ECONOMY EFFICIENCY FOR RENEWABLE ENERGY SOURCES IN GREECE

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ABSTRACT

Energy is one of the most valuable social goods. A very important of the social economy is the search and discovering of new energy sources, the most efficient management and saving of existent energy resources, as well as environment protection. In this paper the contribution of public funding energy projects for producing electricity from RES sectors, to investment efficiency, will be examined. The Renewable Energy Sources under investigation in this paper are: Wind Energy, Solar Energy and Hydro Energy. There will be established for the numerical indeces for measuring and comparing financial efficiency of different energy investments (eg IRR – Internal rate of return and NPV – Net Present Value)

1. Introduction:

The Energy Economy Division is responsible for the development of a new organisation for the electricity markets. Its main focus is on public services and supply security, and on the creation of favourable conditions for increasing the renewable energy contribution as well as the provision of the necessary instruments.

Over the past years, the countries of the E.U. has continued its process of liberalising its energy industries. In Greece, directive 2001/77/EC *on the promotion of electricity produced from renewable energy sources in the internal electricity market* (OJ L283/27.10.2001) in its annex sets an indicative target for Greece to cover a part of its gross national electricity consumption by 2010 from renewable energy sources (RES) equal to 20,1 percent, with the contribution of large-scale hydroelectric plants included.

According to the most recent estimates, the gross consumption of electric power in 2010, amounts to 68 TWh.

Subsequently, production of electric power from RES in the order of 13,7 TWh (including large-scale hydro-electric plants) is the goal for 2010. Electricity consumption in 2005 is estimated to reach 57,8 TWh, with an installed capacity of 12.500 MW of PPC-operated plants and 1400 MW of auto-producers, conventional power and renewable energy sources generators.

The transmission lines in the interconnected system have a length that exceeds 12.000 km whereas the distribution lines exceed 200.000 km. The number of customers served in Greece is some 7 million [1].

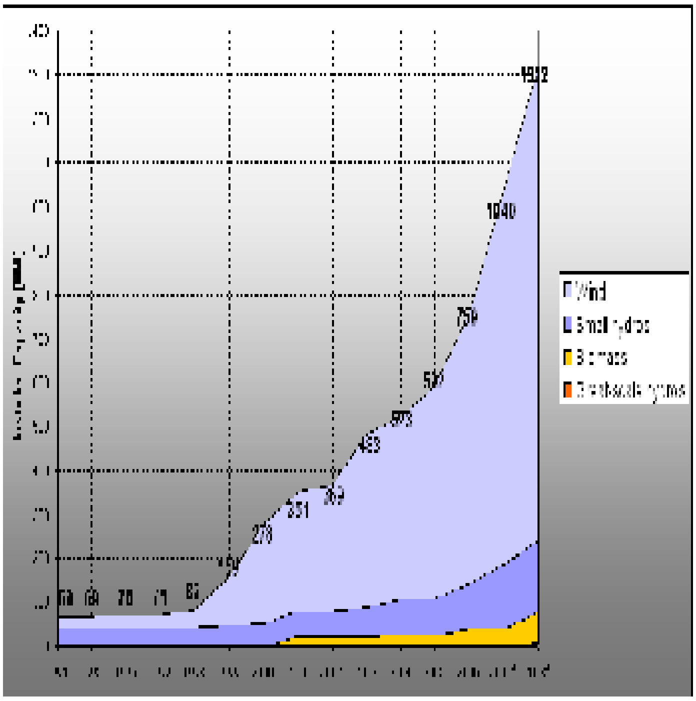


Fig. 1: Evolution ***of RES installed capacity***

According to the above, the installed RES capacity required for 2010 in order for the target to be achieved, are presented in table 1:

	Requirements in installed capacity by 2010, in MW	Energy gene-rated in 2010 in Twh	Percentage share of every renewable energy source in 2010
Wind parks	3,372	7.09	10.42
Small-scale hydro	364	1.09	1.60
Large-scale hydro	3,325	4.58	6.74
Biomass	103	0.81	1.19
Geothermal	12	0.09	0.13
Photovoltaics	18	0.02	0.03
Total	**7,193**	**13.67**	**20.10**

Table1. RES installation requirements to meet the 2010 target [1].

2. General description of under investigation RES

The Renewable Energy Sources under investigation in this paper are: Wind Energy, Solar Energy and Hydro Energy. In general, for the cost calculation of the renewable energy sources, we have two main costs:

a) **the capital costs** (as the preparation, building, integration, support investment, insurance, project management),

b) **the running costs such as variable and fixed costs** (operation, maintenance, overheads).

Generally the shape of the cash flow profile is important, because of the effect that discounting has in devaluing future costs and income.

It's also necessary to measure the value of the renewable energy being produced and the value of an alternative source of energy.

ENERGY TYPE	SALES € / KWh
WIND ENERGY	0,073
SOLAR ENERGY	0,45 (<100 Kw) or 0,4 (>100 kw)
HYDRO ENERGY	0,073

Table 2. Typical Values of R.E.S. in Greece.

Generation of electricity from:	Price of energy (Euro/MWh	
	Interconnected System	Non-intercon-nected islands
Wind energy, hydraulic energy exploited in small-scale hydroelectric plants with an installed capacity up 15 MW, Geothermal energy, biomass, gases released from sanitary landfills and biological treatment plants and biogases, miscellaneous RES, High-efficiency cogeneration of heat and electricity	75.82	87.42
Wind energy from sea wind farms	92.82	
Solar energy utilised in photovoltaic units with an installed capacity less than, or equal to 100 kW, and which will be installed in a lawfully owned or possessed property or in adjacent properties of the same owner or lawful possessor	452.82	502.82
Solar energy exploited in photovoltaic units with an installed capacity of over 100 kW	402.82	452.82
Solar energy exploited in units employing a technology other than that of photovoltaics with an installed capacity up to 5 MW	252.82	272.82
Solar energy exploited in units employing a technology other than that of photovoltaics with an installed capacity of over 5 MW	232.82	252.82

Table 2a: Renewable energy feed-in tariffs in the year 2007 [1]

In general for all the under investigation renewable energy sources in this paper, has high capital costs. On the other hand, the operating costs are low because there are no fuel costs, and operational repair and maintenance costs.

Financial results of the investment plan

Net present value (NPV) is a standard method for financial evaluation of long-term projects.

Used for capital budgeting, and widely throughout economics, it measures the excess or shortfall of cash flows, in present value (PV) terms, once financing charges are met. All projects with a positive NPV are profitable, however this does not necessarily mean that they should be undertaken since NPV does not account for opportunity cost.

Assuming a firm aims to maximise profit, projects should only be undertaken if their NPV is greater than the opportunity cost. To do this, the firm would simply recalculate the NPV equation, this time setting the NPV factor to zero, and solve for the now unknown discount rate. The rate that is produced by the solution is the project's internal rate of return (I.R.R.). The project's I.R.R. could, depending on the timing and proportions of cash flow distributions.

Thus, we can see that the usefulness of the IRR measurement lies in its ability to represent any investment opportunity's return and to compare it with other possible investments.

Both of these measurements are primarily used in capital budgeting, the process by which companies determine whether a new investment or expansion opportunity is worthwhile.

Given an investment opportunity, a firm needs to decide whether undertaking the investment will generate net economic profits or losses for the energy industry. To do this, the firm estimates the future cash flows of the project and discounts them into present value amounts using a discount rate that represents the project's cost of capital and its risk. Next, all of the investment's future positive cash flows are reduced into one present value number. Subtracting this number from the initial cash outlay required for the investment provides the net present value (NPV) of the investment. The following analysis does not take into consideration the current financial results, which are really positive regarding not only the increase of its sales but also of its profitability.

Because of this there will only be an analysis of the expected results that will arise from the materialisation of the suggested investment plan. It is outlined that this form of analysis regarding investment efficiency has minimised the risk because these results will help in the improvement of the efficiency of the suggested investment plan.

Possible scenarios are the existence of long-term borrowings with an interest rate of 5% and for a 15 year duration and in the 2nd year after the materialisation of the investment for the sales of the new investment plan (2,5% respectively for the next years until the end of the first 5 years and 1% the following years.

The following analysis takes into account the scenarios below, which show the viability of the suggested investment plan.

COST OF INVESTMENT FINANCING	TH. EURO / MW nominal power
WIND ENERGY	1000
SOLAR ENERGY	6300
HYDRO ENERGY	1200

INVESTEMENT	WIND ENERGY	SOLAR ENERGY	HYDRO ENERGY	PERCEN-TAGE
TOTAL / MW	**1.000,000**	**6.300,000**	**1.200,000**	**100%**
EQUITY CAPITAL	250,000	1.575,000	300,000	***25,00%***
SUBSIDY FROM THE STATE	550,000	3.465,000	660,000	***55,00%***
BORROWING	200,000	1.260,000	240,000	***20,00%***

ANNEX OF RESULTS OF THE SUGGESTED INVESTMENT PLAN
(amount in thousands Euros)

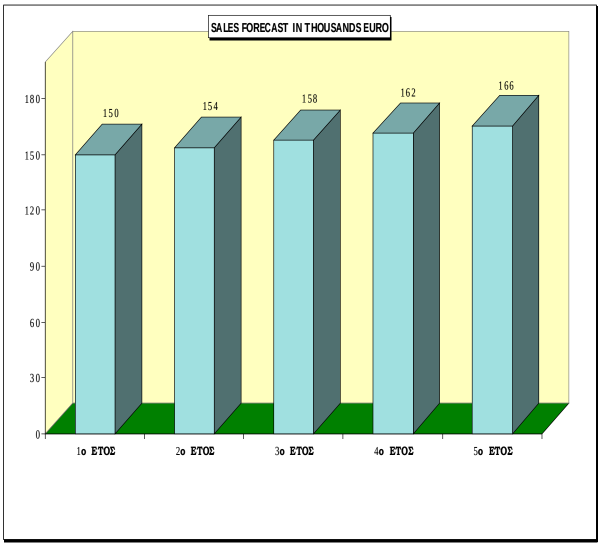
A) BASIC ECONOMY OF A WIND ENERGY PLANT (1 MW)

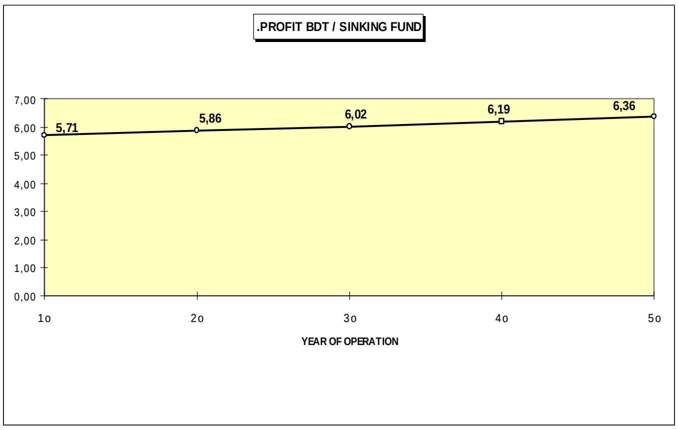
FORECASTED PROFIT & LOSS ACCOUNT (IN THOUSANTS €)

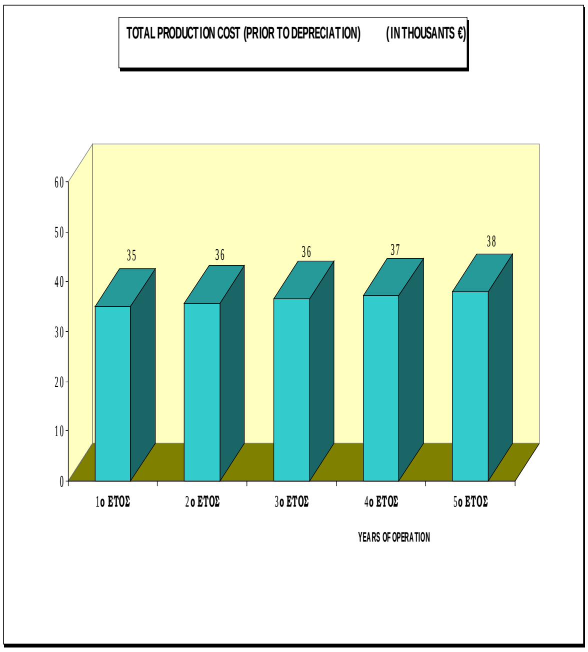
	PERIOD OF CONSTRUCTION DESIGN	1st YEAR	2nd YEAR	3rd YEAR	4th YEAR	5th YEAR
TOTAL SALES		50,000	52,750	57,594	61,594	165,677
% of Cost		23,33%	23,22%	23,11%	22,99%	22,88%
Minus: Cost of Goods sold		35,000	35,700	36,114	37,112	37,995
GROSS WORKING COST		115,000	118,050	121,180	124,341	127,687
Minus: Administration Expenses		5,000	5,050	5,101	5,152	5,203
" Operation & Disposal Expenses						
OPERATION OUTCOME (a)		110,000	113,000	115,079	119,140	122,484
Export Subsidies						
Credit Interest Rates						
Other Incomes						
TOTAL						
Minus: Exchanges						
Other Expenses						
TOTAL						
PROFIT BEFORE INTEREST , TAX& DEPRECIATION						
RATES (a+b)		110	113	116	119	122
Minus:						
-Leasing						
- Long-term Interest Rates		10	10	9	9	8
PROFIT BEFORE DEPRECIATION & TAX)		100	103	107	111	114
Depreciation (total)		50	50	50	50	50
PROFIT BEFORE TAX		50	53	57	61	64
GROSS PROFIT		76,7%	76,8%	76,9%	77,0%	77,1%
NET PROFIT		33,3%	34,8%	36,2%	37,6%	38,9%

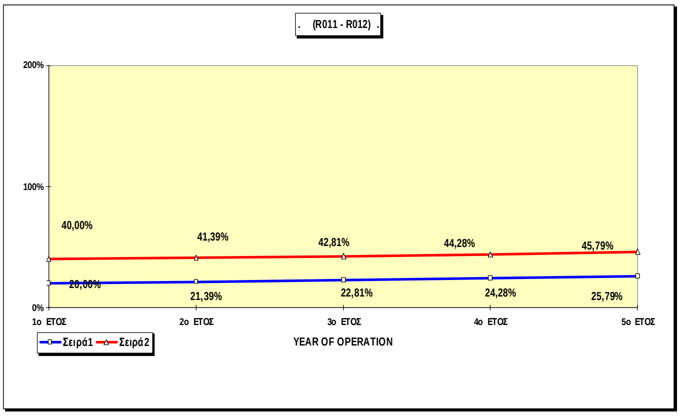
FORECASTED CAPITAL FLOWS (IN THOUSANTS €)

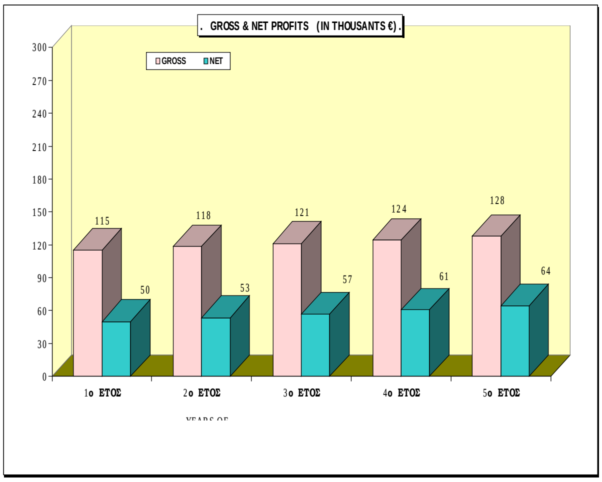
	PERIOD OF CONSTRUCTION DESIGN	1st YEAR	2nd YEAR	3rd YEAR	4th YEAR	5th YEAR
A. INFLOWS						
1. Profit before depreciation		100,000	103,463	107,029	110,701	114,481
2. Company Capital Contribution	200,000					
3. Long-term Investment Loans	200,000					
4. Suppliers Credits (fixed assets)						
5. State Assistance	600,000					
6. Sales of fixed						
7. Other Sources						
TOTAL A	1.000,000	100,000	103,463	107,029	110,701	114,481
B. OUTFLOWS						
1. Investment expenses	1.000,000					
2. Before Operation Expenses						
3. Interest Rates of Construction Period						
4. Annual Investments						
5. Debt Instalments of New Investment Loans		9.268	9,732	10.218	10,729	11,266
6. Suppliers credit service						
7. Income Tax		20.000	21,385	22.812	24,280	25,792
8. Shares		24.000	25,612	27.374	29,136	30,951
9. Other Outflows						
TOTAL B	1.000,000	53,268	56,780	60,404	64,146	68,009
WORKING CAPITAL						
VARIOUS (A-B)		46.732	46,684	46.625	46,555	46,472

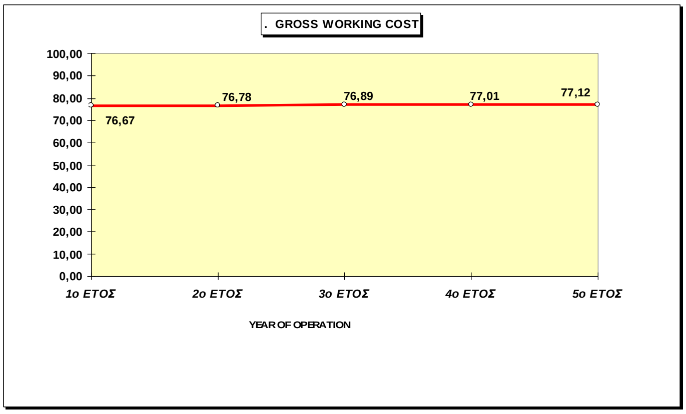

SALES FORECAST IN THOUSANDS EURO
150
154
158
162
166
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ

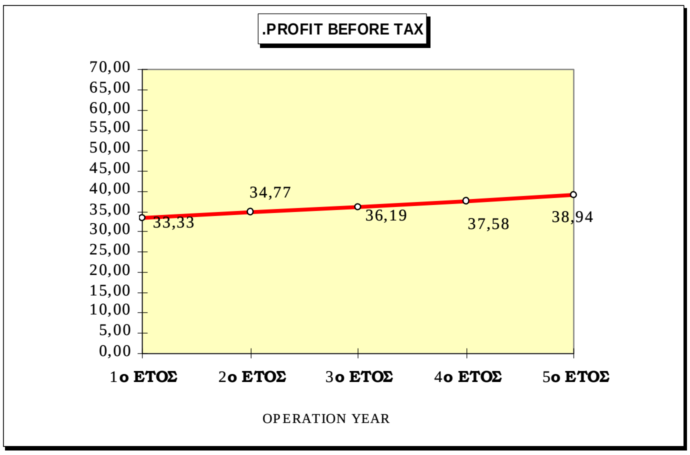

.PROFIT BDT / SINKING FUND
5,71
5,86
6,02
6,19
6,36
YEAR OF OPERATION


TOTAL PRODUCTION COST (PRIOR TO DEPRECIATION) (IN THOUSANTS €)
35
36
36
37
38
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ
YEARS OF OPERATION


(R011 - R012)
40,00%
41,39%
42,81%
44,28%
45,79%
20,00%
21,39%
22,81%
24,28%
25,79%
Σειρά1
Σειρά2
YEAR OF OPERATION


GROSS & NET PROFITS (IN THOUSANTS €)
GROSS
NET
115
50
118
53
121
57
124
61
128
64
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ


GROSS WORKING COST
76,67
76,78
76,89
77,01
77,12
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ
YEAR OF OPERATION


.PROFIT BEFORE TAX
33,33
34,77
36,19
37,58
38,94
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ
OPERATION YEAR

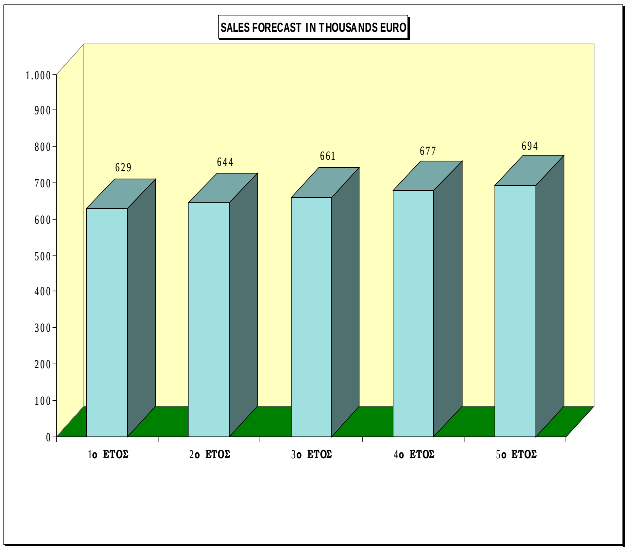
B) BASIC ECONOMY OF A SOLAR ENERGY PLANT (1 MW)

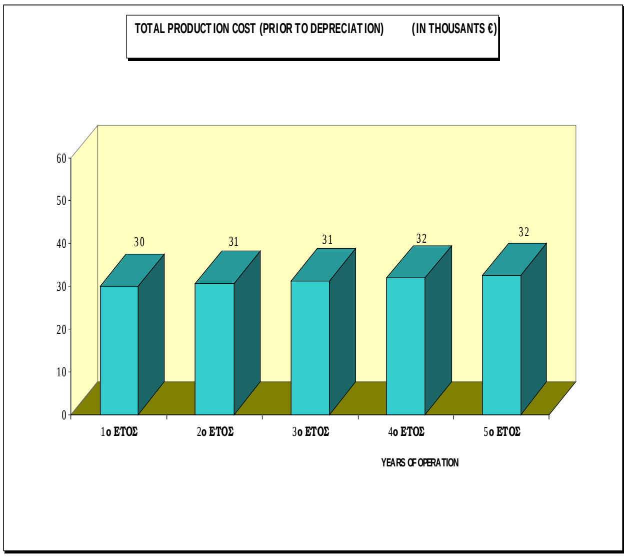
FORECASTED PROFIT & LOSS ACCOUNT (IN THOUSANTS €)

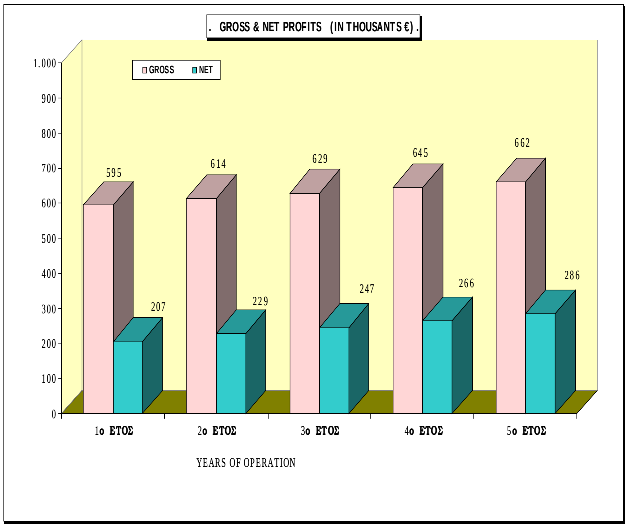
	PERIOD OF CONSTRUCTION DESIGN	1st YEAR	2nd YEAR	3rd YEAR	4th YEAR	5th YEAR
TOTAL SALES		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
% of Cost		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Minus: Cost of Goods sold		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GROSS WORKING COST		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Minus: Administration Expenses		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
" Operation & Disposal Expenses						
OPERATION OUTCOME (a)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Export Subsidies						
Credit Interest Rates						
Other Incomes						
TOTAL						
Minus: Exchanges						
Other Expenses						
TOTAL						
PROFIT BEFORE INTEREST , TAX& DEPRECIATION						
RATES (a+b)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Minus:						
-Leasing						
- Long-term Interest Rates		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PROFIT BEFORE DEPRECIATION & TAX)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Depreciation (total)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PROFIT BEFORE TAX		207	229	247	266	286
[illegible]		94,6%	95,3%	95,3%	95,3%	95,3%
NET PROFIT		32,9%	35.5%	37,4%	39.3%	41.2%

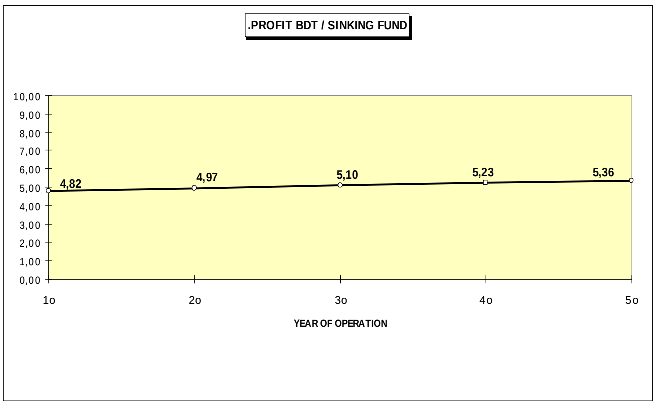
FORECASTED CAPITAL FLOWS (IN THOUSANTS €

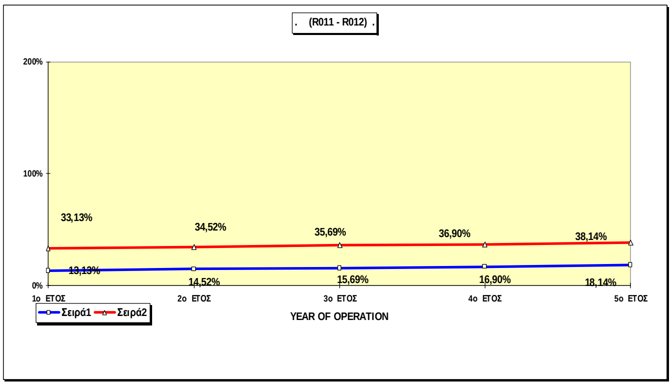
	PERIOD OF CONSTRUCTION DESIGN	1st YEAR	2nd YEAR	3rd YEAR	4th YEAR	5th YEAR
A. INFLOWS						
1. Profit before depreciation		021,740	543,673	062,142	531,148	500,716
2. Company Capital Contribution	1.575,000					
3. Long-term Investment Loans	1.260,000					
4. Suppliers Credits (fixed assets)						
5. State Assistance	3.465,000					
6. Sales of fixed						
7. Other Sources						
TOTAL A	6.300,000	021,740	543,673	062,142	531,148	500,716
B. OUTFLOWS						
1. Investment expenses	6.300,000					
2. Before Operation Expenses						
3. Interest Rates of Construction Period						
4. Annual Investments						
5. Debt Instalments of New Investment Loans		58.391	61,311	14.371	67,595	70,975
6. Suppliers credit service						
7. Income Tax		82.191	91,471	98.857	101,410	114,286
8. Shares		99.235	109,715	118.126	127,751	137,144
9. Other Outflows						
TOTAL B	6.300,000	240,322	262,048	281,861	301,806	322,400
WORKING CAPITAL VARIOUS (A-B)		261.418	281,131	280.281	279,343	278,311

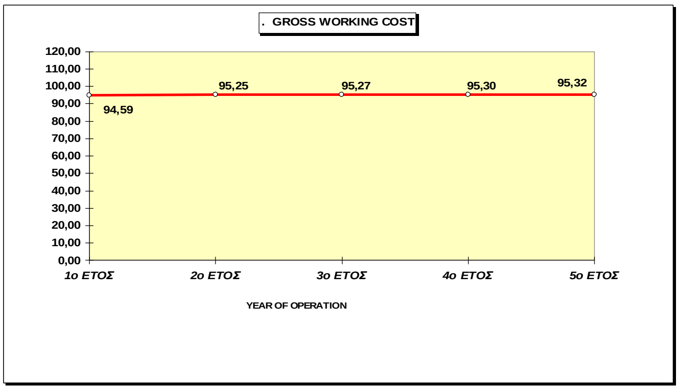

SALES FORECAST IN THOUSANDS EURO
629
644
661
677
694
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ

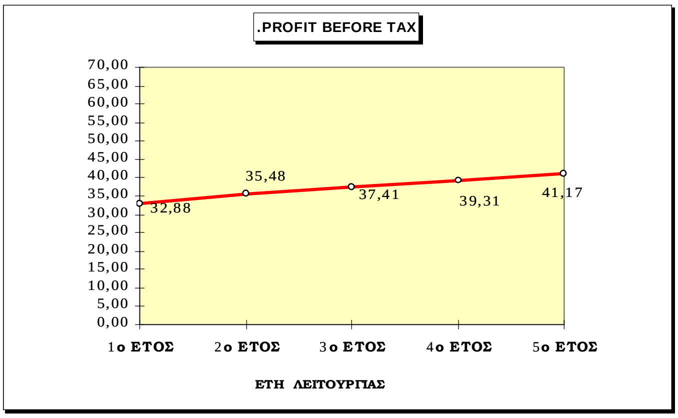

TOTAL PRODUCTION COST (PRIOR TO DEPRECIATION) (IN THOUSANTS €)
30
31
31
32
32
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ
YEARS OF OPERATION


GROSS & NET PROFITS (IN THOUSANTS €)
GROSS
NET
595
207
614
229
629
247
645
266
662
286
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ
YEARS OF OPERATION


PROFIT BDT / SINKING FUND
4,82
4,97
5,10
5,23
5,36
1o
2o
3o
4o
5o
YEAR OF OPERATION


(R011 - R012)
33,13%
34,52%
35,69%
36,90%
38,14%
13,13%
14,52%
15,69%
16,90%
18,14%
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ
Σειρά1
Σειρά2
YEAR OF OPERATION


GROSS WORKING COST
94,59
95,25
95,27
95,30
95,32
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ
YEAR OF OPERATION


PROFIT BEFORE TAX
32,88
35,48
37,41
39,31
41,17
1o ΕΤΟΣ
2o ΕΤΟΣ
3o ΕΤΟΣ
4o ΕΤΟΣ
5o ΕΤΟΣ
ΕΤΗ ΛΕΙΤΟΥΡΓΙΑΣ

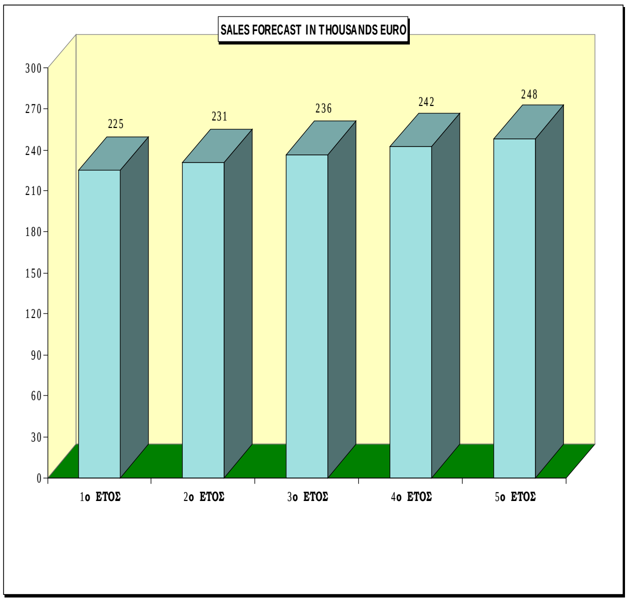
C) BASIC ECONOMY OF A HYDRO ENERGY PLANT (1 MW)

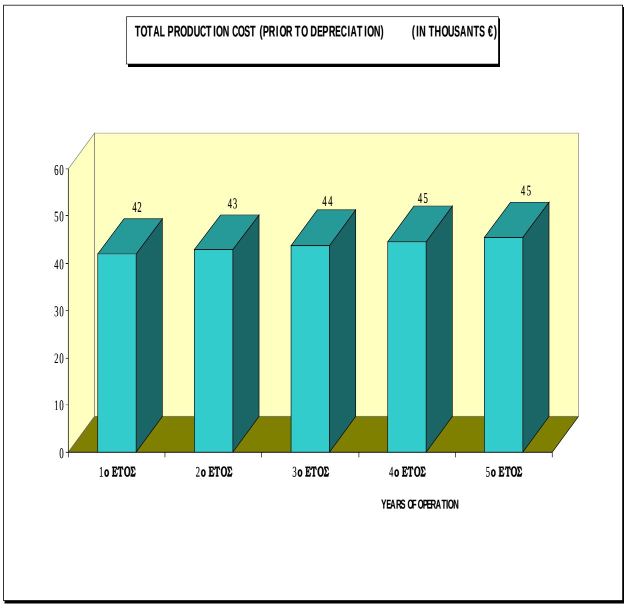
FORECASTED PROFIT & LOSS ACCOUNT (IN THOUSANTS €)

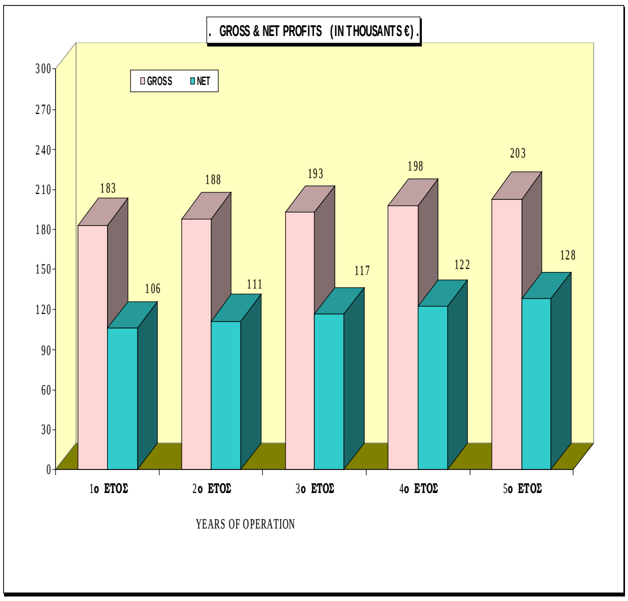
	PERIOD OF CONSTRUCTION DESIGN	1st YEAR	2nd YEAR	3rd YEAR	4th YEAR	5th YEAR
TOTAL SALES		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
% of Cost		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Minus: Cost of Goods sold		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GROSS WORKING COST		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Minus: Administration Expenses		[illegible]	[illegible]	5,101	[illegible]	[illegible]
// Operation & Disposal Expenses						
OPERATION OUTCOME (a)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Export Subsidies						
Credit Interest Rates						
Other Incomes						
TOTAL						
Minus: Exchanges						
Other Expenses						
TOTAL						
PROFIT BEFORE INTEREST , TAX& DEPRECIATION						
RATES (a+b)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Minus:						
-Leasing						
- Long-term Interest Rates		[illegible]	1	1	[illegible]	[illegible]
PROFIT BEFORE DEPRECIATION & TAX)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Depreciation (total)		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PROFIT BEFORE TAX		106	111	117	122	128
GROSS PROFIT		81,3%	81,4%	81,5%	81,6%	81,7%
NET PROFIT		47,1%	48.3%	49,4%	50.5%	51.6%

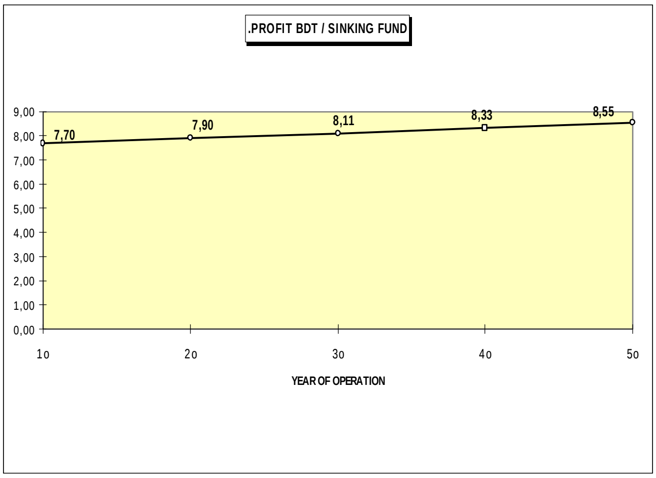
FORECASTED CAPITAL FLOWS (IN THOUSANTS €

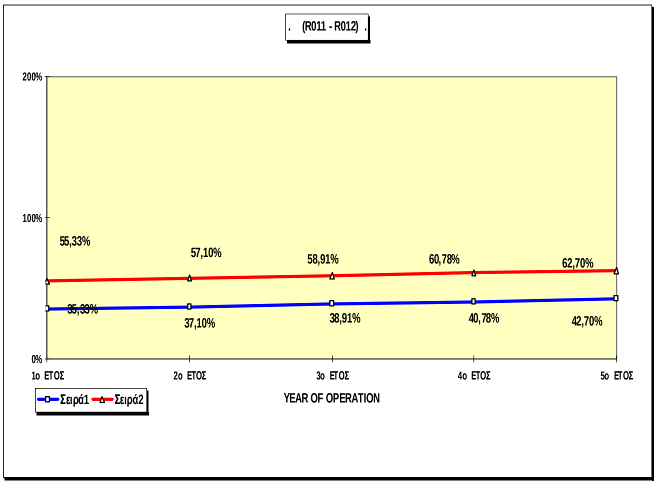
	PERIDO OF CONSTRUCTION DESIGN	1st YEAR	2nd YEAR	3rd YEAR	4th YEAR	5th YEAR
A. INFLOWS						
1. Profit before depreciation		166,000	171,291	176,733	182,331	188,090
2. Company Capital Contribution	300,000					
3. Long-term Investment Loans	240,000					
4. Suppliers Credits (fixed assets)						
5. State Assistance	660,000					
6. Sales of fixed						
7. Other Sources						
TOTAL A	1.200,000	166.000	171,291	176.733	182,331	188,090
B. OUTFLOWS						
1. Investment expenses	1.200,000					
2. Before Operation Expenses						
3. Interest Rates of Construction Period						
4. Annual Investments						
5. Debt Instalments of New Investment Loans		11,122	11,678	12,262	12,870	13,019
6. Suppliers credit service						
7. Income Tax		42,400	44,016	46,693	48,933	01,236
8. Shares		60,830	03,420	06,032	08,719	61,483
9. Other Outflows						
TOTAL B	1.200,000	104.402	109,614	114.986	120,527	128,238
WORKING CAPITAL VARIOUS (A-B)		61,598	61,677	61,746	61,804	61,862

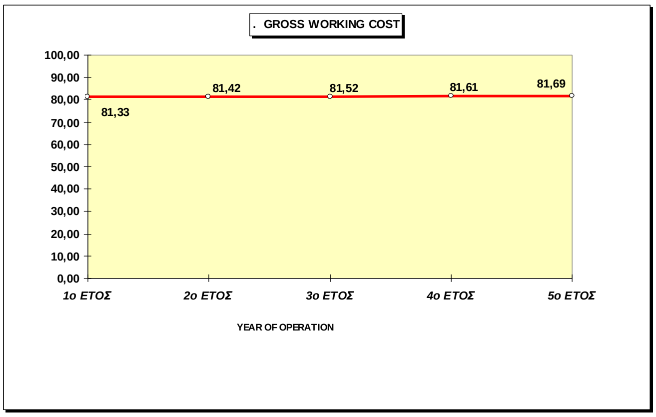

SALES FORECAST IN THOUSANDS EURO
225
231
236
242
248
1ο ΕΤΟΣ
2ο ΕΤΟΣ
3ο ΕΤΟΣ
4ο ΕΤΟΣ
5ο ΕΤΟΣ

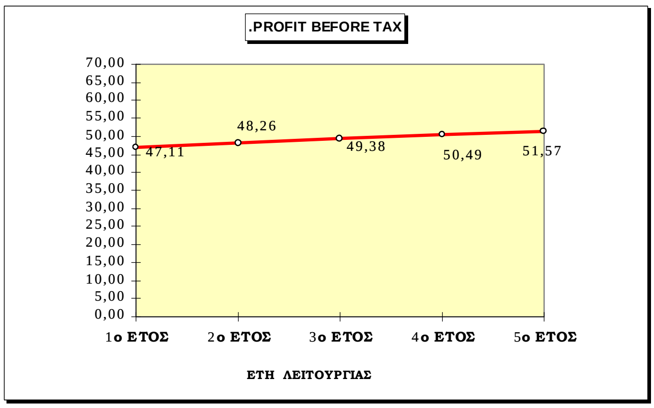

TOTAL PRODUCTION COST (PRIOR TO DEPRECIATION) (IN THOUSANTS €)
42
43
44
45
45
1ο ΕΤΟΣ
2ο ΕΤΟΣ
3ο ΕΤΟΣ
4ο ΕΤΟΣ
5ο ΕΤΟΣ
YEARS OF OPERATION


GROSS & NET PROFITS (IN THOUSANTS €)
GROSS
NET
183
106
188
111
193
117
198
122
203
128
1ο ΕΤΟΣ
2ο ΕΤΟΣ
3ο ΕΤΟΣ
4ο ΕΤΟΣ
5ο ΕΤΟΣ
YEARS OF OPERATION


PROFIT BDT / SINKING FUND
7,70
7,90
8,11
8,33
8,55
YEAR OF OPERATION


(R011 - R012)
55,33%
57,10%
58,91%
60,78%
62,70%
35,33%
37,10%
38,91%
40,78%
42,70%
1ο ΕΤΟΣ
2ο ΕΤΟΣ
3ο ΕΤΟΣ
4ο ΕΤΟΣ
5ο ΕΤΟΣ
Σειρά1
Σειρά2
YEAR OF OPERATION


GROSS WORKING COST
81,33
81,42
81,52
81,61
81,69
1ο ΕΤΟΣ
2ο ΕΤΟΣ
3ο ΕΤΟΣ
4ο ΕΤΟΣ
5ο ΕΤΟΣ
YEAR OF OPERATION


PROFIT BEFORE TAX
47,11
48,26
49,38
50,49
51,57
1ο ΕΤΟΣ
2ο ΕΤΟΣ
3ο ΕΤΟΣ
4ο ΕΤΟΣ
5ο ΕΤΟΣ
ΕΤΗ ΛΕΙΤΟΥΡΓΙΑΣ

After the economical basic analysis, we have for the more various type of renewable energy plant, the following basic results, for the Internal Rate of Return (I.R.R.) and the Net Present Value (N.P.V.):

TYPE OF ENERGY PLANT	IRR	NPV (TH. €)
WIND ENERGY	7,7%	-112
SOLAR ENERGY	5,7%	-1302
SOLAR ENERGY (when sales value was same with the wind or hydro energy)	-5,8%	-4493
HYDRO ENERGY	11,9%	+108

In the following table we can see the contribution of public funding energy projects in either saving energy or producing electricity from RES sectors, to investment efficiency, will be examined, in Greece.

	Reduction in kg/€ cost of investment financing					
	CO2	SO2	CO	NOx	HC	particles
Energy saving	11,900	0,217	0,003	0,017	0,001	0,011
gas	22,066	0,465	0,003	0,014	0,001	0,001
Hydro energy	3,060	0,056	0,001	0,004	0,000	0,003
Wind energy	2,805	0,051	0,001	0,004	0,000	0,003

Table : Environmental efficiency of energy investments in Greece [5]

4. CONCLUSIONS

PV' s project has a negative NPV (= -1302 th. E), but from a business perspective, the firm should also know what rate of return will be generated by this investment. The project's IRR could, depending on the timing and proportions of cash flow distributions, be equal to 5,7%.

WECS' s project has a negative NPV (= -112 th. E) and the project's IRR could, depending on the timing and proportions of cash flow distributions, be equal to 7,7%.

At the end, Hydro' s project has a positive NPV (= 108 th. E) and the project's IRR could, depending on the timing and proportions of cash flow distributions, be equal to 11,9%.

In general, we can see that this energy projects for which the initial capital costs are very large, and annual costs are low, will be less attractive financially than one with a more even cash flow profile.

Via these results, from the same nominal power of different type energy plant of RES, which was investigated in this study, we can take the following classification, via the comparison of I.R.R. and N.P.V. for all the above cases:

a) Hydro energy
b) Wind energy
c) Solar energy

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3. Molly k.Macauley,Jhih-Shyang Shih,Emily Aronow,David Austin,Tom Bath and Joel Darmstadter :"Measuring the Contribution to the Economy of Investments in Renewable Energy:Estimates of Future Consumer Gains,Resources for the future", 2002, http://www.rff.org.

4. J. I. Vargas, "The Technological Prospective: Prediction with a simple mathematical modeling", Economy and Energy Periodical, http://ecen.com,No 45,August-September

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