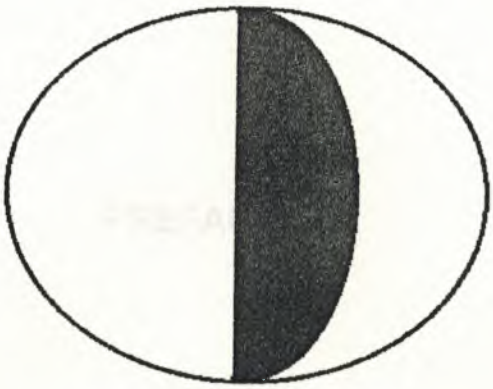

1988

NEAR EAST UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF
ELECTRICAL & ELECTRONIC
ENGINEERING

EE 400

GRADUATION PROJECT

ELECTRICAL PROBLEM OF
T.R.N.C.

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9 3 7 0 1

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PREFACE

In this project, I studied to determine the electrical and generation of energy problems of TRNC.

I would like to thank Mr. Kaan UYAR and Teknecik Power Station personnels because of his continuous help and encouragement.

MEHMET CAMA

CONTENTS

INTRODUCTION

THE ENERGY AND THE LIFE

If somebody arises a question which asks us the most crucial need for all the living creatures in the world, without any doubt, our answer will be energy. The ones which we identify as living creatures; are continuously cycling the energy. Any living organism which loses this ability of recycling energy; is said to be non-living and other living creatures.

The historical information and the scientific data; show us that the action of living takes place in environments which we call as eco-systems. According to the energy flow; the main elements of an eco-system can be illustrated in figure 1. In this figure; the living creatures are grouped under five main sub-groups. The first producers; are the organisms which can turn the inorganic substances into organic substances take their energy from first producers; the secondary consumers take their energy from first consumers; the other consumers supply their energy from either the first producers or first consumers Lastly; the decomposers supply their energy from the dead producer or consumers and convert organic materials into inorganic substances. With this; the living cycle in an ecosystem is performed.

The natural eco-systems can be both found on land and in water. In fact; we can find millions of that in our world. There is also inter-shift of energy between these groups.(1)

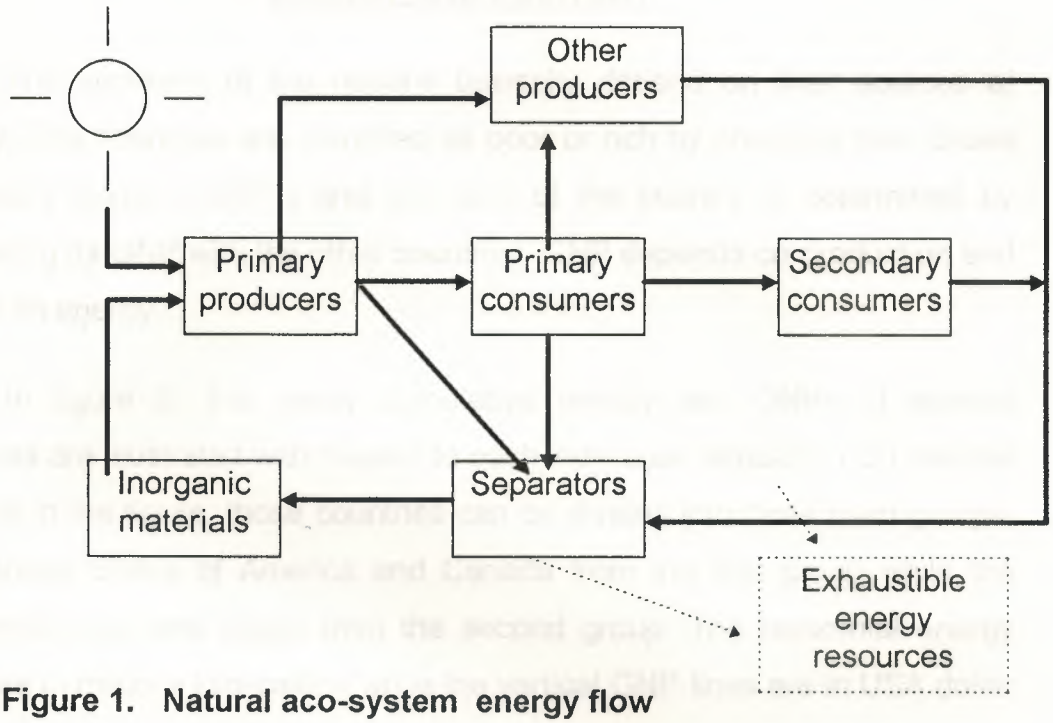


Figure 1. Natural aco-system energy flow

In natural eco-systems there is also a population interchange as well as the energy. A limited number of first producer can feed fewer number of herbivorous, while this is true for the limited of herbivorous to feed fewer number of carnivorous. Moreover; each kind of living creature has to have a number of population to linger on their living.

The manlund which is consuming omnivorous; obey the above rules of an ecosystem and its population altered according to the food that it had found. With the discovery of the agriculture and the subterranean sources; the manlund broke its chains; went out of the eco-systems; became industrialized; started living in cities; increased enormously in population and created the puzzling problems of the modern world. The sources which were identified as infinitely many; now became extremely less because of the population explosion and the extreme use. Today the most important problem is the energy shortage and its high purchasing price.

ENERGY AND ECONOMY

The economy of the nations basically depend on their sources of energy. The countries are identified as poor or rich by checking their Gross National Product (GNP) and the level of the country is determined by comparing its GNP with the other countries. GNP depends on production and mainly on energy.

In figure 2; the yearly cumulative energy and GNPs of several countries are illustrated with respect to each individual, annually. (3). As one can see in the figure; those countries can be divided into three main groups. The United States of America and Canada from the first group while the western-Europe and Japan from the second group. The horizontal energy lines are in millions kilo-calorie while the vertical GNP lines are in USA dollar units.

As every knows; a mature human being needs a calorie of 3000 kilo-calorie. Therefore; the same person needs some 1 million kilo-calorie in a year. The energy which is shown in the second figure; is the total energy that is needed to store; to transport, and to produce.

To explain the subject in a better way; let us indicate the energy that is in our food; in Kilowatt-hour unit. If 1Kws is 860 kilo calorie; a normal man needs 3.5 kWh per day and 1277.5 kWh per year. Because this energy comes mainly from the first producers; and the carnivorous creatures, in fact this energy is extracted from sun. if we consider the electricity consumption in T.R.N.C. as 2700 kWh per person; (4) ; the importance of sun in food producing becomes clearer.

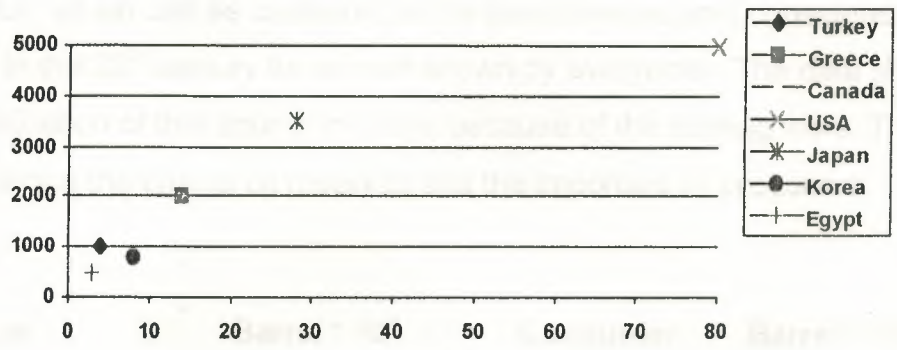


Figure 2. GDP and Energy Consumption per capita of some countries

In the figure 2; let us investigate the GNP and the energy consumption per person. Suppose that the population is kept constant. India needs to improve its GNP by 15 times; if he wants to catch the second-group countries. It seems impossible for India to supply that amount of energy for a population of 1 billion. Therefore; it is impossible for India to reach the second-group countries in the near future.

Turkey; in which the population increases 1 million each year; has to establish important investments for energy; as soon as possible, in order to reach the second-group countries.

On the other hand; the USA has a better energy consumption which is 2.5 times of the other countries and this amount decreases 1.2 in the comparison of the GNPs. This shows the inefficiency of energy-consumption in USA with respect to the second-group countries. This is called as wasting energy and this increases the problems that we face in the modern world.

As it is done above; these two criteria can be investigated individually for any country. One important point to be kept in mind; is then important relation of the national economy and the energy convenience.

THE WORLD OIL REPORT

Oil; or we call as crude oil; is the most desired and consumed energy source in the 20th century for oil; are known by everybody. The data shows us the termination of this source in future because of the coming wars. The table below shows the crucial oil reserves and the important oil producers.

Producer	**Barrel * 10^9**	**Consumer**	**Barrel * 10^6/yil**
- Saudi Arabia	225	- ABD	6323
- Iraq	100	- Japan	1818
- United Arab Em.	98,1	- Germany	831
- Kuveyt	94,5	- Italy	708
- Iran	92,9	- Franca	677
- Venezuela	58,5	- Canada	643
- Russia	58,4	- United Kingdom	634
- Mexico	56,4		
- ABD	25,9	**TOTAL**	11634
- China	24,9		
TOTAL	864,6		

If the oil consumption continues like the one in 1989; the reserves are estimated to be finished in 74 years. If an increase of %1 - %3 is added to the consumption; it reduces to 55 years. Because we are in 1996; then we spent 7 years more; because the estimations are made in 1989. Therefore the oil prices are expected to increase in geometric series.

1992 WORLD ELECTRICAL ENERGY CONSUMPTION

Because electricity is produced long ways from the settlement places; it is thought to be clean. This assumption is true for only hydro-electrical power generators; but a higher percentage is produced by coal-based electrical generators and this produces acid rains as well as the greenhouse effect. Never the less, a contemporary life can not be imagined without electricity. Figure 4A; shows the average consumption of electricity of OECD countries, North and South Cyprus; in 1992 (6). Because the average value is 7000 kw/person; of OECD countries; it is obvious for the countries under the standard to make investments for the electrical energy issue. If figure 4B; the large-populated countries are depicted.

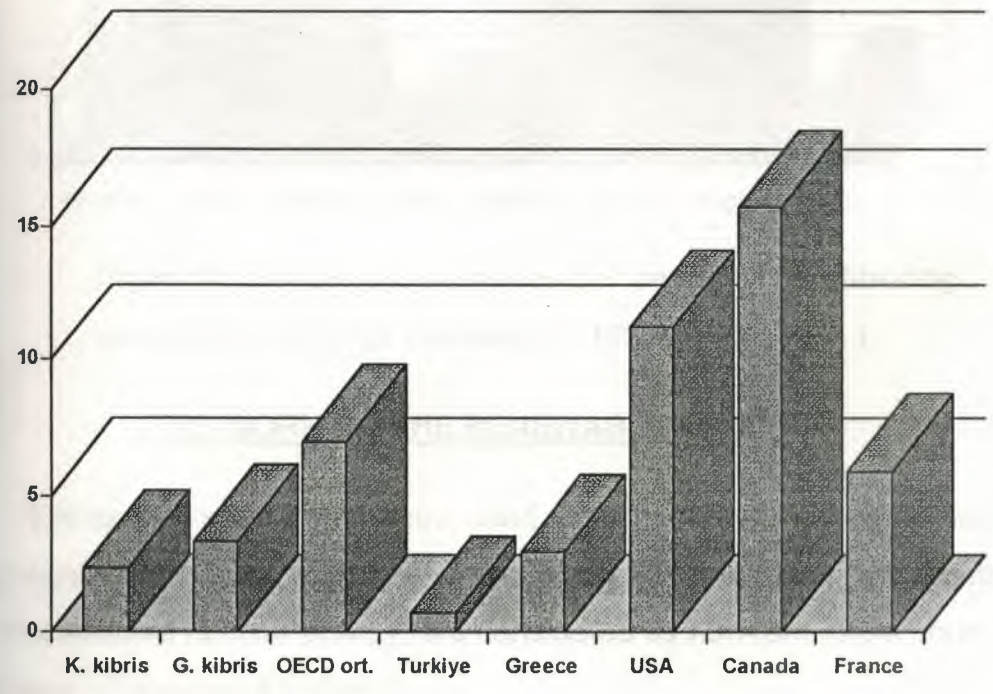


Figure 3. OECD and TRNC 1992 electric consumption per capita(1000kWh)

This figure; is deduced from the related reference (6). The main goal here, is to check the population of Turkey which is considered to be much. By taking the limit of conventional energy sources into consideration; the importance of finding alternative sources; shows its necessity for huge-amount of populated countries.

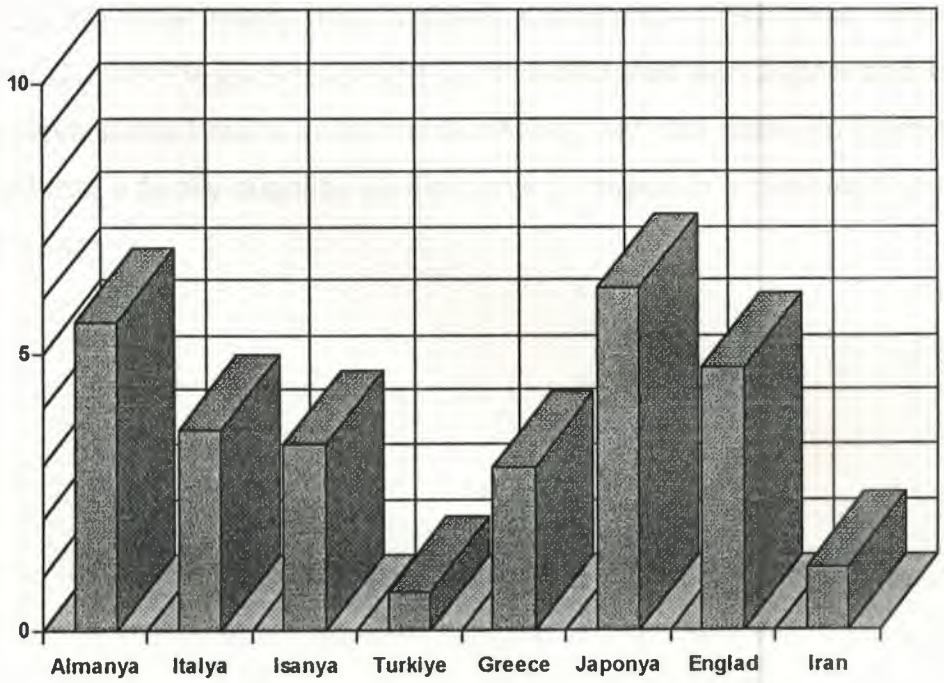


Figure 4. Electric consumption per capita of neighboring countries with large population -1992- (1000 kWh)

THE WORK ON THE RENEWABLE ENERGY

The energy source which are used in the world; can be classified in two groups. The non-renewable and renewable sources. Coal; oil, together with conventional nuclear energy; are considered as non-renewable sources. They have a meaning of limitation.

Sun; wind and water source can be classified as the renewable energy sources. In some areas; the renewable energy refers to alternative energy. Those can be used also in electrical energy production. Till 1993; hydro-electrical generators with a capacity of 643511 MW; geothermal generator with 9369 MW capacity, wind generator with 2652 MW capacity and photo-voltaic generators (PV) with 400 MWP power capacity are established.

The PV applications which are shows above; are at the beginner's level. On the other hand; the European Community (EC) has devoted 3 billions ECU for PV applications. It is also declared that Japan and United States have started some investments dealing with the issue. In Germany; it is stated that a family supplies all their energy needs in a two-storey building for two years.

INTRODUCTION

Energy which is said to be the source for technological development and the civilization; can be produced by various methods.

Oil which supplies the %38.7 of the world-energy need; is assumed to finish in 60 years.

Besides this rapid consumption; we can identify the solar energy coming to our world as an non-terminating source. For instance; the solar energy that is received by the earth in 1 hour; is equal to the energy consumption in a year. The oil-crisis that we have faced in the late 705; shows us the necessity for to use the solar energy. Moreover; the increasing ratio of environmental destruction by the conventional sources prove the cleaning effect of solar energy.

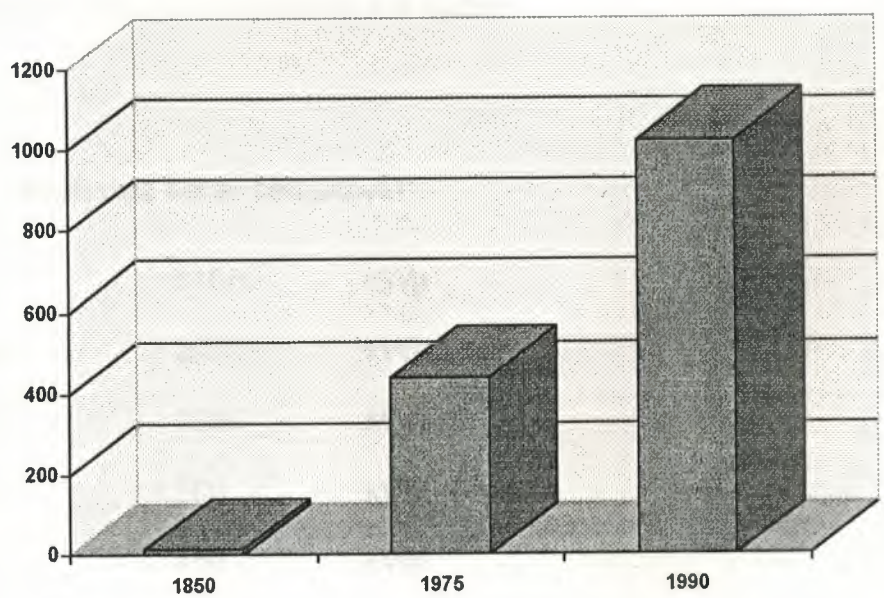


Figure 1. Energy global consumption

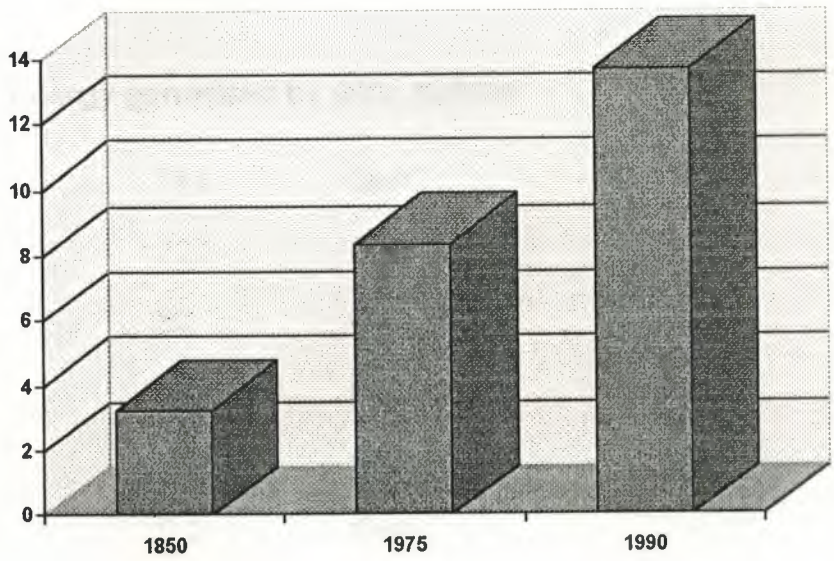


Figure 2. Power capacity of the world

THE RENEWABLE ENERGY INVESTMENTS IN EUROPEAN COMMUNITY

The investments made by some EC. member countries; indicate the importance of and the actuality of the matter.

Table 1: Available solar cell power

Italy	51000	kWp
Germany	2000	kWp
Holland	1000	kWp
Portugal	160	kWp
Greece	150	kWp

Table 2 : Energy generated by wind turbine

Denmark	774	Gwh
Germany	220	Gwh
Holland	80	Gwh
England	10	Gwh
Greece	2	Gwh
Ireland	0.2	Gwh

Table 3 : Direct heating via solar energy

Greece	885	Gwh
Spain	235	Gwh
Germany	160	Gwh
Italy	75	Gwh
Denmark	16	Gwh

The solar-cells which can be classified in renewable sources; are dependable and they have long-life. They attract people for their maintenance-free character. The solar-cell production which was 15 MW in 1994; is expected to reach a value of 242 MW in 2008 with an increase of %10. By this way; their 5$ price will be reduced to 2.6$ in the future.

THE SOLAR ENERGY IN TRNC

TRNC can be thought as a rich-country for solar energy. But; it is used to heat water by collectors; now a days. To broaden its application; the solar energy should be converted into more practical forms. The statistical data which is made in 1993; shows the cumulative electrical energy as 481 KWS. The average per person in OECD countries is 7000 KWS. Each year; the land of TRNC receives a greater amount of solar energy. If we convert it becames 111 times of the energy that is used in the nation in 1993. To produce the energy that was consumed in TRNC, in 1993; we need a solar cell establishment with an area of 1.75 km^2. So; we use the 1/1000 of TRNC land.

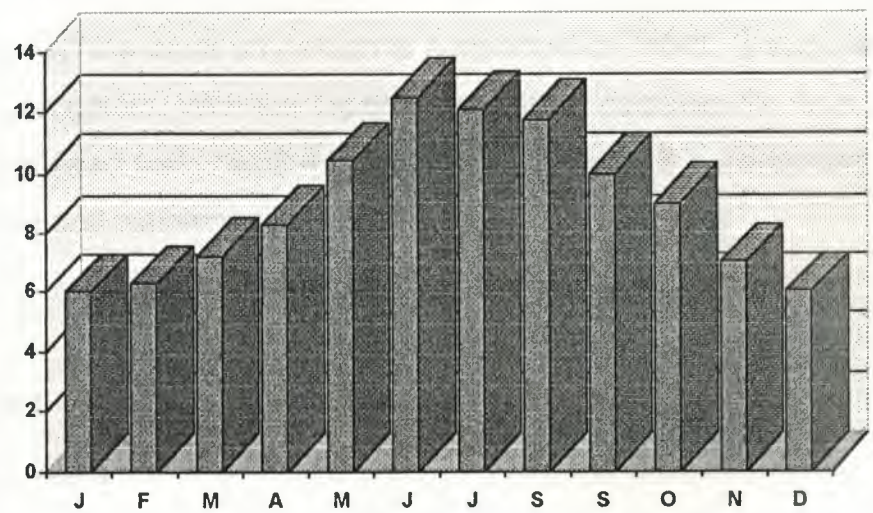


Figure3. Average daily sun times categorized monthly (1981-1991)

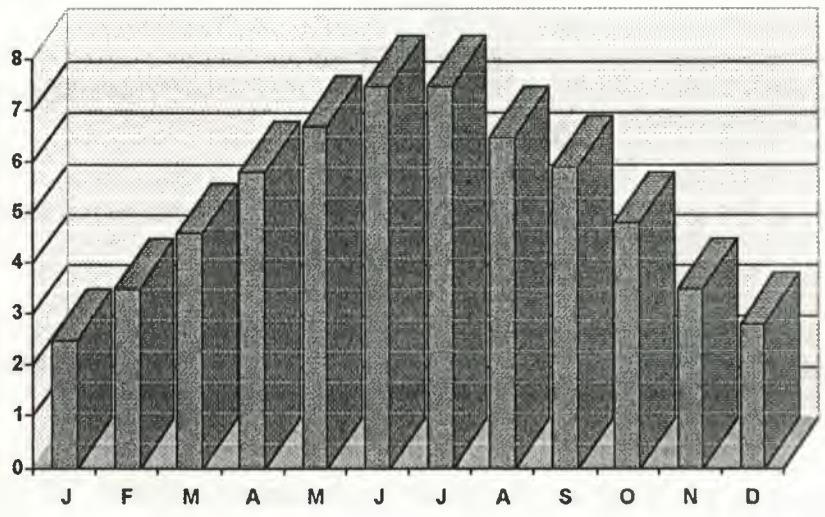


Figure 4. Average daily solar energy categorized monthly (1981 - 1991)

THE COST SUBJECTS FOR THE ELECTRICAL ENERGY PRODUCED IN THERMIC UNITS

Today; the electricity which is consumed in TRNC; is supplied by the thermic generators. With the imported fuel; if we calculate the financial part; for the first year; *fuel (% 52.4); management (% 23.8); investment (%16.4)*; repairing and maintenance (% 7.4)

TABLE 4:

Investment = 75M$

Life = 30 years

Production = 344 MkWh/year

$$\text{Cost Investment} = \frac{75 \times 10^6\ \$}{344 \times 10^6\ \text{kWh} \times 30\ \text{year}} = 0.72\ \text{cent/kWh}$$

Fuel Expenditures = 252.7 gm fuel oil / kWh

1 tons fuel oil = 100$

Cost of Fuel = 2.53 cent/kWh

Other Expenditures (Maintenance, rectified etc.) = %1.5 (75 M$)

$$\text{Other Expenditures Cost} = \frac{75 \times 10^6 \$ \times 1.5}{344 \times 10^6 \text{ kWh} \times 100} = 0.30 \text{ cent / kWh}$$

Management Expenditures (1994) = 370×10^9 TL = 11.2×10^6 $

$$\text{Management Cost} = \frac{11.6 \times 10^6 \$}{530 \times 10^6 \text{ kWh}} = 2.1 \text{ cent / kWh}$$

With %7 inflation expectation the total cost M(X) for only annual fuel consumption of year X is given below.

M(X) = 0.72 + 0.3 + 2.53 + (X - 4)(2.53)(%7)

M(X) = 5058 + 0.021X cent/kWh

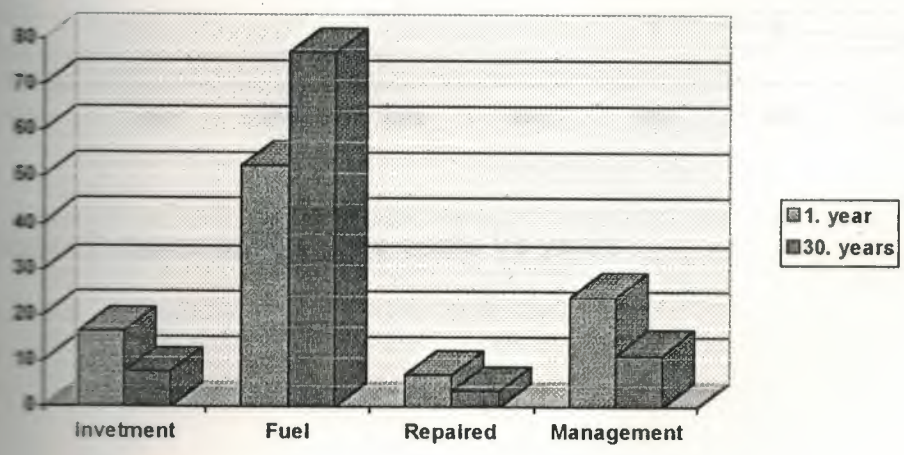


Figure 5. Percentage cost of component

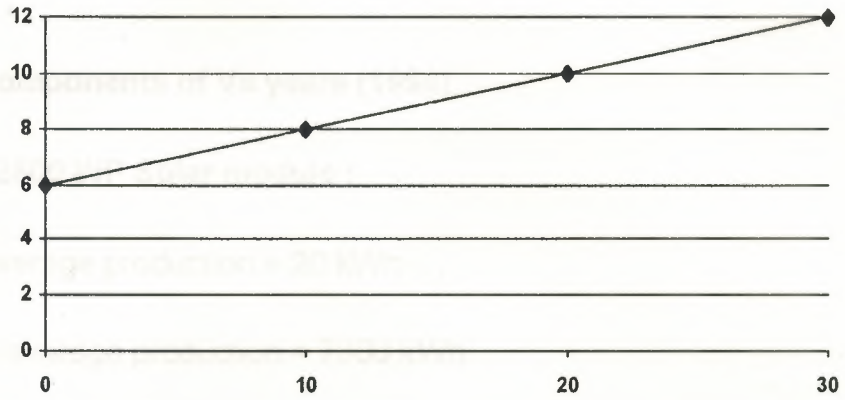


Figure 6. Production costs Vs years

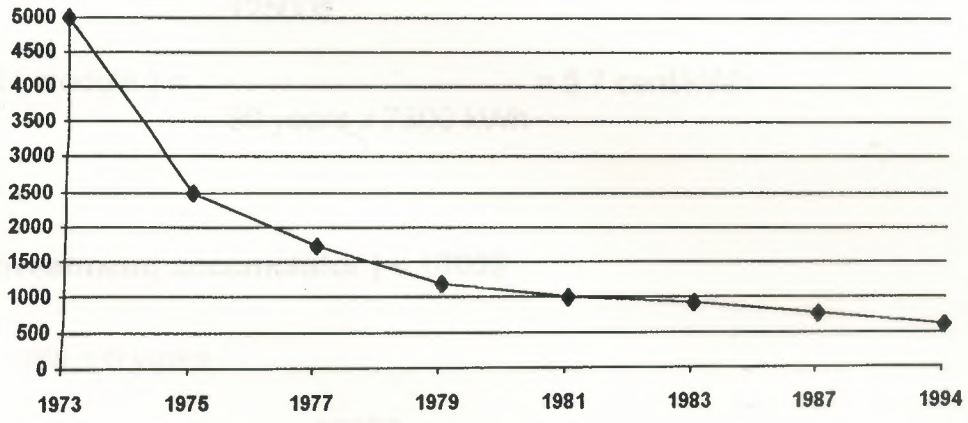


Figure 7. Solar cell module costs Vs years

Cost components of Vs years (1994)

2500 WP Solar module :

Daily average production = 20 kWh

Annual average production = 7300 kWh

a - investment (module) = 12500$

life = 30 years

$$\text{Cost (module)} = \frac{12500\$}{30 \text{ years} \times 7300 \text{ kWh}} = 5.7 \text{ cent/kWh}$$

b - investment(accumulator) = 1000$

life = 6 years

$$\text{Cost (accumulator)} = \frac{1000\$}{6 \text{ years} \times 7300 \text{ kWh}} = 2.3 \text{ cent/kWh}$$

c - Investment (inverter-control) = 2000 $ (2.5 kW)

life = 30 year

$$\text{Cost (I-k)} = \frac{2000\$}{30 \times 2.5 \times 24 \times 365} = 0.3 \text{ cent/kWh}$$

Total Cost = 8.3 cent/kWh

THE HISTORY OF WIND ENERGY AND THE WIND ENERGY TRANSFORMING MACHINES

Because each single area is not heated by sun in equal amounts; the winds are formed. The cumulative energy in the atmosphere is in the form of potential and kinetic energy. Wind which are identified as the air movements; because of the pressure pradiats in the atmosphere, cause potential energy to turn into kinetic energy. In fact; the 4000 KW/m^2 of the solar energy turns to wind energy.

The reason for greater winds; is the equatorial regions which are heated much more with respect to other lands. On the other hand; the 22.3° degree of the earth's angle to the origin; makes the max. differences in winds. Some other sea-land winds; land-sea winds; the maintain; the canyon-winds; play importance here.

The machines that Europe faced in XI. century; has improved rapidly and with the improving technology; the factories has started mass-production. After the establishment of the 30m rotor by USSR in 1930 to Black Sea rim; the bigger wind machines produce more energy; they could have been improved because of their complexity and high purchasing price.

THE APPLICATION OF THE WIND ENERGY SYSTEM

The wind energy machines had been an alternative to other power generating systems for years. With the improvement of modern technology; a greater improvement has been succeeded. There are many reasons for using this technology which can be listed as follows:

1) WECS (Wind Energy Conversion System): The size can be altered according to the power that is needed with a capacity of 1KW or less.

2) WECS can be operated both mechanically and electrically according to the need.

3) WECS have a wide range of application from the farms to houses.

4) WECS can be used both independent or depending to a system of electricity producing networks.

5) WECS can be both imported or be constructed locally

6) WECS can be operated in parallel with the hydro-electrical sources.

7) WECS can be used both day and night.

8) WECS need a small amount of area to receive energy, vertically.

9) WECS can be constructed both in a simple or complex manner according to the need.

10) WECS have no had effect on the environment and the ecology.

THE POTANTIAL AND ANALYSIS OF WIND IN TRNC

The data which is needed to calculate the current wind energy in TRNC; is supplied from the branches of TRNC meteorology department at Girne; Magosa, G. Yurt and Ercan. The wind data which is at least 3 years old and at most 10 years old; are averaged and are analyzed in hourly; monthly; quarterly and annually criteria.

Stations	Regions	Latitude	Longitude	Height	The direction of H. R.
Girne	north rim regions	35' 20'N	33 20'E	08m	W
Ercan	middle Mesarya	35' 09'N	35'09E	118m	W
Magosa	East cost	33' 09'N	33' 56'E	02m	W
G. Yurt	West Mesaria	35'11'N	32'59'E	51m	W

Because TRNC is an island republic, the effects of sea-breezes can be felt better. Especially; the inland winds and the sea-breezes which effect the inlands, causes directional differences; in summer.

The wind turbines have %100 efficiency in converting the wind energy to other forms and it depends on the direction of the wind. It can be calculated as

$$P/At = \frac{1}{2} Xmv2/At = 1/9\ P\ v3$$

The formula that we use above; brought many solutions to the searching activities which are performed in Iraq and Jordan; and helped them to establish WECS in suitable areas.

By using the experiments about the issue; those countries are producing electricity by using WECS.

THE WIND SPEED AND POWER ANALYSIS OF THE STATIONS THAT ARE EXAMINED

Hourly Analysis:

In all the stations to blow harder by 9 o'clock and by reaching its max. around 15 o'clock; starts to lose its strength until it reaches its former value at 18 o'clock. The density of the wind energy starts to increase two hours later than 9 o'clock and loses its energy density after 18 o'clock.

Monthly Analysis:

If the density is distributed on a monthly bases; it is seen that they below more in Girne between December-March period while it is valid for Ercan in the middle mesaria for April-November period.

The potential displays us the same reality for potentially Girne has an advantage in the December-March period while Ercan has that advantage between April and November.

By the seasonal based analyses; it is seen that Girne has the largest potential of wind energy in spring and winter; while Ercan has the leading capacity in Summer and Fall. The other stations have relatively low values when they are compared with Ercan and Girne.

Annual Analysis:

Girne has a leading capacity of 55.4 V/m^2 energy while Ercan is the second in the classification with a value of 50.4 W/m^2. The wind potential is comparitevely low in Magosa and G.Yurt on annual based analysis.

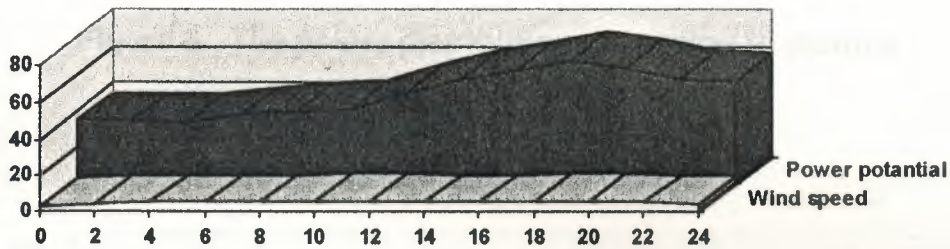


Figure 3a. The speed od wind and power potential of Kyrenia in February

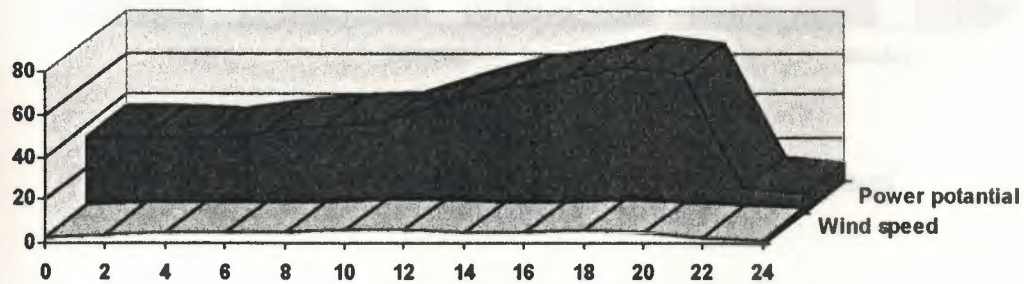


Figure 3b. The speed od wind and power potential of Ercan in August

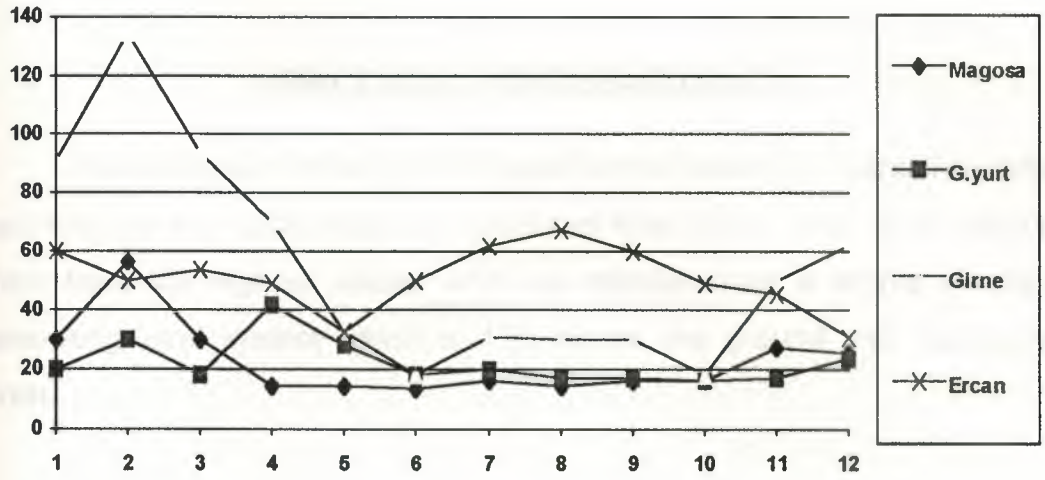


Figure 4. The power distribution according to months

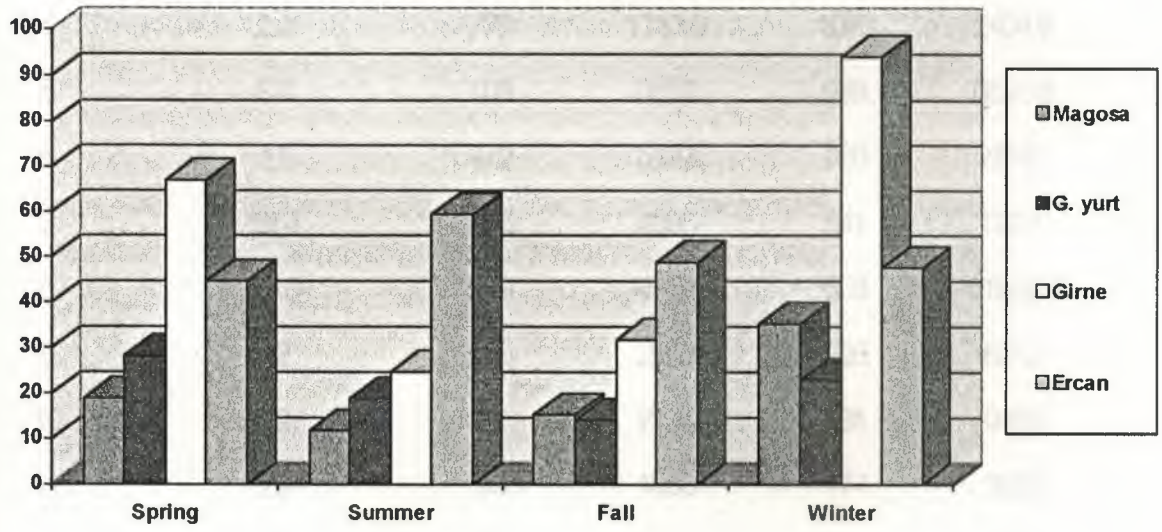


Figure 5. The power distribution according to seasons

ANALYSIS OF WIND FREQUENCY

The calculation of WECS are based on the analysis of wind frequency; according to the data which are gathered from Ercan and Girne stations which have the highest values; and are calculated for a simple electricity generating wind system which is 10m above the ground and having two winds.

	KYRENIA			ERCAN	
Speed (m/sn)	Power output	Annual wind times	Kilowatt-h kWh	Annual wind times	Kilowatt-h kWh
4	2.2	779	1713.8	1093	2404.6
5	6.6	508	3552	988	6520.8
6	11	472	5192	786	8646
7	15.4	266	4096	541	8331
8	19.8	229	4534	603	11939.4
9	22	135	2970	296	6512
10	22	97	2134	431	9482
11	22	90	1980	174	3828
12	22	52	1144	204	4488
13	22	24	528	136	2992
14	22	30	660	522	11484
		Total kWh:	28304		76628

RESULT AND PROPOSALS

The work which is performed in order to calculate the current wind potential of TRNC; shows us that the value changes between 20.0W/m^2 (Gazimagusa) and 55.0 W/m^2 (Girne). This is an approximate calculation of the wind energy potential. But we can obtain higher values in Girne in winter season and in Ercan in summer season. These power rates are sufficient enough for air conditioning and irrigation purposes in both Ercan and Girne; and this can be supplied by a small mechanical WECS. Nevertheless; TRNC has much more windy places; but the lack of the stations; lead us to incorrect results. Therefore; the meteorology office started to build stations in those districts.

ENTRANCE

There had been a greater energy crisis in TRNC in the second half of 1994. The current system has a max. deficit of 80 MW in TRNC; but the system which was established lately with a power of 60 MW; can solve the problem for the time being. The increase for the demand of energy; increases %9 each year in TRNC and by checking the statistical data; it is observed that energy is needed in winter at peak values.

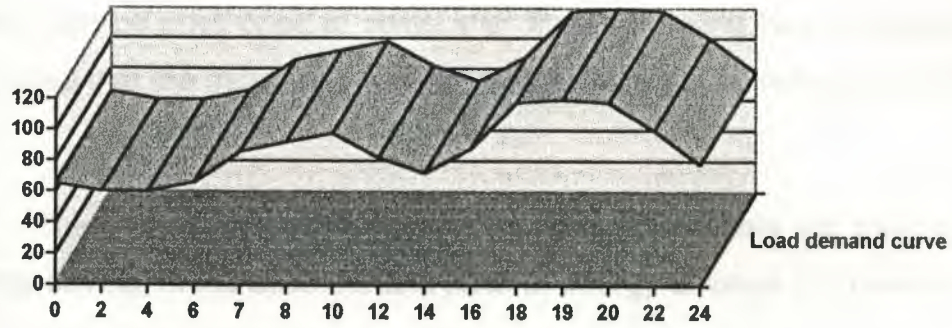


Figure 1. TRNC 1994 hourly load demand curve in December

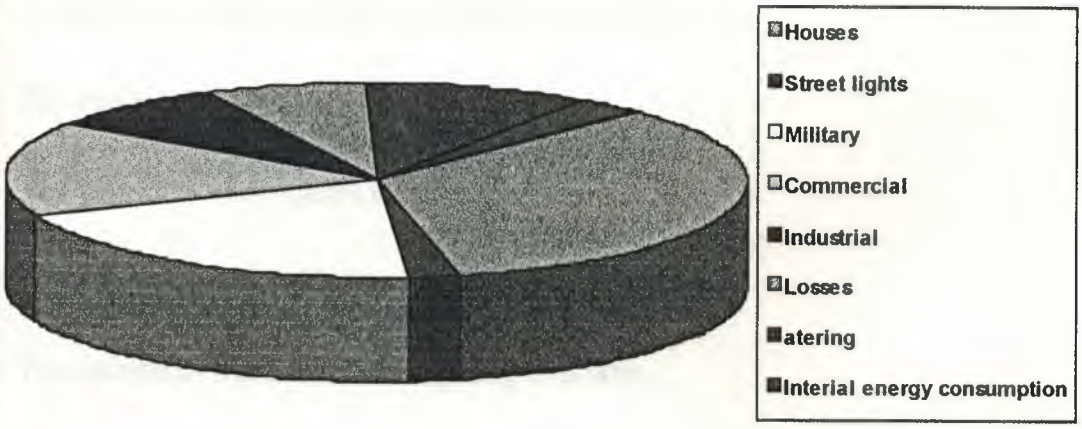


Figure 2. Distribution of energy demand according to consumers

THE APPLICATION OF PARTIAL DEMAND MANAGEMENT IN TRNC

With some short-term investments; the current energy demand in TRNC; can be postponed to some later time. By taking new measures; it is estimated that the increase percentage of energy will be reduced to %4 from %9.

The proposals can be listed as follows; to educate the people about energy saving; to increase the unit price of energy at times it is needed much by the industrial and commercial enterprises.

The max. load is obtained in winter because of heating with electricity. The price of energy was under the world-standards and this led Cypriot citizens to use electricity for heating purpose. Kibtek should increase the price of electricity in order to encourage the people to use gas or other sources. Government should direct people to new types of sources by the cost policy.

To develop the construction sector and to back up the new technologies in order to build houses with the following specifications.

- To use materials which has much energy efficiency.
- The high-efficient heating systems.
- The use of double-glass windows.
- The roof and wall isolation.
- The usage of more efficient lighting systems.
- To design houses with passive solar heating.
- To heat water in a higher efficiency with solar energy collectors.

The second important point in to supply water-heating by solar energy in winter. It is estimated to have 10 MW decrease by encouraging the use of other sources.

Especially in summer; because of the increasing water need; the underground water is pumped to the surface the water pumps which are run by electricity. It is assumed that the today's need is supplied by inefficient electrical machines with a supply of 10 MW.

THE PLANNING OF INTEGRATED SOURCE

The planning of integrated source is a method in which the main aim is to transfer the energy to consumer in the most efficient way and that is done by the measures that are taken both in the supply and demand stages. The goal is to supply the need of the consumers in the cheapest way. It forces people to use energy much in times of the decreasing demand.

Kibtek will have the advantage of controlling of both supply and demand if it starts practicing the above method. By combining the conventional method with this specific (technology); the energy consuming behavior of the consumer can be altered.

Kibtek has to control the changes that take place in the production cost and the energy demand. Kibtek has to take the following points into consideration and to find solution to them.

- The non-stable load increases.
- The high-cost of new production units.
- The increasing prices of fuel-oil.
- The problems which are formed by the environmental corrosion.

A PROPOSAL FOR TRNC

Kibtek has to establish a planning department and should control the energy consumption. There should be a collabration between EMU; the mechanical and electrical engineering departments of that university, the architects in Cyprus and with the mechanical engineers throughout the nation. One of the main aims of this group, is to educate the people and give seminars about it. The for-coming energy demand should be estimated at once and new investments have to be established. This is an additional task for this committee.

RESULT

In order to create valid solutions to the energy problem and find the exact energy policies; an Integrated Source Planning should be established at once. The participants who will participate the planning committee should be EMU, KTM and Mimarlar Odasi under the supervision of Kibtek. It isn't possible to form a planning committee without the control of Kibtek.

THE INVESTIGATION OF THE SOLAR ENERGY POTENTIAL IN TRNC.

The production and consumption of energy; became one of the signs of the nations development and welfare; and it is directly proportional with the economical improvement. The energy sources that the mankind use; has been changed according to the technological developments. In today's world; the energy that the mankind needs; is supplied mainly from hydro-energy and from the nuclear energy.

The energy sources; according to the production amounts; can be divided into two as " the conventional energy sources " and " the non-conventional energy sources". Moreover; the energy sources which can not be used in the past because of technological inconvenience; is named as the renewable energy sources. The conventional energy sources are the fossil fuel; hydra-energy and the nuclear energy. The non-conventional energy sources are the solar energy; Joe-thermal energy; the tidal energy the wave energy and the wind energy.

The need of energy in today's world; supplied by the fossil sources with a rate of %90. The most frequently used source is oil among the fossil sources. According to some assumptions; the fossil sources if the consumption continues with this rate. Therefore it is inevitable for countries to use the renewable sources and find other alternatives for this purposes.

THE RENEWABLE ENERGY SOURCES AND SOLAR ENERGY

The importance of renewable energy depends on the potentials of the countries. While some countries others are continuing intensive research about wind energy. Without any doubt; solar energy is the most applicable and popular among the category of the renewable energy sources.

Sun is the only source which gives infinite energy to our world and other planets. All living organisms need sunlight in order to survive. Coal; oil and water potential; are produced by chemical and physical effect of wind and solar energy. Sun which can be named as a thermonuclear reactor ; delivers a power of 62 MW/m^2 in some wavelengths and only 1 of 2 billionth of the energy which is delivered from sun; can reach the earth's atmosphere.

Never the less; the amount of energy that our world receives; is thousands times of the world energy consumption.

Solar energy has many advantages to other kinds of sources.

a) Solar energy is the cleanest and the only inexhaustible energy source.

It is a clean type of source and has no wastes like carbon monoxide gas; smoke, radiation and sulfur.

b) It is quite available for local purposes. Solar energy can be practically used in any condition, and in every where.

c) It is independent of the economical situation, for no material is imported from abroad.

d) It is needs no complex technology for its application.

Although solar energy has many advantages which can be seen clearly; there are some reasons for its less frequent use.

a) Because the amount of the solar rays coming to planar surfaces, is relatively less; large surfaces are needed.

b) It has to saved because of non-continuos solar energy.

c) Especially in winter when there is a higher demand for energy; solar energy is rather ineffective because of atmospherically reasons.

d) Areas which are not shaded by any means; should be used; so as to receive solar rays continuously.

e) The first cost value of solar energy systems; is extremely high.

Today; they use of solar energy is getting wide because of the continuous increase in the prices of oil.

THE FIRST APPLICATIONS OF SOLAR ENERGY

Although our planet has always been influenced by the solar energy; scientist have just started it as a means of energy source. According to some media; there are many examples about its applications in the past which are listed as follows.

- Socrates stated the importance of putting more windows on the southern pert of the houses to receive more energy and also showed that the wall of the north-side of a building should be high so as to block the wind.
- According to a claim; Archimides used icbukey mirrors to focus the sunlight in order to burn the ships which besieged SIRAKUZA.
- A French scientist Belidor made the first pump which was operated by sunlight.

- With the Galilee's discovery of lens; the research about sun; has improved.
- Another French scientist Mouchot prepared a book about the solar energy.
- Mouchot focused the sun rays by the help of the parabolic mirrors and operated a steam-engine. He also performed experiments about the sun-ovens and the solar energy operated pumps.

The first crucial meeting was helped in New Delhi and it was concluded to form the International Solar Energy Society.

SYSTEM WHICH USE SOLAR ENERGY

The conversion of solar energy into some other valid energy types; is possible by the thermal and photovoltaic principles. Systems which are depending on thermal concepts; have wider applications.

Thermal Application

There are too many systems in which the solar energy is shifted into other forms of energy by thermal principles. These system are

a) Low-temperature applications (20 - 100^{0}C)

b) Mid-temperature application (100 - 300^{0}C)

c) High-temperature applications.

In Low-temperature applications; flat collectors are widely preferred. Some of these applications are;

- The hot-water supply of the houses.

- Heating of houses.
- Green house heating.
- Drying of agricultural products.
- Cooling of houses.
- Heating of swimming pools.
- Sun-ovens and sun-stoves.
- Pure-water production.
- Salt production.
- Solar energy operated pumps.

In the applications above; the solar energy is conducted by a heat shifter (especially flat collectors) to a fluid (water, air, hydrocarbons with halogen) and the fluid which reaches higher-temperature values is either stored or is sent to the system. This is much more economical than the low temperature applications; like the greenhouse heating; heating of houses and water supply.

- In mid-temperature applications; the sun-rays are stored by either focusing or refracting with the help of focused collectors. In these applications; apparatus which can follow the sun movements; should be used.

- In the high-temperature applications in which the value is above 300^0C; systems which are called heliostats are used so as to focus the rays in a greater surface. Mirrors are practically used in sun-ovens and in solar-power systems to obtain 3500^0C heat. These technology is widely used to USA and France in order to melt; cut and casting of metals.

Photovoltaic Applications

The solar cells which operate when the solar rays reach them at a right angle; are based on the photovoltaic affect.

The efficiency of solar cell varies between %3 - % 25. They were developed for space programs and started to spread to all instruments which are away from the electricity network. (sea torches; cellular phones and wireless equipment's, automated meteorology equipment; home-type electricity run equipment).

There are some advantages of using photovoltaic principles because of its features; like the silent operation; Discharging of non hazardous wastes, having the ability of generation power at any where and at any rate. It has also some disadvantages as well; like the high-production price; the complex technology and low efficiency.

THE ANALYSIS OF SOLAR ENERGY POTANTIAL IN TRNC

The solar lightning is not distributed properly over the world. Bounded by the research and developing of solar energy program; The European Community has produced an Atlas of European Solar Radiation and as one can see figure 1; Turkey and TRNC are displayed as well. as it is seen from the map; the southern part of Turkey and the whole of TRNC are put in the sunny region. According to the solar energy while TRNC is put in the higher section of solar energy.

According to the research containing the 8 years data of Ercan and Guzelyurt stations between 1986-1993; and their development by the bimetallic actinograph and the Campbell Stokes type of heliograph; the time of radiation and the intensity of solar energy are measured; taking the months

as bases of the cumulative values of each day and they are averaged according to the 8 years cumulative values divided into months.

By applying the Angstrom relation and some other valid relations; the daily average intensity of solar radiation and the cumulative annual time of radiation are calculated by drawing the regression graphics the energy ratios are followed along the regression lines. Moreover; they 8 years monthly average solar radiation intensity values are drawn on a radiation time table.

RELATIONS THAT ARE USED

Some relations that are used for the calculation of solar energy in Ercan and Guzelyurt; are listed below.

a) The Angstrom Relation:

$$H/H0 = a + b\ (\ S/S0) \quad \ldots\ldots 1$$

Here;

H : The solar radiation value which is calculated on earth (cal / cm^2)

H0 : The solar radiation value above the atmosphere (cal / cm^2)

S : The radiation time that is measured on earth (hour)

S0 : Assumed radiation time (hour)

a , b : Linear regression constants.

b) Theoretical Solar Radiation Time :

$S0 = 2/15 \text{ arc Cos} (-\tan\delta\tan\phi) \ldots\ldots\ldots\ldots\ldots\ldots 2$

ϕ : Latitude angle

δ : Declination angle

c) The Solar Radiation Value Above The Atmosphere :

$H0 = 1400/\pi(\bar{R}/R)\, IO (W \sin\phi\sin\delta + \cos\phi\cos\delta SINw) \ldots\ldots 3$

$\bar{R}$: Average Sun-earth distance (km)

R : Actual Sun-earth distance (km)

IO : The Sun constant (1.94 cal/cm. min)

w : The length of half day (degree; radian, hour)

RESULTS

According to the data which is gathered from Ercan and Guzelyurt station in 8 years between 1986-1993, generally the time for solar radiation varies between 4 hours 48mins. (December) and 12 hours (July) and the least radiation results are obtained in November, December; January and February.

In May, June, July, August and September; the time for solar activity is about 10 hours or more; while this time reduces to 7-9 hours in March, April and October.

The average solar energy intensity varies between 193.2 cal/cm (December) and 609.2 cal/cm (July). This intensity goes to its max. value in June and July while it goes to its min. value in December and January. The solar energy intensity has a value of 400 cal/cm per day while it is about

200cal/cm per day in December and January. The intensity varies between 250-400 (cal/cm per day) especially in February, March, October and November.

According to the calculations which are based on the sunlight period and the solar energy intensity; the annual total sunlight time in TRNC is about 3126 hours while it is 8 hours 36mins per day in average. They average solar energy intensity is 415 cal/cm per day.

According to the regression lines which are obtained by the application of Angstrom method to the data obtained monthly calculated values show in order and no deviation has been reported. But it is seen that there is a cumulation of energy values in the June, August and September region. This is the natural consequence of the comparatively low cloudy periods of time.

As a result of the examinations about the matter; it is seen that TRNC is in the sunny region in which the sunlight is obtained at peak value. Therefore; the country is rich about this particular source of energy. Still, we are using this technology in our houses for the hot water purposes. On the other hand; there is a great demand for energy in other fields of industry. Finally which is a renewable source for its energy need, apply this technology to the current energy generators to regulate new measures for the application of this powerful type of energy for the current energy deficit.

Ercan and guzelyurt stations H, H(0),S, and S(0) monthly average values

Morts		January	February	March	April	May	June	July	August	September	October	November	December
ERCAN	H(ot)	233.5	299.3	399.7	512	567.2	630.5	625.8	583.2	504.6	379.1	264.2	207.1
1986-93	S(ot)	5.9	6.2	7.2	8.9	10	11.5	12.3	11.6	10.2	8.2	6.6	4.6
8 year	Ho(ot)	431.9	550.2	705.7	849.8	944.4	981.2	961.1	885.5	761.8	608.1	468	397.9
	So(ot)	9.9	10.7	11.8	12.9	13.8	14.3	14.1	13.3	12.3	11.2	10.2	9.7
Guzelyurt	H(ot)	205.5	266.7	365.8	464.8	525.3	587.8	581.8	524	453.9	337.3	240.6	179.4
1986-93	S(ot)	5.6	6	7.2	8.8	10	11.7	11.8	11.2	10.1	8.2	6.6	4.9
8 years	Ho(ot)	431.4	549.8	705.4	849.6	944.3	981.2	961.2	885.4	761.5	607.7	467.5	397.4
	So(ot)	9.9	10.8	11.8	12.9	13.8	14.3	14.1	13.3	12.3	11.2	10.2	9.7

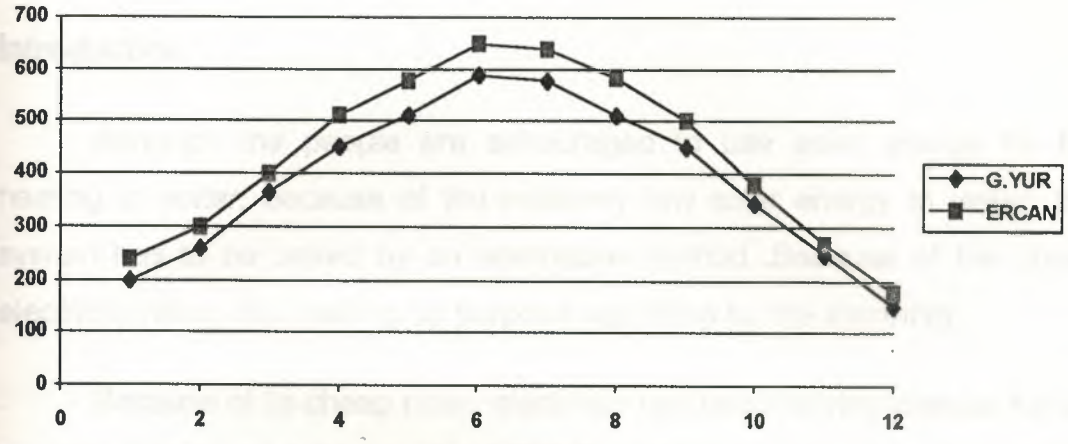


Figure 2. Annual change of sun times in the Ercan and Guzelyurt stations during the 8 years period 86093 (cal / cm2.gun)

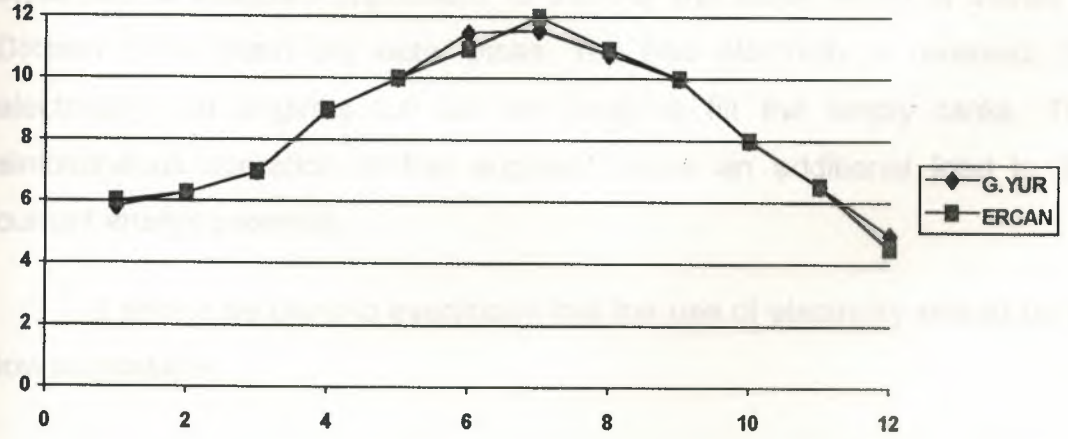


Figure 3. Annual change of solar energy in ercan and guzelyurt stations during the 8 year period 86 -93(hour)

THE USE OF ENERGY EFFECIENTLY IN WATER HEATING BY ELECTRICITY

Introduction:

Although the people are encouraged to use solar energy for the heating of water; because of the relatively low solar energy in water; this system has to be baked by an alternative method. Because of the cheap electricity rates; this backing up purpose was done by the electricity.

Because of its cheap rates; electricity has become very popular for the use and it seem as if the people of TRNC were encouraged to use electricity until 1994 by the rates which were less than the production cost. Because of the high energy demand in the second half of 1994; there has been a great energy crisis.

Because of the frequent electricity cuts; Lefkosa can not receive water in order. The water pump are run by electricity and if they do not receive electricity; it becomes impossible to transfer the water which is stored in Dikmen to the main city water pipes. The time electricity is received; the electrically run engines run all day long to fill the empty tanks. The simultaneous operation of this engines; cause an additional load to the current energy potential.

It should be clear to everybody that the use of electricity should be as low as possible.

THE SYSTEM THAT USED IN TRNC TO HEAT WATER

The most widely-used system in TRNC for the water heating; is the solar energy conversion system which is backed up by electricity. Because of the main aim of catching the optimum solar energy; the systems are situated on the roofs. The lack of the water-lining engineering caused the houses to have unisolated hot-water pipes; which come directly from the hot water thanks. In winter; the electrically operated heaters interfere with the problem as a result of the insufficient solar energy intensity. It becomes impossible to keep the water at high degrees because of the unisolated pipes and the outside-placement of the water thanks. Therefore; the electrically operated heaters are used more to keep the temperature of the water at fixed values; and this cause an increase in the consumption of the energy.

THE SITUATION OF ENERGY IN TRNC

In the second half of 1996; TRNC will have two steam turbines with a power capacity of 60 MW. Although the highest demand in 1994 in winter at 19:00 hours was about 122 MW; it is estimated to have need of 145 MW in 1996 with an increase of %9; per year.

The construction of new power-plant is expensive and causes the environment to get in dirt. Therefore; the electricity consumption should be controlled. The reason of the formation of peak in winter time at 19:00; depends mainly on the operation many electrical instruments at same time by the commuters.

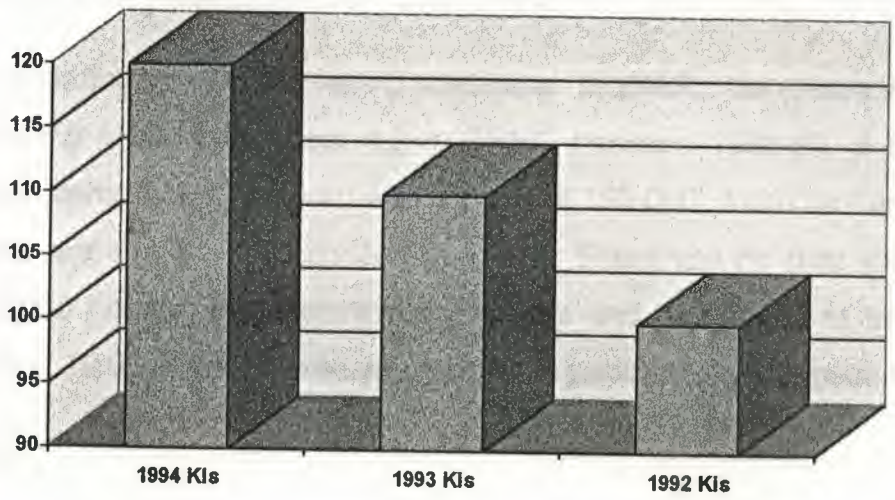


Figure 1. Peak values of electrical energy annually in TRNC

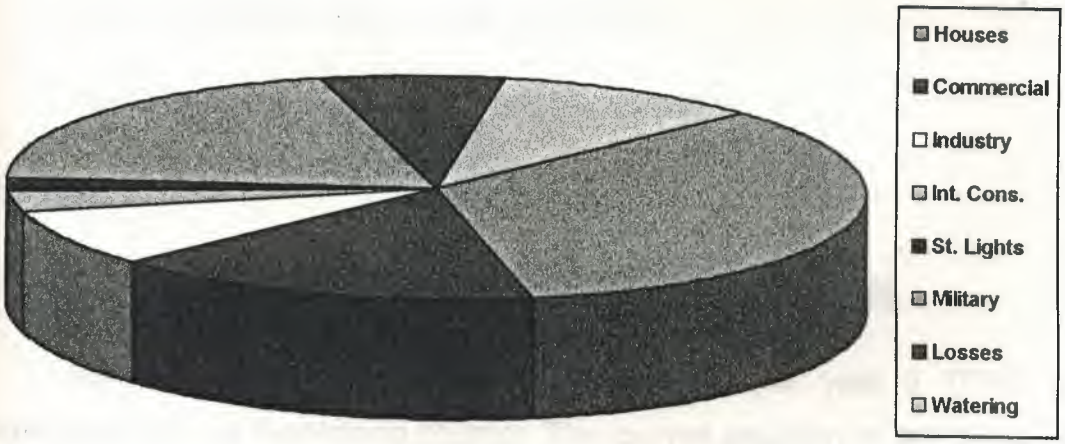


Figure 2. Energy usage according to consumer categories

THE EFFECT OF ELECTRICALLY HEATING WATER TO THE PEAK LOAD

According to the surveying company COMAR; the percentage of people living in flats; is about 4.2 in TRNC between 1988-90. If the last population census is considered with a value of 156.000; it can be concluded that there are some 38000 houses in TRNC. There are no data there are some 38000 houses use electrical appliances and how many of them are operated at 19:00 hours. The example which is performed in the peak load.

Example:

If %80 of the houses in TRNC use electrical water heating appliances.

3800(number of houses) x 0.8 = 30.400 houses

If %50 of them are switched on at 19:00 hours

30400 (number of house) x 0.5 = 15.200 houses

If each electrical heater consumes 3 kW

15200 (number of houses) x 3 kW = 45.6 MW

ALTERNATIVES FOR WATER HEATING SYSTEMS

The need of electricity should increase %4 per year if TRNC is considered to be a developing country. The current situation of %9 increase should be limited. One effective way limiting this; is to develop alternatives for heating water instead of electricity.

If electricity is still used for heating water; this should be done at off-peak hours and in an efficient way. The following proposals should be both encouraged and legislated

1) The use solar energy in water heating should be encouraged more; any better systems should be used widely as soon as possible and they should be fixed properly. The current solar energy collectors show a low quality output because of the lack of engineerial assistance. Especially in winter; the performance concept should be realized very clearly and be kept high as much as possible.

2) If any alternative system is planned to be other than solar energy; this choice should not be electricity. During the period of house designing; the-following systems can be used by the assistance of mechanical engineers.

   a) LPG water heaters

   b) Any central heating system if it is possible,

1) The operation of current electrical water-heating appliances should be done according to the following proposals.

- The water-heating should be done at off-peak times. People should avoid heating water between 17:00 and 20:00. By doing this; the need of electricity at peak-times will be switched to other period of times. This operation can be performed by a timer or a program which encourages this concept by KIBTEK.

For instance; the electricity board can advise its customers for the controlling of electrical heaters by itself with amazing discounts. So; the board closes all the heaters for 6 hours by paying money.

- Necessary measures should be taken in houses where electricity is used for water heating; in order to have optimum benefit. Standards should be developed and be legislated. The hot-water cylinders should be isolated with the materials which have the specifications of KTMMOB.

Result:

If the above proposals are used; there will be an easy for the electricity demand. This causes a decrease in electricity cuts and as a consequence the cities receive much water. The platform for performing the necessary measures; can be established by the law-makers in senate.

HEATING WITH ELECTRICAL RESISTANCE STONES AND PROBABLE MEASURES

Energy Production:

Electricity is the most expensive type of energy. The oil energy which is used for producing electricity; has many losses like the %32 at the production stage in the power-plant, %34 while transferring the energy through the wires; and in the transformers.

Under today's circumstances; the cost for producing a power-plant for each kW is about 1500 Dollar or 60.000.000TLs. Instead of producing electricity we must use the current energy with optimum efficiency; and should develop law according to the demand.

By examining the increase in the economy and the increase in the population; the current production level (120 MW) with reach 180 MW by the 2000. The time the second unit is completing as soon as possible,

Usage :

There is a big energy crisis in TRNC and the production can not satisfy the demand.

The 1200 MW energy which is produced; should be used for

1) Enlightenment
2) Heating
3) Water heating
4) cooling
5) For mechanical energy

Heating :

Because TRNC is situated in the hot-temp regio; the houses were built according to all possible ventilation principles. The citizens of TRNC are not familiar with the isolation of houses. The number of houses in which the isolation concept is used; are really a few.

Families who maintain their heating problem by air-conditioners or central heating systems; are very low and electrical stoves are used in common; in TRNC. These stoves are in the shape of a radiator having three resistance sticks; each having 2000 W power combined with a concave mirror.

There are no heat limiters or sensors in these type of stoves while the electrical radiators bear all this functions. Therefore the resistive stoves only heat themselves and must be operated continuously.

THE PRIMARY TECHNIQUES IN HEATING

There are simple and correct ways of heating.

The most efficient way in saving energy; is to switch of the stoves if they are needed.

Stoves which save energy should be used in heating environments.

In order to obtain heat; we must avoid using the electrical resistance operated stoves and should use liquid gas obtaining stoves or other types which are operated by fossil fuels.

THE EXCHANGE PROGRAM

Kibtek has to regulate an exchange problem for the shifting of the resistance-stick stoves by the replacement of liquid gas operated ones. The main goals here is to encourage the consumer to use liquid-gas instead of electricity.

The board or the ministry in charge; can supply the stoves with a price of 4.500.000. TL while it has a price of 6.000.000. with its current retailing price containing all the customs—tax. With an additional 1.000.000. which can be taken from the consumer; this price decreases to 3.500.000. TL.

The electrical-resistance operated stoves is estimated to spend 3.240.000 TL. of fuel in winter for 90 days and the affiliated ministry will return the money back in 13 months. After this; there will be a saving each year for that amount of money and this will be performed free of charge.

ANALYSIS OF THE EXCHANGE OF ELECTRICAL RESISTANCE STOVES BY LIQUID-GAS

The current electrical resistance = stove;1 stick, 1000 W

Stove operated by liquid gas = 0 W

The saved energy = 1000 W

Annual consumption = 720 hours (90 days , 8 hours per day)

Annual saved energy kWh = 1000 w x 720 hours =720 hours = 720 kWh.

Cost of electricity /kwh^2, real = 4.500 TL

Cost of electricity /kwh^2, consumer = 1.500 TL

Cost of electricity /kwh^2 , dumping = 3.000 TL

Annual national saving = 4.500 TL x 720 kWh = 3.240.000 TL

Annual consumer saving = 1.500 TL x 720 kWh = 1.080.000 TL

Annual subvention = 3.000 TL x 720 kWh = 2.160.000 TL

The cost of gas stove operation = 100.000 TL / 75 hours = 1.334 TL/hours

Annual 720 hours consumption :

Gas- stove usage expense : 1.335 x 720 = 960.480 TL

The electrical-resistance stove expense : 1.500TL x 720kwh = 1.080.000 TL

The difference in expense of using gas-stove : 1.080.000 - 960.480 = 119.520

Annual national electricity saving : 3.240.000 TL / single resistance stove

Annual consumer usage saving : 119.520 TL

Cost of gas-stove : 6.000.000 TL (Relative)

Cost of gas-stove : 4.500.000 TL (Whole-sale)

Cost of electrical resistance - stove : 750.000 TL

Money needed for exchange : 1.000.000 TL

Cost of exchange to Kibtek : 4.500.000 - 1.000.000 = 3.500.000 TL

Time for return of investment : 3.500.000/3.250.000=1.80 years

Time for return of investment : 1.000.000/119.520=8.36 years

The consumer instead of using single-stove which can only heat itself; can have the chance of using a liquid-gas stove which can up a whole room by only paying 1.000.000. front to the exchange and this investment will return to him 8.36 years.

RESULT OF ANALYSIS

We can not predict the number of houses in TRNC precisely; for neither Kibtek nor the government has any statistic data in TRNC; it is estimated to be 58.000 houses in the country. If each person use a single electrical-resistance stove in the 90 days winter period; average.

1000W x 720 hours = 720 kW - 90 days / Electricity consumption for single house and the cumulative national consumption for personal heating is

720 kWh x 58.000 = 410760 MW / 90 days or

44.760 (90 x 24) = 19.33 MW / hours

If we consider that %50 of the 58000 houses joining this campaign, the national energy saving in the 90 days winter period is about 20.880 MW ; daily energy saving is about 20.880 / (90 x 24) = 9.67 MW/hour and the national energy saving will be about 93.960.000.000 TL ($ 2.291.707).

THE MEASURES THAT SHOULD BE PERFORMEN BY FORCE IN SHORT TERM

The import of electrical resistance-stoves should be limited or be banned.

The types of the electrical stoves that can be used; should be determined as soon as possible.

No important tax should be taken in the importing section of the liquid-gas stoves and the people should be encouraged to do so. This kind of measure will decrease the national consumption by %2

Houses which use liquid-gas operated stoves or any other energy types other than electricity; should be rated with a lower price for electricity. An intensive campaign should be started in order to show people how the electricity is produced and how to use it in the most efficient way.

RESULT

The electrical engineers board; the mechanical engineers board; the civil engineers board and the architects board should establish a national electricity committee whose advises and proposals will be united form alternatives for the best use of electricity in TRNC.

After the intensive campaigns; the people of TRNC whose educational level is high; will take necessary precautions which will decrease the demand from 120MW to 85 MW.

ENLIGHTENING AND THE USAGE OF COMPACT FLUORESCENT LAMPS IN ENLIGHTEMENT

Enlightening

The bulbs in which there are filaments, are oftenly used and turn electricity to both heat and light.

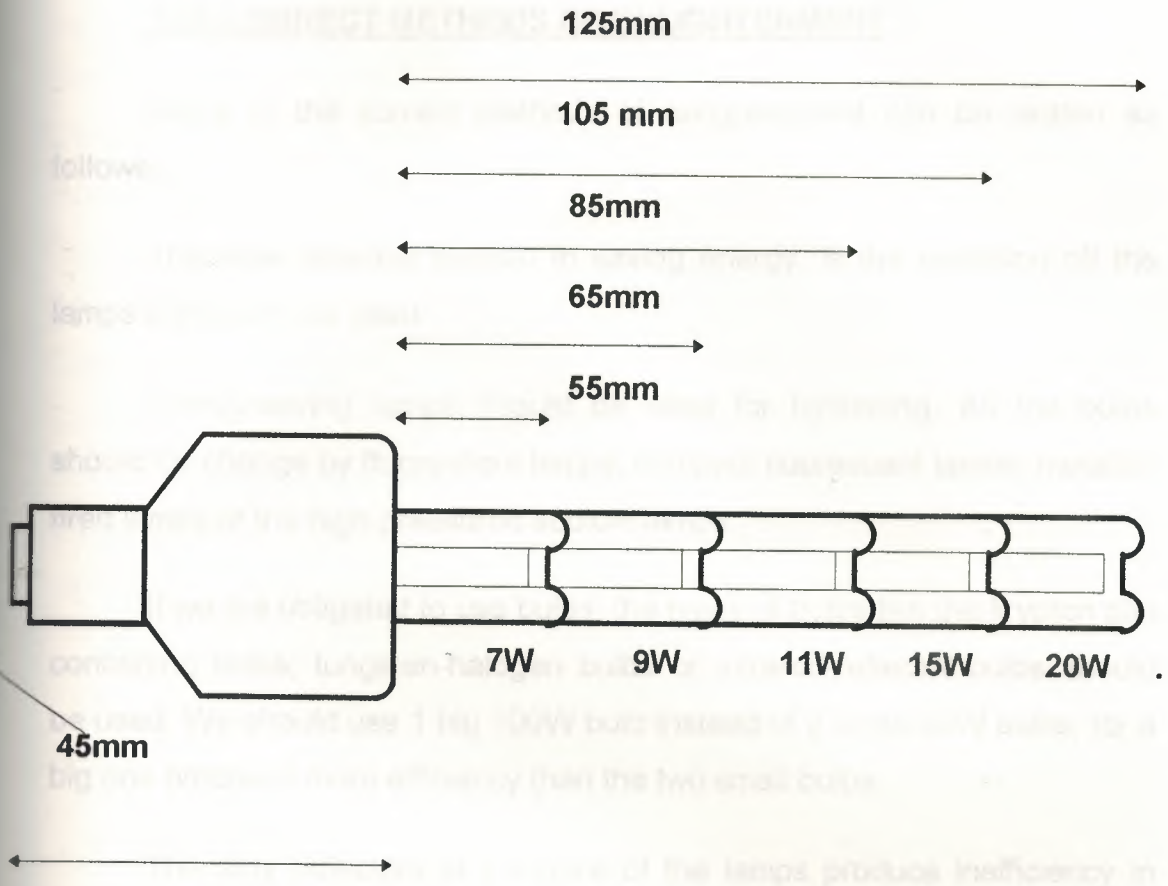
Because we need only a limited amount of electricity for illumination; the old technology bulbs consume energy more that we actually need. Therefore there is an amount of %66 of energy that is lost. Instead of operating the old technology bulbs; we have to use the metal lighting lamp; high-pressure sodium lamps; and the mini or normal sized fluorescent lamps.

The T12 fluorescent lamps which are standard in TRNC; are forbidden to use by 1-1-95 in the United States of America. The T8 coded fluorescent lamps which consume %15 less energy; can be used effectively.

The mini-fluorescent and the slim-fluorescent lamps can be operated economically; have higher life and can perform light close to the quality of daylight.

COMPACT FLOURESCENT LAMPS

Most of the Cypriots are not aware of the production of compact fluorescent lamps. These extraordinary lamps; can be both attached to E-27 (screwed) or B-22 sockets and can produce light closer to the quality of conventional bulbs.



The traditional lamps have a life about 600 - 950 hours while T12 coded fluorescent lamps have a life of 2000 hours and the compact fluorescent lamps have 4000 hours. The electronic ballast has a life of 10.000 hours. The light which the traditional 60W bulb produces; can be matched by a 34W classical t12 fluorescent lamp or 11W compact fluorescent lamp.

Although it seems that the compact fluorescent lamp has a purchasing price higher than the price of a bulb; it is obvious to save %25 - %50 more if we consider the factors of the frequency of usage and the ratio of life.

The lamps which are put in the streets, should be high-pressured sodium lamps.

THE CORRECT METHODS OF ENLIGHTENMENT

Some of the correct methods of enlightenment can be written as follows:

The most effective method in saving energy, is the switching off the lamps if they are not used.

Energy-saving lamps should be used for lightening. All the bulbs should be change by fluorescent lamps, compact fluorescent lamps; metallic-fired lamps or the high-pressured sodium lamps.

If we are obligated to use bulbs; the types of bulbs like the krypton gas containing bulbs; tungsten-halogen bulbs or infrared-reflector bulbs should be used. We should use 1 big 100W bulb instead of 2 small 60W bulbs; for a big one produces more efficiency than the two small bulbs.

The dirty reflectors at the back of the lamps produce inefficiency in reflecting the light and the energy is consumed much. Thus; the reflectors should be cleared periodically.

Current lamp	: 75W,1210 Lumen
Compact fluorescent lamps	: 20W,1200 Lumen
Saved energy	: 55W
Annual consumption amount	: 730 hours
Annual saved energy	: 55w x 730 saat=40.15 kWh
The life of bulb	: 600 hours
The life of compact fluorescent bulb	: 4.000 hours
Cost of electricity (actual)	: 4500TL
Cost of electricity (consumer)	: 1500 TL
Cost of electricity (subverted)	: 3000 TL
Annual saving	: 4500 x 40.15 = 180.675 TL
Annual consumer saving	: 1500 x 40.15 = 60.225 TL
Annual subvention saving	: 3000 x 40.15 = 120.450
Saving during the life of lamp	: 4 x 180.675 = 722.700 TL

Saving during the life of lamp (consumer)	: 4 x 60.225 = 240.900 TL
Saving during the life of lamp (subverted)	: 4 x 120.450 = 481.800 TL
Cost of purchasing A.F lamp	: 70.000 TL
Replacement by 4000 hours	: 4000/600 = 6.67 times
Purchasing cast by 4000 hours	: 6.67 x 70.000 = 466.900 TL
Annual replacement cost saving	: 466.900/4=116.725 TL
Cumulative annual national saving	: 180.625+116.725=297.400
Cumulative annual consumer saving	: 60.225 + 116.725 = 176.925
Cost of compact fluorescent	: 395.000
Time for return of investment	: 395.000/297.400= 1.33 year
Time for return of investment (consumer)	: 395.000/176.950=2.23 year

RESULT OF THE ANALYSIS

Because of the absence the exact number of houses in TRNC; it is supposed that there are 58.000 houses each having one compact fluorescent lamp for a year.

58000 x 180675 = 10.479.150.000 TL. national energy saving and by purchasing fluorescent lamps instead of bulbs in 4 years for each consumer

466900 - 395000 = 71900 TL/4 years

THE TEST RESULT OF THE ENDURANCE OF COMPACT FLOURESCENT LAMPS

Twin-tube type :Made by Bolitong; Chinese made; 11W, 4000k without ballast.

Light-Bulb type :Made by Panasonic; Japanese made; 16W; white with ballast.

Electronically Ballast :Made by Lohuis; Holland made;

Magnetically Ballast : Made by B6; Hong-Kong made; 20W, 0.37 A.

Panasonic bulb which is produced with an electrical ballast has worked correctly under all situations.

A FLS trademark; having two in parallel combination with electronically ballast; having a Twin tube model in compact fluorescent shape; has worked only 72 hours by the generators.

Two twin tube compact fluorescent lamps with Bolitog trademark having 2 with parallel combination with magnetic ballast; has worked correctly under all circumstances.

5 twin tube compact fluorescent lamps with Bolitong and FLS trademark; having 5 with parallel combination with electronic ballast, has worked well only 48 hours by the generators.

Bolington and FLS made; twin tube model compact fluorescent lamps having 5 with parallel combination with electronically ballast; have worked well for 120 hours by the generators and the inverters.

Because TRNC is not a garbage area for compact fluorescent lamps; the ministry which is affiliated with energy; should bring minimum standards to the meter by the collaboration with the KTMMOB union.

SHORT-TERM MEASURES; REINFORCED BY LAW

The production and the import of conventional incandescent bulbs be prohibited.

The immediate regulation and observation of the minimum standards compact fluorescent lamps with electric ballasts.

A lower rate has to be applied to consumers who are using compact fluorescent lamps.

An intensive campaign about illumination has to be initialized to show people the production phases and the money needed to produce electrical energy.

Result :

The usage of electrical energy must be efficient at most by applying the proposals of Kibtek and a group of technical people from the electrical Engineers board; Mechanical engineers board; civil engineers board and the architects board.

After the intensive educational campaigns and the law-forced measures; it is estimated to have a decrease to 85 MW from 120 MW.

Water Heating :

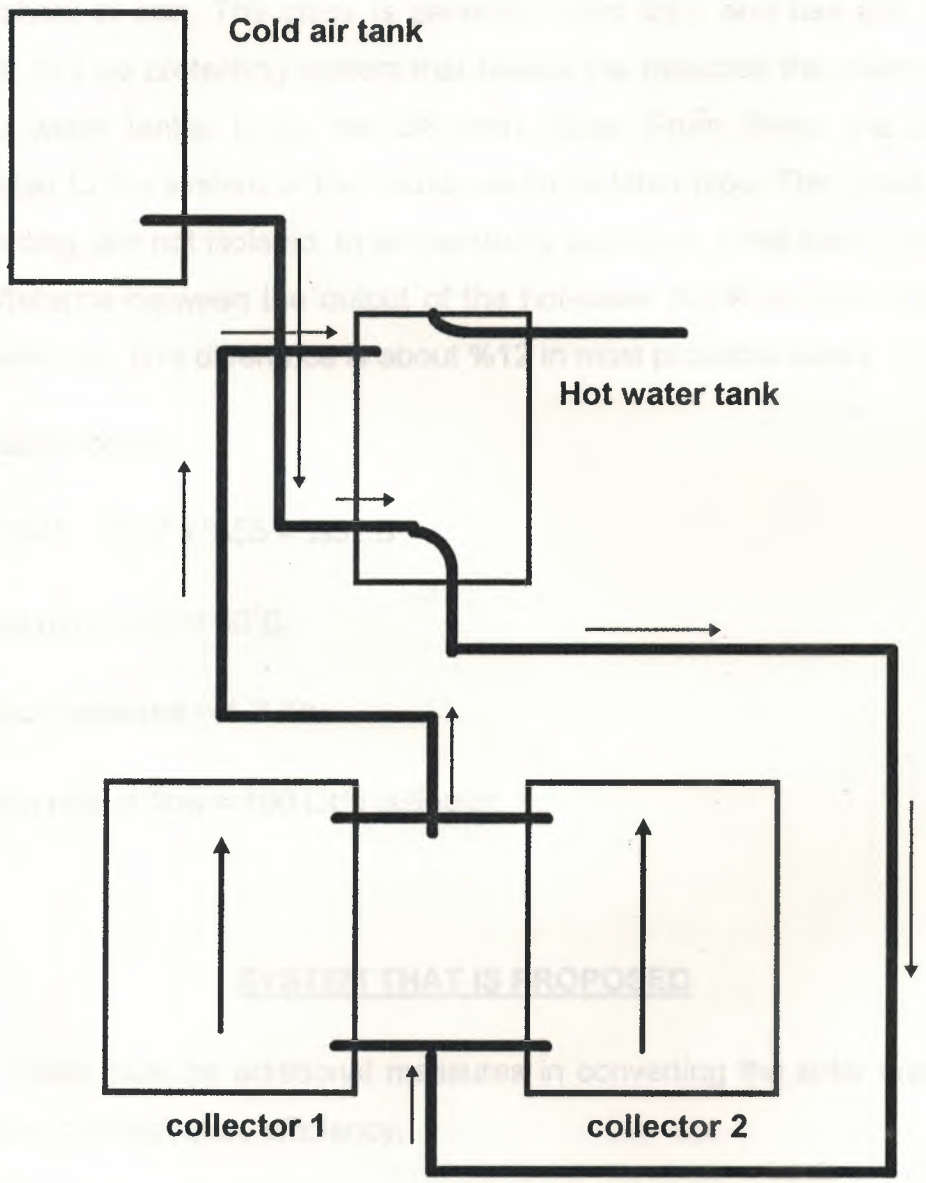
Because TRNC in location in the hot-weather region, most of the houses use solar energy for heating of water; by considering 300 sunny days per year.

The frequently used system was first used in Israel in 1960 and with a name of THIR, it was imported to TRNC under patent; with a combination of a cold-water tank; hot-water adder and 2 collectors.

THE CORRECT ESTABLISHMENT PRINCIPLE OF THE SYSTEM

- Collectors should be faced to south pole.
- If possible; they should not be shaded in any season.
- If there are additional collectors; they must placed at least 3 meters away.
- As a principle; collectors have an angle with the ground according to its latitude. That is 50° for Cyprus because there is no need to heat water in summer.

- There must be multi-collectors and the entrance for the not and cold water pipes; should be in the middle.
- Connections should be avoided if they are unnecessary.
- All pipes; especially the hot water pipes should be isolated till the cold-water tab.



CLASSICAL SYSTEM

In the classical system; there are 8 ½ inch pipes on the black dyed sheet of iron. Only %50 of these pipes can be exposed to sunlight. By the 2mm conduction layer; there is a heat exchange between the pipes and the metal sheet of iron. The glass is generally 1mm thick and has only single layer. It has no protecting system that blocks the reflected the collectors to the hot-water tanks; is by the 3/8 inch pipes. From there; the tank is connected to the system of the house via an isolated pipe. The pipes within the building; are not isolated. In single-storey buildings; it has been observed 5°C difference between the output of the hot-water thank and the output of the house-tab. This difference is about %12 in most probable cases.

Cumulative losses

%45 + %12 x %55 = %51.6

Average max. heat = 60°C.

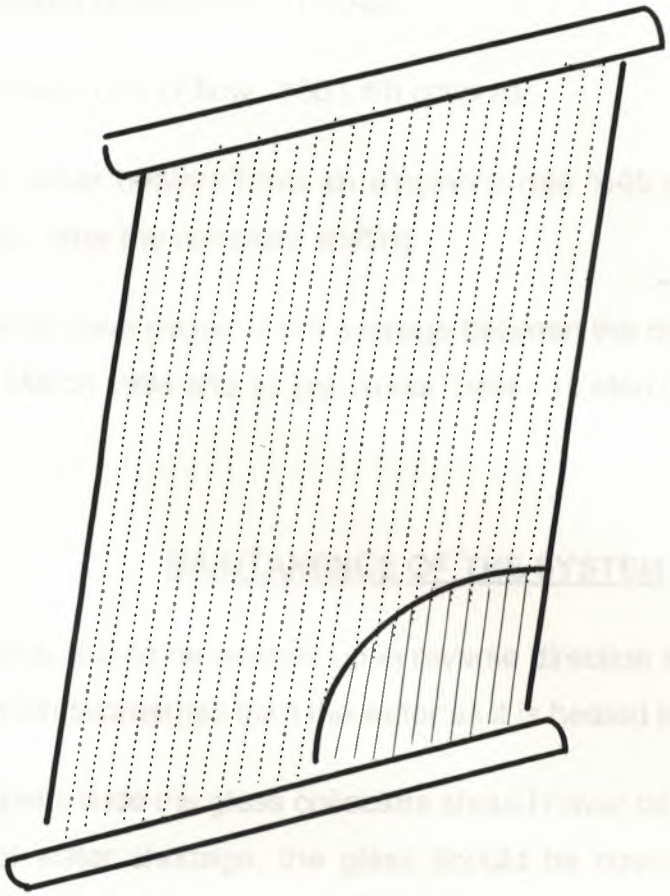
Operation pressure = 1-3 Atu.

Optimum rate of flow = 100 Lit/h collector.

SYSTEM THAT IS PROPOSED

There must be additional measures in converting the solar energy to hot water to obtain max. efficiency.

- the glass that covers the collector should be covered with special folio that is specially manufactured and having transmission media of %98 efficiency and that does not reflect the solar rays (75 - 100y).



Face view

Inside of the collectors:

- %25 more efficiency can be gained by the panels that have the water pipes inside and made from mono-sheet of polypropylene.
- The usage 8 copper pipe inside he collectors in mm radius. To have the clips in %40 width allows the %100 heat transfer from the sheet of iron on the ground.
- The pipes within the building should be isolated.

With these simple precautions; efficiency can rise to %75.

Average max. heat : 68°C

Pressure of operation : 1-4 Atu

Optimum rate of flow : 150 Lit/h collector.

The water heaters have an efficiency rate %45 before; and this rate rises to %65 after the complete shifting.

The 90 days period is the average between the dates of 15 December 1993 - 15 March 1994 and 15 December 1994 - 15 March 1995.

MAINTANENCE OF THE SYSTEM

- The pipes should be washed up in reverse direction so as to get rid of the lime which submerges from the water as it is heated inside them.
- The pipes inside the glass collectors should never be left without water. In case of water shortage; the glass should be covered with any kind of material.
- Actually; the system is already protected problems between -5°C and -10°C and that lasts for some hours; do not affect the system and the pipes.

RESULT AND THE NECESSARY MEASURES THAT SHOULD BE TAKEN

The board of mechanical engineers should back up the usage of the new %75 system other than the classical %75 efficient system and has to define the min. standards and report them to the ministry of energy of TRNC.

The natural consequence of the Cyprus will benefit if he uses this private feature and by using this; the country will have at least %10 energy saving.

THE PRODUCTION AND APPLICATION OF ELECTRICAL ENERGY IN TRNC

What is the current situation of electrical energy in TRNC which is the main reason in developing a country? After the urgent need of electricity demand after 1974; two gas turbines were constructed in Dikmen and Teknecik with the successive years and amounts of 30MW in 1975 and 30MW in 1977.

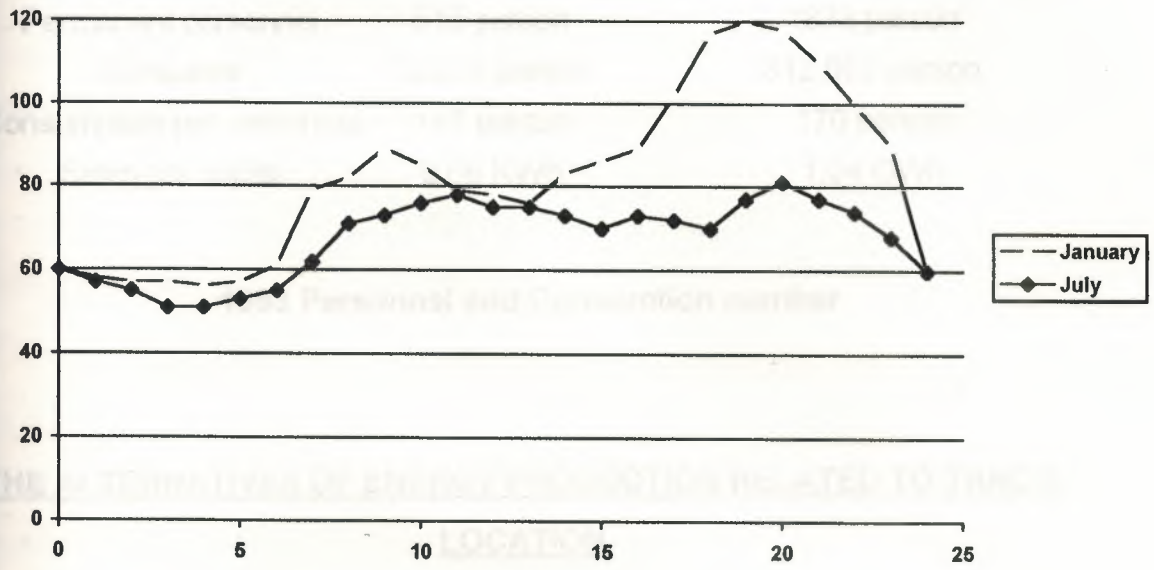
These power-plant do not have the capacity of supplying the electrical energy of TRNC. Because of the age of the system and its goal which is just to supply the puan need; it is only possible 52MW in summer for heating purposes and 40MW for cooling purposes. The negligence of the maintenance; will cause high-cost of repairing. The unit price is thought to be in USD/KWH for the establishment of the new gas power-plant.

In 1993-94 period; our peak load is about 120 MW in winter while it is 80 MW in summer. If the current supply is known to be 52 MW in summer for air conditioning and 40 MW in winter for heating; it is evident that we can supply only %43 of the demand in winter and %50 of the demand in summer.

Years	TRNC production (Million KWH)	From south (Million KWH)	TRNC Consumption (Million KWH)	TRNC per capita consumption (KWS)
1982	0.909	230.991	231.9	1.513
1983	0.561	250.639	251.2	1.615
1984	1.384	265.416	266.8	1.688
1985	1.012	289.678	290.69	1.813
1986	2.676	309.354	312.03	1.918
1987	53.647	277.153	330.8	2.004
1988	78.206	247.394	325.6	1.946
1989	27.045	312.495	339.54	2.005
1990	54.834	323.606	387.44	2.207
1991	37.566	375.054	412.62	2.374
1992	65.2	389.57	454.77	2.596
1993	61.55	419.86	481.41	2.717

	South CYPRUS	TRNC
ESTABLISHED POWER	657 MW	60 MW
WINTER PEAK	503 MW	120 MW
SUMMER PEAK	448 MW	80 MW

Established power and peak load condition in1993



Daily curves of 93 Summer and Winter peak loads

	TRNC	SOUTH CYPRUS
	Millions KWh	Millions KWh
House	165.73	650.505
Commercial	77.19	744.466
Industry	38.52	391.848
Watering	48.53	93.181
Street lights	8.89	31.241
Military	95.13	
Losses	33.58	
Power station	13.62	
Out of peak load	0.22	
Total	481.41	1.911.241

Distribution of energy among the sectors in 1993

	TRNC Kibtek	South Cyprus Electricity Office
Permanent personnel	515 person	1838 person
Consumer	75.875 person	312.892 person
Consumption per personnel	147 person	170 person
Sales per capita	0.66 KWh	1.04 GWh

1993 Personnel and Consumtion number

THE ALTERNATIVES OF ENERGY PRODUCTION RELATED TO TRNC'S LOCATION

1) The continuation of the usage of the current Gas Turbine power-plants and the increase in capacity by establishing new ones.
2) The electrical energy production from solar energy.
3) The establishment of the coal based gases turbine power-plants.
4) The transfer of electricity energy from Turkey under the sea via cables.
5) Construction of fuel oil based pas turbine power-plants.

1) The continuation of the usage of the current Gas Turbine Power-plants and the increase in capacity by establishing new ones.

The increase in the number of gas turbine power-plants is not planned. They have high-maintenance cost; short operational time and efficiency.

The operational cost of a gas turbine includes the maintenance-repairing replacement of parts and its spares and the fuel. The routine

maintenance expense can reach %20 of the first cost. Thought it is possible to repair the parts with a cost of %20 - %40 of the actual price, this is not valid for TRNC. The combustion rooms; the combusted gas transmission rooms and the turbine wings which rotate in high speed inside the hot gas; can be in corrosioned; be deformed or may have cracks; because of the high heat of the gas.

Because of the above factors; it is assumed that the gas turbines can not be used for base loads by the electricity boards. Its small size; ability to operate in short periods of time and the relatively short time needed for construction; makes them preferable for puant loads. In some occasions and in the countries where the fuel is cheap; they are out of use for base loads.

2) The electrical energy production from solar energy:

We can use the solar energy in order to produce electrical energy; but this does not solve the current problems of TRNC.

As everybody knows; the solar energy is not a continuos type of energy which is available throughout the day. The current problem of TRNC is the absence of a power-plant which can supply the base loads of the nation. Moreover; the process of developing electrical energy from the photovoltaic cells; is a new type of formation and has a low efficient output. The first-cost of the solar energy systems is very high.

3) Establishment of the Coal Based Gaseous Turbine Power-plant:

In a coal power-plant; 0.35 tons of coal is needed for the production of 1 MW. A twelve weeks storage should be kept for any inconvenience in supplying coal by any means of strike or etc. So; 70000 tons of coal is needed each 5 tons of coal need $50m^2$ land. Because the country does not have that amount of coal; new coal ships and harbours have to build for the demand.

One of the other major problems of the coal operated power-plants; is the environment garbage; by the ash and the sulfur oxide gases. This ash many be %20 of the amount of the coal that and the unwanted effects for the tourism activities.

4) Transfer of Electrical Energy From Turkey Under The Sea Via Cables

It is planned to use two aluminum conductor HV DC cables having 900mm^2 area, transferring max. power of 130MW from Turkey.

The current power-plant should be used reactive capacitors when the network is operated by the south of Turkey with 2 cables.

Although Anamur-Kormacik section is designed because of 654m distance for the transfer of electricity power; the 1300m depth of the sea blocked this project.

The definite sea-bed searching is performed by METU and MTA and it is reported that the deepest part is about 1070m. while the average depth is above 500m. Pirelli - Ecomar which can build cables for 1000m under the sea; proposed that the 90km Akkuyu - Teknecik path is more suitable for the purpose.

Although there are no examples of cable-lining under sea over 680m depth; the commercial firms guarantee the cable design; replacement and fixing of this 1000m. project.

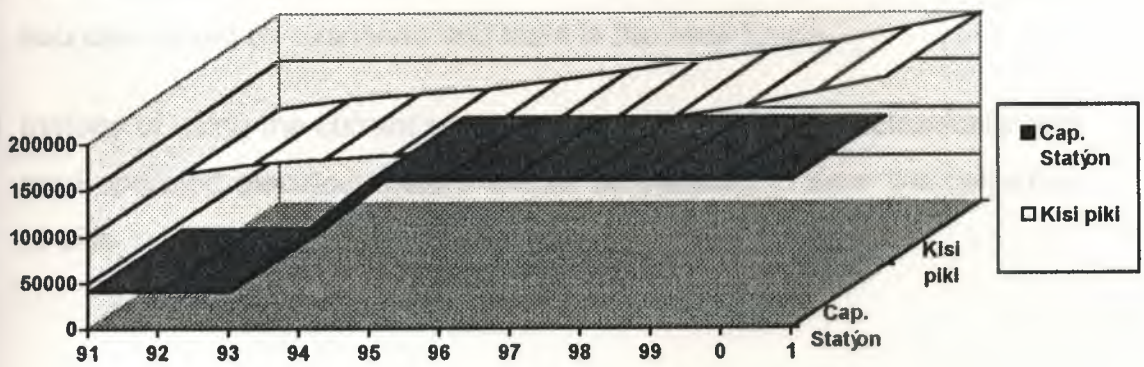
We have to rethink the matter as the technology improves fasted; nowadays.

5) Construction of Fuel-Oil Based Gas Turbine Power-plants:

Fuel-oil which can be used in gas-turbine power-plants as coal; has many advantages over coal as the storage; transferring and usage. In the

Fuel-oil power-plants; some 0.25 tons/MWh fuel-oil is needed for the operation. Although it has no ash problems; it has the same sulfur oxide gas problem like coal; and this represents high environmental danger. By the using of %1 sulfur containing oil; 10kg of fuel-oil that is burned. Those power-plants which use fuel-oil as the primary fuel; need $150m^3$/MWh water capacity for the cooling purposes. Thus; it is inevitable for the places near sea for the construction of the power-plants. The circulation water which is needed for the vapor containers is in ratio with the cooling water as 1/70 and needs a capacity of $2m^3$/MWh. In order to complete the missing water vapor; an addition amount of water needed which is %2 of the circulation water.

Because of the location of TRNC; the country has to develop energy sources; secure and independent from the southern part of the island. Therefore the 1st alternative which is the fuel-oil operated power-plants having a handling capacity of 60 MW; have been started to be established as technician was killed. Because of the reports completed about the 1. unit, the people at charge thought that the same production faults can happen at the 2. unit; too. Therefore; people who are authorized about their jobs; can not take the risk of operating the other II. unit. Nowadays; the testing join another source which can deliver 60 MW load.



Result:

During my speech; I have tried to explain the starting point till the current situation of the energy issue in TRNC.

The main characteristics of producing; transferring and delivering activities of electrical energy; is the sum of live and continuos actions. Therefore; the labors; the technicians and the engineers work in an alarming situation; 24 hours in a day; in everywhere like the power-plant; network; managerial section and the center. The most important thing that can be said now is;

a) To supply the national energy need from the fuels cheaper the government has to perform entrusting for the issue.

b) With the improved technology; an energy line should be brought from Turkey and new power-plant should be started to build to supply the energy need in the 2000s.

c) Regarding the concept of the education for the industry; the technical high-schools should devote lectures for the electricity production in cooperation with Kibtek and the ministry of education with technicians working for Kibtek have to give lectures as practical purposes.

d) The energy-saving should be encouraged and the alternative energy sources should be examined and build in the near future.

e) Instead of using the current energy-meters; new type of electronically and card operated electrical meters should be installed to ease the collection of bills.

THE INCONVENIENCES OF ELECTRICAL ENERGY IN TRNC

It becomes clear that there is a misuse of electrical energy by government institutions. The units which do not pay their bills correctly; like the government units; the schools, military units and their houses; the Kibtek workers; cause an increase in the power consuming graphics especially in puvant times cause the system become overload and cause the electricity cuts.

One other major point is the isolation-free pipes within the apartments. Although it is so simple and so cheap to use; nobody does this because of no rules forced by law and therefore lots of water has gone for nothing besides the energy loss.

Let's check the matter to see how much electrical energy is gone for nothing while we heat water. The heat energy which is used to heat a substance is called the amount of heat. Its unit is watt/sec. We can use the units like Joule (J) and kilo-calorie (kcal), too. The relation between these units is as follows.

1ws = 1J = 0.239 kcal

4187ws = 1000 cal = 1 kcal

In practical; kWh is used for electrical work. The value of heat which increases the temp of substances by 1°C is called the specific heat value of that substance. The table below shows the specific heats of some substances.

The calculation of the heat increase of substances from a value to another; is calculated by the following formula.

$Q = M \times C (t_2 \times t_1)$

t_1 = initial temperature

t_2 = final temperature

C = coefficient of specific heat

M = mass

Q = amount of heat

By the above formula let's calculate the amount of heat; needed to heat in our houses.

Amount of water to be heated : 120 Lt.

The average temperature of water in winter : 5°C.

The final temperature to the water heated : 70°C.

C = 4.19

Q = 120000 x 4.19 (70 - 15) = 276540000 Ws = 7.684 Wh.

If the power of the heater is 3KW, then we have to heat the water for 2.56 hours. If we isolated our system completely; with the help of the solar panels, the water which is at 40 - 45°C should be heated up to 70°C. So; the amount of energy that is consumed becomes

Q = 12000 x 4.19 (70 - 40) = 15084000 Ws = 4.19 kWh.

This takes only 1.45 hours. It means that we spend %50 less energy for that heating of water; in practice. If we consider to have 80000 subscribers and take the simultaneously factor as 0.1; the puvant power time is ratio of consumed electrical; energy for the heating of water as

P = 0.1 x 80000 x 3 = 24000 kW = 24MW.

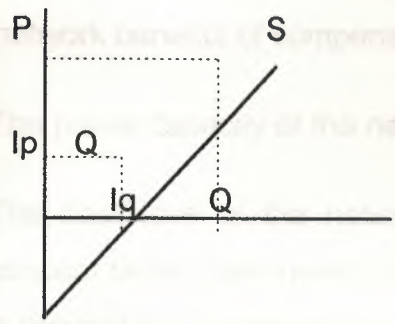
So we obtain a saving of 12 - 15 MW by isolating the hot-water pipes.

One point that we have not emphasized for the electrical energy saving machines. Each subscriber use this machines at least once every day. The above machines can work at suitable programs according the amount of load and these machines which are 2.5Kw; in shorter periods of time.

The leading technical inconveniences can be written as the insufficiency and the bad situation of energy transferring lines and the transformers. The aerial transferring lines which are still used in Lefkosa and its surroundings; makes a lot of trouble in transferring the energy.

On other subject that we must consider in order to pet out of this energy deficit is, the reactive power which influences most by the inconvenience of the aerial lines; its inability to be compensated and the lack of using dissuasive rates of electrical energy consumption. This task which is not performed by Kibtek; has formed industrial sites with power factors around 0.7. as a response to this; each site use %25 of the consumed energy for nothing. It means that %25 energy is added to the actual need for to perform the need. Let's investigate this unavailability.

The relation between the imaginary power; active power, reactive power and the currents can be visualized in the following diagram.



The Q angle between the active power and the imaginary power is called the phase angle and its cony is called power factor. The allowance of power value for most of the countries is about 0.9. If we examine a unit whose puvent value is 50 MW:

$CosQ_1 = 0.7$ $S_1=P / CosQ = 50 / 0.7 = 71.4$ KWA

$CosQ_2 = 0.9$ $S_2=50 / 0.9 = 55.5$ KWA

$S = S_1 - S_1 = 71.4 - 55.5 = 15.9$ KWA

As ir seen from the above example; by keeping the constant at 0.9; we can prevent losing energy by the consuming of 15.9 power.

The most practical and efficient way of compensating reactive power; is to capacitors. The power of capacitor needed to compensate the reactive power can be calculated in various ways. If we apply the above example in the following case; we calculate the capacitor power to be

$Q_1 = 0.7$ for $Q_1 = 51$ kVAr

$Q_2 = 0.9$ for $Q_2 = 24$ kVAr

$Q = Q_1 - Q_2 = 51 - 24 = 27$ kVAr.

The compensation of reactive power has many advantages for both the consumer and the network. The point that we should emphasize here is the network benefits of compensation. We can summarize this as follows:

1) The power capacity of the network increases
2) The heat loss of the network decreases. In order to understand this concept better; lets investigate the matter in detail. If the consumed power is thought to be constant;

by using the $P = R (I)^2$ formula we can obtain the

$P = R (P)^2 / (U) Cos^2$ formula.

By the application of the formula; we can calculate the heat loss. By the correction of the power coefficient with the conversion of the active power in terms of the partial heat loss; the gain is

$\%Z = 100 (P1-P2) / P = 100 (1-Cos\ Q_1 / Cos\ Q_2)$

Calculated by the above formula. If the system is fully compensated, the $Cos\ Q_2 = 1$ and some network heat loss can be listed as follows for the various power coefficients.

$Cos\ Q_1$	%Z
0.9	19
0.8	36
0.7	51
0.6	64

As the increase in the value of Cos Q from 0.70 to 0.90; gives us %40 saving in energy.

If we want to talk about the benefits of the compensation of the reactive power for the consumer; it can be concluded as the binding the energy need. Moreover; the subscribes will be saved from high values of money if the reactive power rate is issued and compensated.

As the measures that we listed above; we can decrease the energy deficit without increasing the capacity of energy production.

WHAT SHOULD BE DONE TO OVERCOME THE PROBLEMS

Short - term measures :

One of the main factors is to swifter the realization of the energy bills and the collection of money.

Though it is already against to the constitution; become of the equal rights principle; the so-called privileged sections of the community should be billed and the amount of energy that they consume should rather by the means of cost value. Therefore; Kibtek has to create a financial source and widen this with great care and with at most speed.

Another short-term precaution is the allowance of the community to use other kinds of alternative energies other than the electricity by using the customs as a weapon. People should be encouraged to use liquid fuel ar liquid gas; in order not to electricity. The affiliated government units have to regulate and have to practice these measures.

The manucipilities have to be given rights for the checking of the building pipelines as if they are isolated or not. The board of KTMMO should inform its members to do so. At the same time; the heater should be installed timers in order to activate the puvant time. In order to succeed; the affiliated units should work hard.

One of the other short-term precaution id the increase of the limit of the some industrial complexes to the 0.9 value of power coefficient by Kibtek. As a conclusion; Kibtek has to install reactive power counter to this units and their rate of consuming energy should be high.

As one can see; by applying the above short-term measures; the puvant time which is 120 MW in winter; can be decreased to around 80 - 90MW. As the compensation of the industrial factories which takes a longer period of time; this value can easily be reduced to 70 MW. As a conclusion;

the energy deficit can become less as the introduction of some new measures without performing new investments.

Longer - Term Measures :

The first thing that should be done in the long-term is to refine the current transferring lines and to create new sources. The refinement and the repairing of both energy transferring lines and the transformers; can be performed in a certain period of time if the necessary financial sources are created. The foundation of new energy investments need comparatively large amounts of money and this takes a long time. If the specifications of an island republic is considered; it is clear that we need highly-efficient types of power-plant which have the ability to store energy.

Starting from this aspect; instead of sending people to Turkey in order to beg for money; the avaibilities of living an undersea connection from the Turkey to the TRNC; should be carefully investigated.

Result :

In order to get out of the energy shortage; Planning and clever strategies are needed although the above are not sufficient. Kibtek should change its monumental, inactive and insufficient appearance at first. In order to do that; the company should be shifted to a private enterprise; immediately. In order to attract the people's attention to the matter; some seminars should be performed. The most important step that needed to perform all the above concepts; is to establish on Energy Commission.

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