54	1,193,518.48	835,023.06	224,772.07	952,420.58	1,076,120.96	380,723.61
16,904,512.81	4,332,925.56	2,028,541.54	1,197,688.13	830,853.40	217,720.57	955,747.94	1,072,793.60	371,148.38
16,904,512.81	4,289,596.31	2,028,541.54	1,201,816.09	826,725.45	210,885.10	959,042.02	1,069,499.52	361,822.95
16,904,512.81	4,246,700.35	2,028,541.54	1,205,902.76	822,638.78	204,259.14	962,303.16	1,066,238.38	352,740.62
16,904,512.81	4,204,233.34	2,028,541.54	1,209,948.57	818,592.97	197,836.37	965,531.69	1,063,009.85	343,894.83
16,904,512.81	4,162,191.01	2,028,541.54	1,213,953.92	814,587.62	191,610.64	968,727.94	1,059,813.60	335,279.24
16,904,512.81	4,120,569.10	2,028,541.54	1,217,919.21	810,622.32	185,576.01	971,892.22	1,056,649.32	326,887.65
16,904,512.81	4,079,363.41	2,028,541.54	1,221,844.86	806,696.68	179,726.68	975,024.86	1,053,516.68	318,714.06
16,904,512.81	4,038,569.77	2,028,541.54	1,225,731.24	802,810.29	174,057.07	978,126.17	1,050,415.37	310,752.62
					-2,521,098.84			**1,257,438.45**

8.3 DEI's charges

ΤΙΜΟΛΟΓΙΟ ΒΥ

Το **Τιμολόγιο ΒΥ** απευθύνεται σε **εμπορικούς** και **βιομηχανικούς** πελάτες Μέσης Τάσης με Υψηλό Συντελεστή Χρησιμοποίησης.

Χρέωση Προμήθειας (με ισχύ από την 01.09.2019)

Περιλαμβάνει το κόστος και τις λοιπές δαπάνες της ΔΕΗ για την παραγωγή και την προμήθεια της ηλεκτρικής ενέργειας στους πελάτες.

Ζώνη	Χρέωση Ισχύος (€/kW/μήνα)	Χρέωση Ενέργειας (€/kWh)
7:00-23:00 τις εργάσιμες μέρες όλο το έτος	8,88	
7:00 - 23:00 τις εργάσιμες μέρες όλο το έτος		0,06470
23:00-7:00 τις εργάσιμες μέρες και όλες τις ώρες του Σαβ/κου και των αργιών του έτους		0,05057

ΧΖ=ΜΖ * Ημέρες Περιόδου Κατανάλωσης/ημέρες μήνα

Στις παραπάνω χρεώσεις προστίθεται χρέωση CO_2 (€/kWh), όπως αναλυτικά περιγράφεται παρακάτω.

Ρήτρα Αναπροσαρμογής CO_2

Μεθοδολογία υπολογισμού της μοναδιαίας χρέωσης του Κόστους Εκπομπών Διοξειδίου του Άνθρακα CO_2

Η μοναδιαία χρέωση εκπομπών CO_2 στον πελάτη υπολογίζεται με τον παρακάτω τύπο:

$$T_{co_2}n = \frac{P(n-1) * Q(n-1)}{E(n-1)}$$

Όπου :

- **n**: ο μήνας κατανάλωσης ηλεκτρικής ενέργειας
- **$T_{co_2}n$:** Μοναδιαία χρέωση εκπομπών CO_2 για κατανάλωση ηλεκτρικής ενέργειας του μηνός n (€/kWh).
- **P(n-1):** Μέσος όρος τιμών κλεισίματος του συμβολαίου μελλοντικής εκπλήρωσης (Future) EUA, όπως αυτές διαμορφώθηκαν στο χρηματιστήριο εκπομπών (ICE) με μήνα ωρίμανσης τον Δεκέμβριο του έτους χρήσης (€/tn) κατά τον προηγούμενο της κατανάλωσης μήνα.
- **Q(n-1):** Μηνιαία απολογιστικά στοιχεία (προσωρινά) για τις συνολικές εκπομπές CO_2 των Σταθμών Παραγωγής της ΔΕΗ Α.Ε. στο Διασυνδεδεμένο Σύστημα κατά τον προηγούμενο της κατανάλωσης μήνα.
- **E(n-1):** Μηνιαία απολογιστική εκκαθαρισμένη ενέργεια της ΔΕΗ Α.Ε. στο Διασυνδεδεμένο Σύστημα κατά τον προηγούμενο της κατανάλωσης μήνα.
  https://www.theice.com/marketdata/reports/ReportCenter.shtml?reportId=10&contractKey=20#report/10/reportId=10&contractKey=2

Ρυθμιζόμενες Χρεώσεις[1]

Οι Ρυθμιζόμενες χρεώσεις εγκρίνονται από την Πολιτεία και εφαρμόζονται σε όλους τους πελάτες που κάνουν χρήση του Εθνικού Ηλεκτρικού Συστήματος, ανεξαρτήτως του προμηθευτή που έχουν επιλέξει.

	Σύστημα Μεταφοράς	Δίκτυο Διανομής		Λοιπές Χρεώσεις (€/kWh)	ΕΤΜΕΑΡ (€/kWh)	ΥΚΩ (€/kWh)
	Χρέωση Ισχύος (€/kW/μήνα)	Χρέωση Ισχύος (Μοναδιαία Πάγια Χρέωση) (€/kW/μήνα)	Χρέωση Ενέργειας (Μοναδιαία Μεταβλητή Χρέωση) (€/kWh)			
Εμπορικό	1,197	1,097	0,0028	0,00007	0,00878	0,01790
Βιομηχανικό	1,197	1,097	0,0028	0,00007	0,00878	0,00691

Χρεωστέα Ισχύς: Η Καταμετρηθείσα Μέγιστη Ζήτηση (ΜΑ) της περιόδου κατανάλωσης μεταξύ 11:00-14:00.

Η Ενεργειακή Χρέωση του Δικτύου Διανομής προσαυξάνεται σε συνάρτηση με το **συνφ.**

Διευκρινίσεις

- Το **Τιμολόγιο ΒΥ** αφορά περίοδο μήνα. Εάν η καταμέτρηση γίνεται σε περίοδο διαφορετική από μήνα, τότε για τη Χρέωση Ισχύος γίνεται αναλογική χρέωση χρησιμοποιώντας τον συντελεστή Α = ημέρες περιόδου κατανάλωσης/ημέρες μήνα.
- **ΧΖ**: Χρεωστέα Ζήτηση, **ΜΖ**: Καταμετρηθείσα Μέγιστη Ζήτηση στις εργάσιμες μέρες μεταξύ 7:00-23:00,
  ΚΜΖ: Καταμετρηθείσα Μέγιστη Ζήτηση, οποιαδήποτε ώρα ημέρας ή νύχτας,
  ΣΥΝΤ. ΧΡΗΣ/ΣΗΣ: Κατανάλωση Περιόδου/(24 * Ημέρες Περιόδου Κατανάλωσης * ΚΜΖ).
- Με βάση το νομοθετικό πλαίσιο ως ισχύει, η ΔΕΗ συνεισπράττει με τους λογαριασμούς ηλεκτρικής ενέργειας τέλη, φόρους (ΦΠΑ, Ειδικός φόρος Κατανάλωσης (ΕΦΚ) και Ειδικό Τέλος 5‰) και ποσά υπέρ τρίτων (ΔΤ, ΔΦ, ΕΡΤ, ΤΑΠ) όπως ορίζονται από την Πολιτεία.

1.Ισχύς Χρεώσεων:
Σύστημα Μεταφοράς & Δίκτυο Διανομής από 1.4.2020, Λοιπών Χρεώσεων από 1.12.2016, ΕΤΜΕΑΡ από 1.1.2018 & ΥΚΩ από 1.1.2012.

9 Bibliography

[1] “Alternative Maritime Power (AMP) | Air Quality | Port of Los Angeles.” https://www.portoflosangeles.org/environment/air-quality/alternative-maritime-power-(amp) (accessed May 09, 2020).

[2] “What is Alternate Marine Power (AMP) or Cold Ironing?” https://www.marineinsight.com/marine-electrical/what-is-alternate-marine-power-amp-or-cold-ironing/ (accessed May 09, 2020).

[3] “European Commission Directorate General Environment Service Contract on Ship Emissions: Assignment, Abatement and Market-based Instruments Task 2a-Shore-Side Electricity Final Report Entec UK Limited,” 2005.

[4] S. Daniels and Pe. Project Manager, “VIA E-MAIL,” 2007.

[5] “KIRK® Key Interlock - KIRK® The Leader in Trapped Key Interlocks.” https://www.kirkkey.com/ (accessed Oct. 27, 2020).

[6] “Markets | ASG Connectorized Cables.” https://www.asgcables.com/markets/ (accessed Oct. 27, 2020).

[7] “Shore Power Systems for Ports | Cavotec SA.” https://www.cavotec.com/en/your-applications/ports-maritime/shore-power/shore-power-systems-for-ports (accessed Oct. 27, 2020).

[8] “Princess Ships Clear the Air with Shore Power Connections - Princess Cruises.” https://www.princess.com/news/backgrounders_and_fact_sheets/factsheet/Princess-Ships-Clear-the-Air-with-Shore-Power-Connections.html (accessed May 09, 2020).

[9] “Types of Cruise Ships: Ship Information - Princess Cruises.” https://www.princess.com/ships-and-experience/ships/ (accessed Oct. 27, 2020).

[10] “2020 Commission: Combine the ports of LA and Long Beach | 89.3 KPCC.” https://www.scpr.org/news/2014/04/10/43410/2020-commission-combine-the-ports-of-la-and-long-b/ (accessed Oct. 27, 2020).

[11] “Ιστορία της Πόλης της Σούδας | Ιστορία | Επισκέπτης | Δήμος Σούδας.” https://www.chania.gr/archive/souda/www.souda.gr/visitor/histoty/history-of-souda.html (accessed Nov. 06, 2020).

[12] “Σούδα: Το μεγάλο φυσικό λιμάνι της δυτικής Κρήτης - Unique Creta.” https://www.uniquecreta.com/2020/05/12/souda-to-megalo-fysiko-limani-tis-dytikis-kritis/ (accessed Oct. 27, 2020).

[13] “International Convention for the Prevention of Pollution from Ships (MARPOL).” http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx (accessed Oct. 12, 2020).

[14] “Air Pollution.” http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Air-Pollution.aspx (accessed Oct. 14, 2020).

[15] “Ένας πρακτικός τεχνικός οδηγός,” 2011. Accessed: Nov. 03, 2020. [Online].

Available: www.helapco.gr.

[16] K. V Vidyanandan, “An Overview of Factors Affecting the Performance of Solar PV Systems,” 2017. Accessed: Oct. 30, 2020. [Online]. Available: https://www.researchgate.net/publication/319165448.

[17] Ε. Ηλεκτρικών and Κ. Και Ηλεκτρονικής, “ΠΟΛΥΤΕΧΝΕΙΟ ΚΡΗΤΗΣ Τμήμα Μηχανικών Παραγωγής και Διοίκησης Τομέας Συστημάτων Παραγωγής.”

[18] “World Bunker Prices - Ship & Bunker.” https://shipandbunker.com/prices#MGO (accessed Dec. 23, 2020).

[19] “Frequency Converter 50Hz 60Hz, and 400Hz | ATO.com.” https://www.ato.com/frequency-converter (accessed Oct. 27, 2020).

[20] “Why are Transformer and Alternator Ratings in kVA on Ships.” https://www.marineinsight.com/marine-electrical/why-are-transformer-and-alternator-ratings-in-kva-on-ships/ (accessed Oct. 27, 2020).

[21] "A Cold Ironing Feasiblity Study and Cost Benefit Aalysis" , Kritikos Orfeas Markos, June2017

[22] "Διερεύνηση Μεθόδων Ενεργειακής Αναβάθμησης στο Λιμάνι της Ηγουμενίτσας", Βασιλική Μουροκώστα, Οκτώβριος 2018

[23] Εμμανουήλ Δουνδουλάκης, "Σύγκριση μεθοδολογιών υπολογισμού εκπεμπόμενων αέριων ρύπων στη ναυτιλία", Μεταπτυχιακή Διατριβή, Σχολή Μηχανικών Παραγωγής και Διοίκησης, Πολυτεχνείο Κρήτης, Χανιά, Ελλάς, 2018

[24] "Μελέτη Φωτοηλεκτρικών Διατάξεων", ΜΟΤΟΡ ΟΪΛ (ΕΛΛΑΣ), Ιανουάριος 2018

[25] "Shore-Side Power Supply", ABB, 2008

[26] " Praeus Cold Ironing Front End Engineering Design Study", elemed, March 2018