



**REPUBLIC OF CYPRUS**



**MINISTRY OF COMMERCE INDUSTRY AND TOURISM**

**ANALYSIS OF CYPRUS SUCCESS IN MEETING THE  
NATIONAL INDICATIVE TARGETS  
FOR PRODUCTION OF ELECTRICITY FROM  
RENEWABLE ENERGY SOURCES**

**OCTOBER 2005**

## 1. **INTRODUCTION**

Article 3 of Directive **2001/77/EC** of the European Parliament and of the Council of 27<sup>th</sup> September, 2001 on the promotion of electricity produced from renewable energy sources (RES) in the internal electricity market requires Member States to publish a report setting national indicative targets for future consumption of electricity produced from renewable energy sources.

Member States shall publish for the first time not later than 27 October, 2003 and thereafter every two years, a report which includes an analysis of success in meeting the national indicative targets taking account, in particular, of climatic factors likely to affect the achievement of those targets and which indicate to what extent the measures taken are consistent with the national climate change commitment.

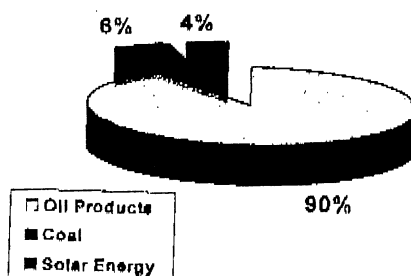
The promotion of electricity produced from RES is a high community priority as outlined in the **WHITE PAPER** on renewable energy sources with the following targets:

- Help double the share of renewable energy from 6% to 12% of gross energy consumption.
- Establish a framework to increase the share of green electricity from 14% to 22% of gross electricity consumption by 2010.
- Further compliance with the commitments made by EU Member States under the 1997 **KYOTO PROTOCOL** on reducing greenhouse gas emissions by 8% between 2008 and 2012. (For the period up to 2008 the Member States undertake to make demonstrable progress in achieving their commitments by no later than 2005.

The promotion of electricity produced from RES will be beneficial to all Member States and contribute to environmental protection and sustainable development. In addition this can also create local employment, have a positive impact on economic and social cohesion, contribute to security of supply and make it possible to reducing emissions of CO<sub>2</sub> and other pollutants (acid, toxic rain, etc) much faster.

## 2. BACKGROUND

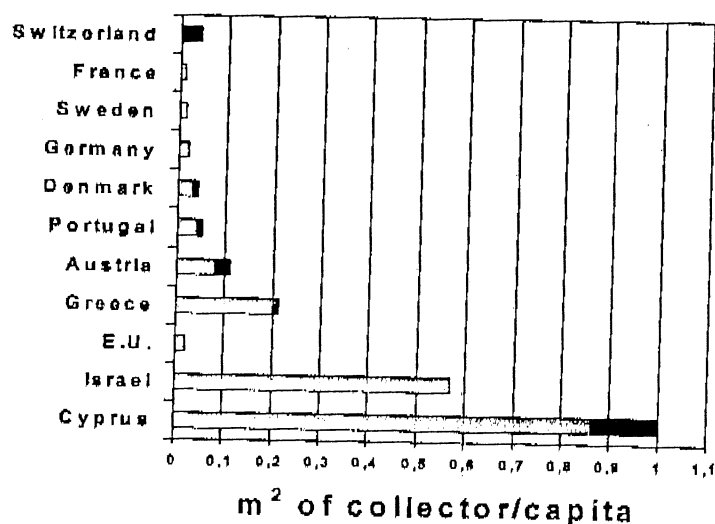
Cyprus is an island with no indigenous sources of energy; it is almost entirely dependent on imported energy. In year 2002, imports of oil products, coal and pet coke for home consumption, amounted to 470 million Euros, representing approximately 12% of the country's domestic imports. Energy is therefore, of vital importance to the island's economy.



The energy consumption is predominantly oil-based and amounts to 90% of the total energy consumption. Other forms of commercial energy used are coal and pet coke for the production of cement amounting to 6% of the total energy consumption. The remaining 4% is mainly solar energy and at the moment is the only substantial contribution of renewable energy sources.

### 2.1 SOLAR HOT WATER SYSTEMS SUCCESS STORY

Cyprus is one of the leading countries in the use and construction of solar water heating systems, 93% of households are equipped with solar water heaters and 53% of hotels have installed large solar water heating systems. **The EU Study "Sun in Action" ranks Cyprus first with 0.86 m<sup>2</sup> of installed solar collector per capita.**



Increased efficiency and cost effectiveness of solar hot water systems contributed to their wide penetration in urban, rural and isolated communities in Cyprus. Local industry is characterized by high quality of standards in the construction and know how in this field. In



Cyprus manufacturers provide their products directly to the end users. The average market price of a typical thermosyphonic system of 150 lt hot water capacity, with 3m<sup>2</sup> of solar collectors is about 1000 Euro plus 15% VAT. This price includes the installation cost and the hot and cold water storage tank.

## 2.2 **ELECTRICITY GENERATION**

Electricity power generation is currently oil-based and uses about a third of oil imports. However, the plans are for importation and utilization of liquefied Natural Gas (LNG) for electricity generation by 2008.

The Cyprus Government energy policy has the following main objectives:

- **Compliance with the relevant European Directives**
- **Securing energy supply**
- **Meeting energy demand**
- **Energy conservation and promotion of renewable energy sources.**
- **Mitigation of energy consumption impact on the environment**

## 3. **ACTION PLAN**

The Action Plan is the result of the Cyprus Government commitment towards the promotion of RES and Energy Saving. It provides the creation of a special financing mechanism to promote energy conservation and to increase the share of renewable energy sources. The Action Plan sets targets for the increase of the utilisation/contribution of the country's main renewable energy sources, to the total electricity consumption and overall to the total energy balance. It includes a financing mechanism for programmes to encourage renewable energy sources and it proposes measures to eliminate administrative obstacles. The Action Plan covers the period 2002 - 2010.

### 3.1 **EXPECTED RESULTS**

Increase the share of energy from renewable sources in the provision of total energy produced from 4% in 1995, to 9% in 2010. Increase of electricity generated from renewable energy sources, from the present zero level, to 6% by 2010.

The above stated targets are indicative and are subject to re-evaluation every two years.

Additional programs for the promotion of renewable energy sources and energy conservation may be introduced in future, so as to achieve the targets set by the Action Plan.

#### **4. LAW FOR THE PROMOTION OF RES**

To enforce the provisions of Directive 2001/77/EC of the European Parliament, Cyprus has introduced relevant legislation for the implementation and monitoring of the announced energy policy.

A new law [33(I) 2003], provides for the creation of a Special Fund whose proceeds will come from a levy of £0.0013 per KWh (approximately 0.0074 euro cent) on all electricity consumption, donations and government grants. The Fund finances programmes for the promotion of renewable energy sources and energy conservation which are approved by the Council of Ministers. It is managed by a Committee headed by the Permanent Secretary of the Ministry of Commerce, Industry and Tourism.

The Law was approved in 2003. Its implementation is monitored by the Energy Service of the Ministry of Commerce, Industry and Tourism.

The Energy Service operates its own Applied Energy Centre (AEC), which in close collaboration with the Cyprus Institute of Energy (CIE), serves as the focal point for all efforts in the field of energy conservation and renewable energy sources.

The Cyprus Institute of Energy was established in 2000 by the Minister of Commerce Industry and Tourism and its primary objectives are to promote Renewable Energy Sources utilization and energy saving/conservation. It shares the facilities with the AEC and it has the flexibility to cooperate with the private sector. Both the AEC and the CIE play a significant role during the implementation phase of the national grant scheme for the promotion of RES.

#### 4.1 **ARRANGEMENTS FOR FINANCING**

The Law provides for the financing mechanism for programs for renewable energy sources and energy conservation.

The Electricity Authority of Cyprus will be purchasing all electricity generated from renewable energy sources at the price of 3,7 Cyprus cents per KWhr.

Provision of grants and subsidies of about £42 million Cy Pounds by 2010 for the implementation of programmes for renewable energy sources and energy conservation.

#### 4.2 **REDUCING ADMINISTRATIVE OBSTACLES**

Cyprus government, with the cooperation of all competent authorities and bodies has established the legal framework and prepared the necessary infrastructure for the liberalization of the electricity market. As a result 35% of the electricity market has been opened to competition, as from the date of accession (1/5/2004), thus terminating the monopoly status that the previous law was providing to the Electricity Authority of Cyprus.

Following a decision by the Council of Ministers, the Cyprus government has created the Cyprus Energy Regulatory Authority (CERA) as an independent authority, with the aim of securing competition and for the protection of all consumers, responsible for the regulation of the electricity and gas market with exclusive rights to issue licenses for all activities relating to electricity and gas, to approve tariffs, to dissolve disputes, to protect consumers and to secure a reliable electricity system.

#### 4.3 **FACILITATING GRID CONNECTION**

Following a decision by the Council of Ministers, the Cyprus government has created the Transmission System Operator (TSO) as an independent authority, to facilitate and guaranty access to the country's transmission and distribution system, with exclusive duties to operate, synchronize and control the transmission system with objective, non discriminatory criteria, to secure the proper maintenance and development of the electricity network and to arrange for the trading of electricity on a dally basis.

## 5. **GRANT SCHEMES**

Grants and/or subsidies are provided for investments by companies, households and public sector bodies in energy conservation and in renewable energy systems such as wind, solar thermal, photovoltaic, small hydro, biomass and desalination.

### **Energy conservation**

- A1. Energy conservation in existing enterprises.  
30%. Maximum amount of grant £50,000
- A2. Thermal Insulation of Existing households  
30%, Maximum amount of grant £1,000
- A3. Co-generation.  
30% Maximum amount of grant £100,000.  
Day Rate: 1,71cent  
Night Rate: 1,50 cent [Day=07:00-23:00 Night=23:00-07:00]

### **R.E.S.**

#### Wind Energy Systems for electricity generation

- B1.1 Large commercial Systems greater than 30KW  
- For the first five years 5,40c per KWh, subsidy 5,40-3,70 =1,70c per KWh  
- For the next 10 years the subsidy will vary from 2,80c up to 5,40c per KWh, depending on equivalent hours of operation of the wind park, (average of the first five years).

- B1.2 Small systems of up to 30 KW capacity  
40% Maximum amount of grant £10,000. 3,70c/KWh No operating support is offered

#### Solar Thermal Systems

- B2.1 Installation or/and replacement of central water heating systems. 30% of eligible costs. Maximum amount of grant £10,000
- B2.2 Installation or/and replacement of space heating and cooling.  
40% of eligible costs. Maximum amount of grant £50,000
- B2.3 Domestic solar systems new and / or replacement  
20% Of investment, maximum amount £100 for forced circulation systems and £200 for thermosyphonic systems.

	B2.4 Installation and / or replacement of swimming pool water heating systems. 30% of eligible Investments, maximum amount of grant £10,000
Biomass	<p>B3 Biomass, landfill and sewage waste utilization</p> <p>For Small and Medium Size (SMS) enterprises the grant will be 30% in the form of regional aid plus de minimis aid. In any case the total amount from both forms of aid will not exceed 40% of eligible costs. 3,7 cent per KWh. The maximum amount of grant is £400.000. No operating support is offered</p>
Photovoltaic Systems	<p>B4.1 Small photovoltaic systems of 5 KW capacity, connected to the grid.</p> <p>-for households and other entities and enterprises not engaged in economic activities the grant is set to 55% of eligible costs. The maximum amount of grant £9.500</p> <p>-For enterprises the grant is 40% of eligible costs. The maximum amount of grant is £7.000. Subsidy <math>12 \text{ c/KWh} - 3,70 = 8,30 \text{ c/KWh}</math></p> <p>B4.2 Small hybrid/stand alone PV systems (not connected to the grid), of up to 5KWp capacity.</p> <p>-for households and other entities and enterprises not engaged in economic activities the grant is set to 55% of eligible costs. The maximum amount of grant £9.500</p> <p>-for enterprises the grant is 40% of eligible costs. The maximum amount of grant is £7.000</p>
Desalination using RES	<p>B5 Desalination using RES</p> <p>-For Small and Medium Size (SMS) enterprises the grant will be 30% in the form of regional aid plus de minimis aid. In any case the total amount from both forms of aid should not exceed 40% of eligible costs. The maximum amount of grant is £100.000</p>
Hydroelectric systems	<p>B6 Hydro</p> <p>-For Small and Medium Size (SMS) enterprises the grant will be 30% in the form of regional aid plus de minimis aid. In any case the total</p>

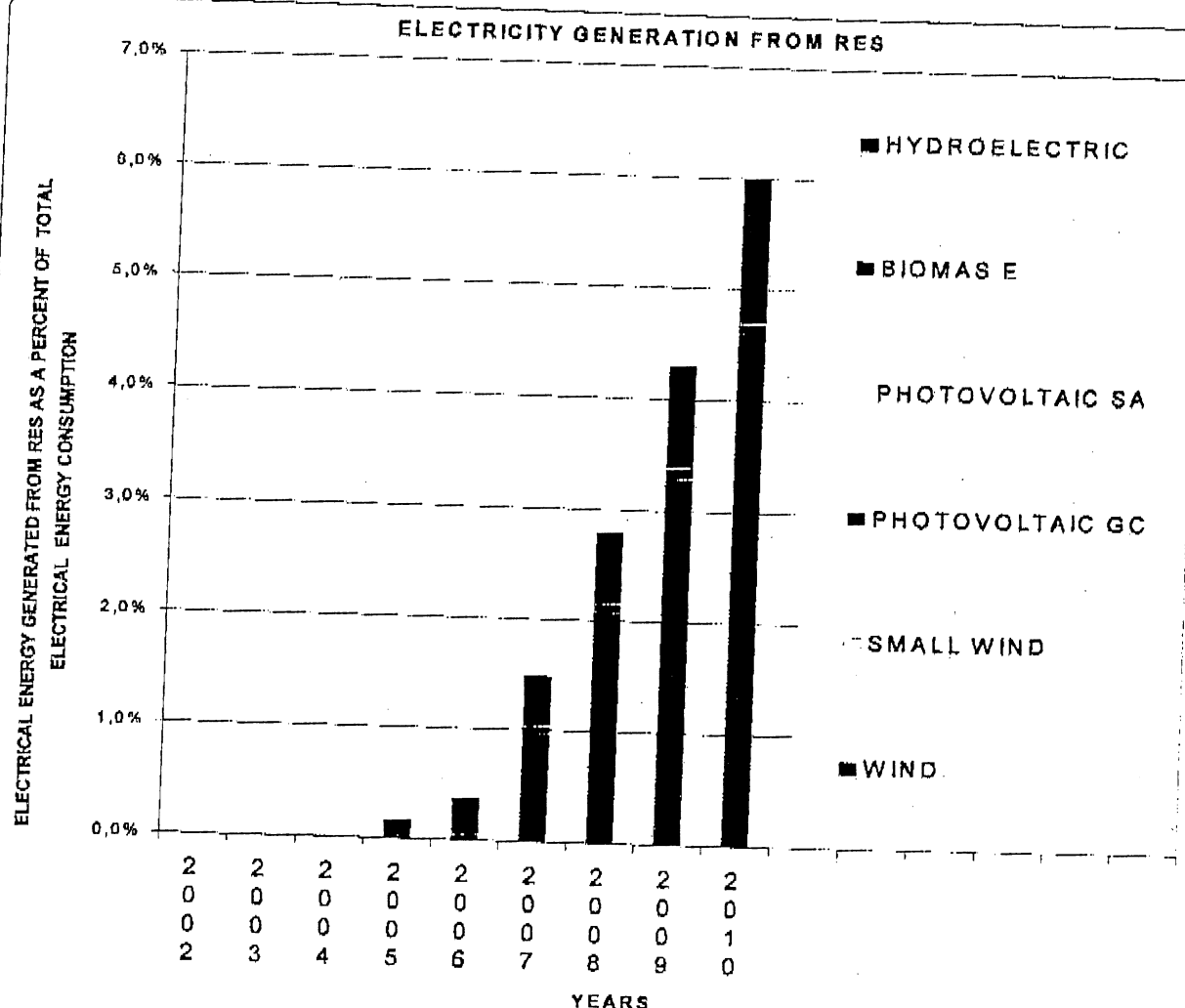


amount from both forms of aid should not exceed 40% of eligible costs. The maximum amount of grant is set to £30.000. Price for generated KWh is 3,70 cent. No running support is offered.

## 6. Expected results per category

The following energy contribution to the country's energy balance is expected by year 2010, provided that all £42 million are offered in the form of grants and/or subsidies.

Increase of the share of energy from renewable sources from 4% in 1995 to 9% of total energy consumed in 2010. Increase of electricity generated from renewable energies, from the presently zero level, to 6% by 2010.



Year	WIND	SMALL WIND	PHOTOVOLTAIC GC	PHOTOVOLTAIC SA	BIOMAS E	HYDROELECTRIC	
2002	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%
2003	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%
2004	0,000%	0,000%	0,001%	0,000%	0,000%	0,000%	0,001%
2005	0,000%	0,001%	0,031%	0,006%	0,072%	0,061%	0,171%
2006	0,000%	0,002%	0,047%	0,009%	0,172%	0,143%	0,373%
2007	0,967%	0,004%	0,062%	0,012%	0,309%	0,136%	1,488%
2008	2,069%	0,005%	0,075%	0,014%	0,604%	0,128%	2,796%
2009	3,283%	0,007%	0,086%	0,016%	0,782%	0,123%	4,297%
2010	4,588%	0,008%	0,088%	0,017%	1,179%	0,117%	5,997%

#### 6.1 Monitoring the process and time frame

The Programme is being implemented since February 2003 and shall expire the last day of 2006. The progress is monitored by the Energy Service of the Ministry of Commerce, Industry and Tourism.

The programme is a substantially improved version of a previous programme implemented in the period 1999 – 2002, covering a much wider range of sectors of economic activity and providing much more generous incentives. It is expected that a revised version of the programme will be introduced when the existing programme expires.

### 7. RES POTENTIAL

The main renewable sources for production of **electricity** in the republic of Cyprus are presented by their exploitable potential.

- 1 \*\*\*\*\* Wind
- 2 \*\*\* Biomass
- 3 \*\* Small Hydro
- 4 \* Solar

#### 7.1 Wind Potential (On shore)

In Cyprus there are some areas with mean wind velocity of 5-6 m/s and few areas with 6,5-7m/sec. The estimated maximum exploitable potential is 150-250MW considering the following restrictions.

- Sub regions dedicated to special activities are excluded.
- Sub regions of less than 5m/s are of no interest, at least for the current state of technology.
- Sub regions of very high altitudes or slope.

The wind in Cyprus is affected by the following factors:

- From anticyclones moved from west to east, from the Siberian anticyclone during the winter and from the low pressure created in the area of India and expanded until the area of Cyprus during the summer.
- Sea breezes generated in coastal areas as a result of the different heat capacities of sea and land, which give rise to different rates of heating and cooling.
- Mountain valley winds created when cool mountain air warms up in the morning and begins to rise while cool air from the valley moves to replace it. During the night the flow reverses.

## 7.2 Wind Potential (Off shore)

The prospect of installing wind turbines in the Southern coast of Cyprus (near shore applications) is currently being investigated.

Initial studies showed that due to the high depth of the sea at relatively short distance from the shore, more than 30m depth at a distance of 300m from the shore, the cost of the installation of the wind turbines is expected to be very high, to the extent that the elevated wind resource which exists at those areas will not be enough to compensate with the increase in revenue so that these kinds of projects are economically feasible.

## 7.3 Solar Potential

The Meteorological service of Cyprus has classified the Island in 14 zones from a climatic point of view. However, from the considerations, affecting the use of solar energy, the classification may be broadened to 3 zones – coastal, central plains and mountains.

The collection of sunshine duration data at a number of meteorological stations started in 1959. Statistical analysis shows that all parts of Cyprus enjoy a sunny climate. The mean daily sunshine, i.e. the time interval from sunrise to sunset, for Cyprus varies from 9.8 hours in December to 14.5 hours in June.

The mean Global Solar Radiation in MJ/m<sup>2</sup> per day and in KWh/m<sup>2</sup> per day is shown on the following table:

MEAN HOURLY GLOBAL SOLAR RADIATION ( $\text{KJ/m}^2$ ) AT ATHALASSA (ON A HORIZONTAL SURFACE)  
PERIOD : 1999-2002

PERIOD : 1999-2002													
Hour	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
TOTAL (MJ/m <sup>2</sup> )	9.7	13.3	17.3	20.8	25.1	27.5	27.1	24.2	20.5	15.6	10.9	8.1	18.3
TOTAL (KWh/m <sup>2</sup> )	2.7	3.7	4.8	5.8	7.0	7.7	7.5	6.7	5.7	4.3	3.0	2.3	5.1

#### 7.4 Biomass Potential

The theoretical potential is always estimated from data for the cultivated areas for each crop and the residue yield. Then the available potential can be evaluated with the assumption that only a portion of the theoretical potential is available for energy exploitation since there are other uses for most agricultural residues. Current biomass exploitation refers to a significant amount of agricultural residues in connection to the traditional wood stoves and the prospects of the development of energy crops, even though, further analysis and on site investigation may identify possible difficulties on harvesting of agricultural byproducts for bioelectricity production.

Biomass resources in Cyprus include a wide range of biomass residues, agricultural and forest, municipal solid waste, sewage water sludge and a considerable potential of energy crops, which include traditional herbaceous crops, or short rotation woody crops. A large energy potential exists from energy crops that can be grown on deforested or otherwise degraded lands.

- Exploitation of agricultural residues. (lignocellulosic, other vegetation, animal wastes)
- Energy crops.  
(rape seed, sugar beet, sorghum),
- Forestry wastes  
(woods maintenance, forestry exploitation),
- Exploitation of landfill gas from the following waste disposal plants.  
Lefkosia: 100,000 tn wastes/y, capacity:  $1.1\text{MW}_e$  ( $1.5\text{MW}_{th}$ ),  $7.5\text{GWh/y}$   
Lemesos: (150,000 tn wastes/y, capacity:  $1.75\text{MW}_e$  ( $2.5\text{MW}_{th}$ ),  $15.6\text{GWh/y}$   
Larnaka: (45,000 tn wastes/y, capacity:  $0.45\text{MW}_e$  ( $0.7\text{MW}_{th}$ ),  $2.7\text{GWh/y}$   
Total: 295,000 tn wastes/y, capacity:  $3.3\text{MW}_e$  ( $4.7\text{MW}_{th}$ ),  $25.8\text{GWh/y}$

**7.4 Hydro Potential**

In Cyprus the potential for small hydro plants is very limited, especially with the water shortages over the last years. The suitable sites are estimated as being adequate for a maximum of about 1MW installed capacity.

**8. RES APPLICATIONS****8.1 Wind turbines**

Wind energy has become a techno-economically viable source of energy. For the moment it is the most preferable renewable energy source and its utilization enjoys the wide social acceptance.

**Applications submitted under the grant scheme for the promotion of RES**

Category	Applications Submitted	Approved	Installed	Existing	
B1.1 Large commercial Systems	200MW	65MW	None	None	
B1.2 Small systems of up to 30 KW capacity	24KW	24KW	None	203KW	

It is expected that by the end of year 2006 a total of about 60MW of wind turbines will be installed and running. This will mean that approximately 2%-3% of the total electricity consumption during 2006 will be produced from wind energy.

**8.2 Photovoltaic**

Photovoltaics have a very large potential and are widely used for decentralized applications by populations not yet connected to the main electricity grids. Although in Cyprus there are very few areas that the national grid does not cover, it is estimated that up to 100KWp of PV/small wind hybrid systems can be installed. The major drawback of this technology is the very high cost of initial investment.

Grid connected photovoltaic applications are also on the rise, mainly due to the generous provisions of the grant scheme. With the current level of subsidies such

plants have on average an amortization period of approximately 10 years. With the currently available information it can be concluded that about 400KWp to 600KWp of photovoltaic grid connected systems are to be installed every year.

Applications submitted under the grant scheme for the promotion of RES

	Average size	Applications Submitted	Approved	Installed	Existing	Total installed capacity end of 2005
B4.1 Grid connected	≤ 3.2 KWp	550KWp	500KW	200KW	None	200KW
B4.2 Stand alone	≤ 1.2 KWp	110KWp	100KW	70KW	20KW	100KW

Despite the fact that a relatively large amount of funds will be offered for these categories of investments, the total contribution of photovoltaic generated electricity is not expected to exceed 0.1% of the total electricity consumption in year 2010.

### 8.3 Biomass

Although no applications have been submitted under the new grant scheme for investment in these fields, it is expected that by the end of year 2006 at least 480KW capacity of bio-plants will be installed and in operation.

### 8.4 Small hydro

In Cyprus the potential for small hydro-plants is very limited. The suitable sites are adequate for a maximum of 1MW installed capacity. However, taking into consideration the variability of rainfalls in Cyprus and the low hydro potential, it is clear that significant risk exists in this kind of investments.

No applications were submitted until today for this category of investment.

## 9. **PREVENTED EMISSION IN CONNECTION WITH NATIONAL CLIMATE PROTECTION COMMITMENTS**

The Kyoto Protocol tackles emissions of six greenhouse gases as follows:

- Carbon dioxide (CO<sub>2</sub>)
- Methane (CH<sub>4</sub>)
- Nitrus oxide (N<sub>2</sub>O)
- Hydro fluorocarbons (HFCs)
- Perfluorocarbors (PFCs)
- Sulphur hexafluoride (SF<sub>6</sub>)

Even though, Cyprus does not have a target under the Kyoto Protocol it is one of the country's priority because the protocol represents an Important step forward in the effort to tackle global warming as it includes binding, quantified objectives for limiting and reducing greenhouse gases.

The increased use of renewable energy prevents the release of climate relevant gases emitted when fossil sources of energy are used and is thus a crucial component of Cyprus climate protection strategy.

Other components of the Cyprus climate protection strategy with equal and perhaps greater importance than the various renewable energy sources are the following:

- Decarbonization of Electricity and Fuels
  1. Substituting natural gas for oil
  2. Storage of carbon captured in power
- Efficiency and conservation
  1. Improve fuel economy of vehicles
  2. Reduce reliance on cars
  3. More efficient buildings
  4. Improve power plant efficiency
- Natural gas
  1. Forest management
  2. Agricultural soil management

**Available data for emissions of greenhouse gases ( kt )**

Greenhouse gases	1999	2000	2001	2002	2003
CO2	6351.9	6675.1	6584.5	6790.5	7176.9
CH4	41.26	42.08	44.28	45.94	47.36
N2O	3.02	3.10	3.05	3.11	3.23

Please note that data for HFCs, PFCs and SF6s are not available.

**10. CONCLUSION**

The accession of Cyprus in the European Union entails the need to comply with European energy policy and commitments.

Today Cyprus is almost entirely dependent on imports of fossil fuels. It is therefore very important for Cyprus to utilize all the available RES potential on the Island and achieve high levels of energy savings in order to comply with the relevant European directives, secure energy supply, continue to meet energy demand, reduce the impact on the environment from energy consumption and most importantly reduce the dependence on imported energy.

At present the 6% target for RES electricity contribution by year 2010 is considered to be difficult but attainable. It is envisaged that by implementing the required legislation, reinforcing and upgrading the various Grant schemes, creating the various mechanisms that will reduce the administrative obstacles, the target will be achieved.



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