IN2RURAL

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Differences between two photovoltaic systems in irrigation

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UMANS – Urbanisme I Medi Ambient Nebot I Segarra

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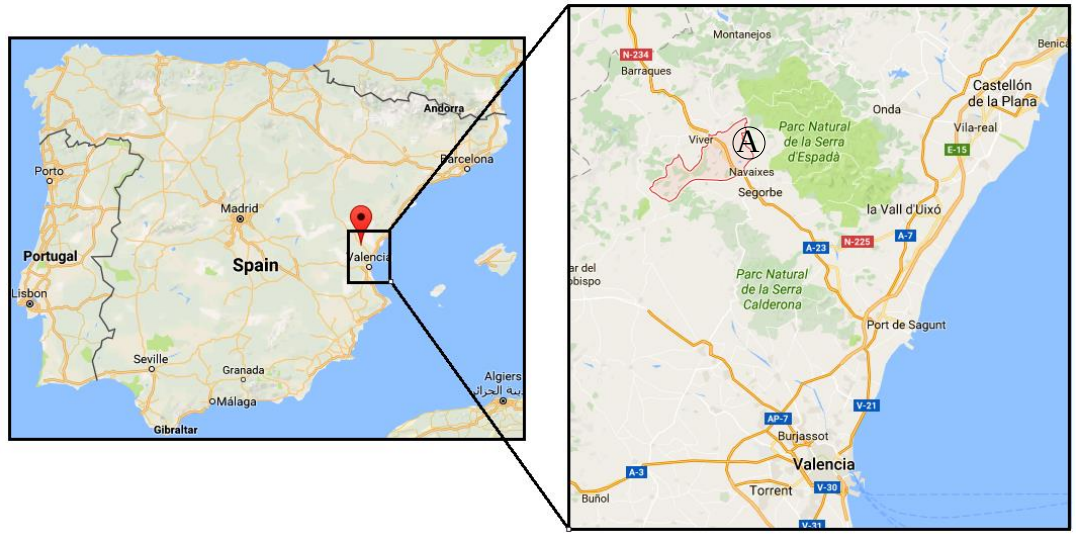
Location and Purpose



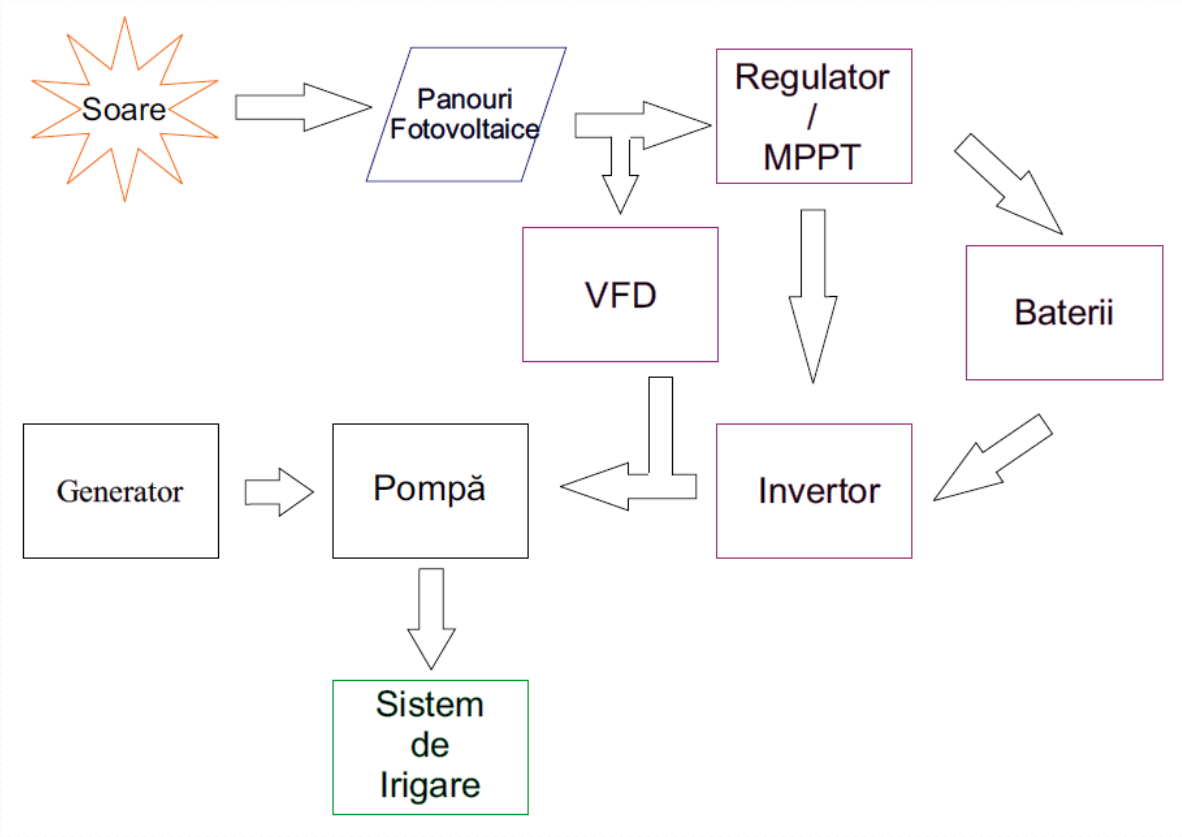
A

The project aims to develop a photovoltaic power supply system for an irrigation pump located near the town of Jérica in Castellón, Spain

Agricultural area

- 75660 m2
- 30 ha of almonds;
- 3 ha lavender;

Photovoltaic installation



The Actual System

Generator CTM-60 L, Carod

≈ 9225.66 Liters of fuel

- 8.59 l/h;
- 1.120 €/l

→ 10332.74 €/ an

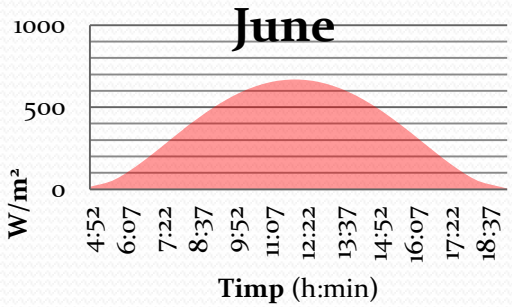
≈ 27.7 equivalent tCO_2

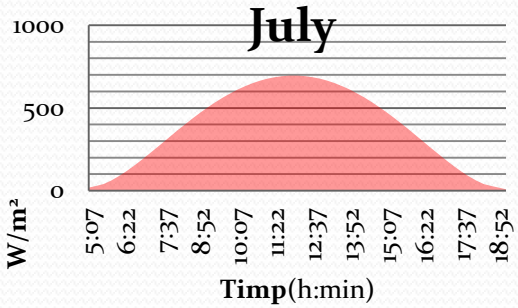
Sizing of the plantinstalaţiei

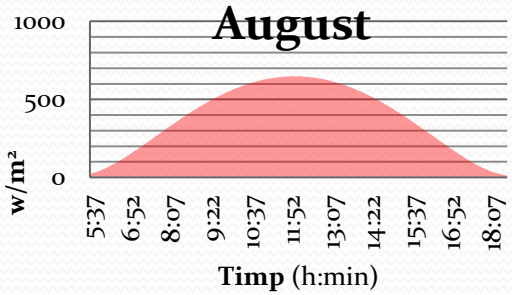
Producer		HN Bombas	
Model		GJ012-25	
kW	HP	11	15
Tension		400 V	
Frequency		50 Hz	

The need for irrigation hours

Monts	Mar.	Apr.	Mai	Iun	Iul	Aug.	Sept	Oct.	Nov.
Hour	3	4	4	5	5	5	4	3	2







First plantinstalaţie

68 Panouri Fotovoltaice *AS-6p-310*

- 4 rânduri (4 x 17 panouri)
- 21.08 kW.

Producer	Amerisolar
Model	AS-6P-310
Nominal power(P_{max})	310 W
Open circuit voltage(V_{oc})	45.5 V
Short circuit current(I_{sc})	8.85 A
Voltage at rated power(V_{mp})	36.9 V
Current at nominal power(I_{mp})	8.41 A
Efficiency (%)	15.98

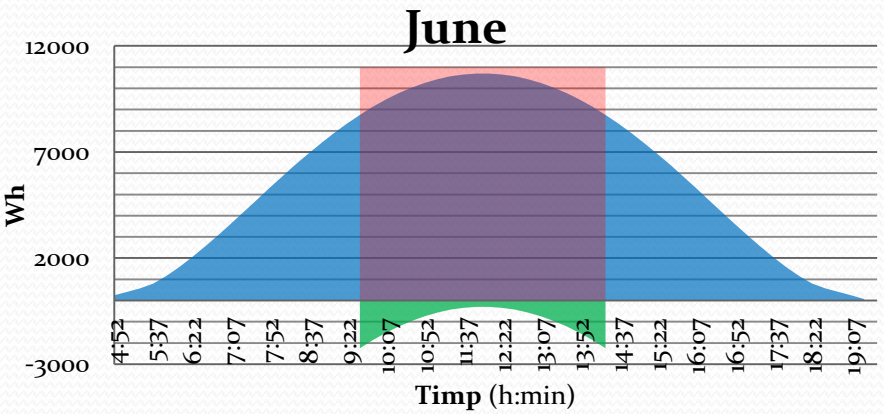
Producer	Baico
Model	Iskut Solar 425
V in (VDC)	320 - 850 V
Vin P1 nom* (VDC)	> 560 V
Max V out (VAC)	3 x 400 V
Max I out (A)	25
Weight	8.5 kg

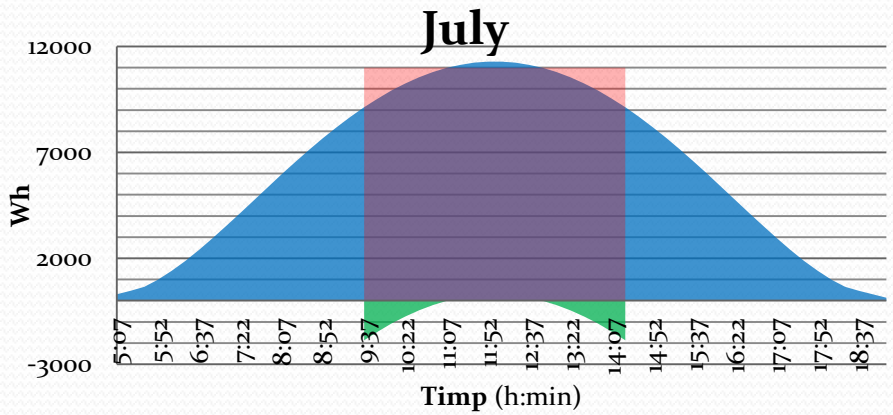
2nd installation

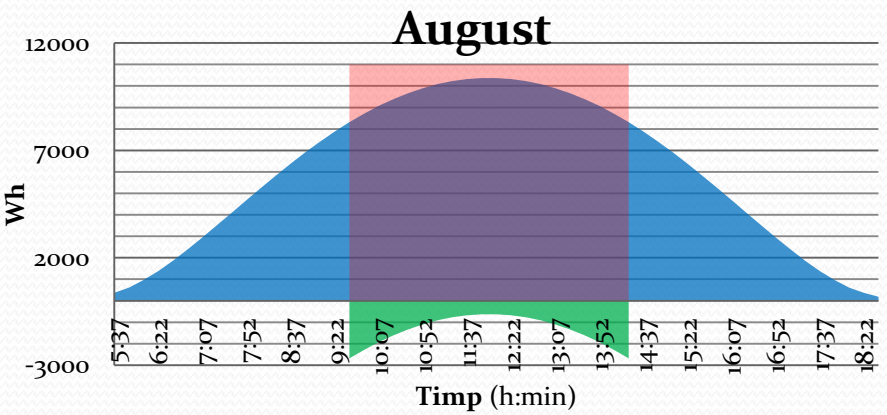
52 Photovoltaic Panels AS-6p-310

4 rows (4x 13 panels)

16.12 kW.





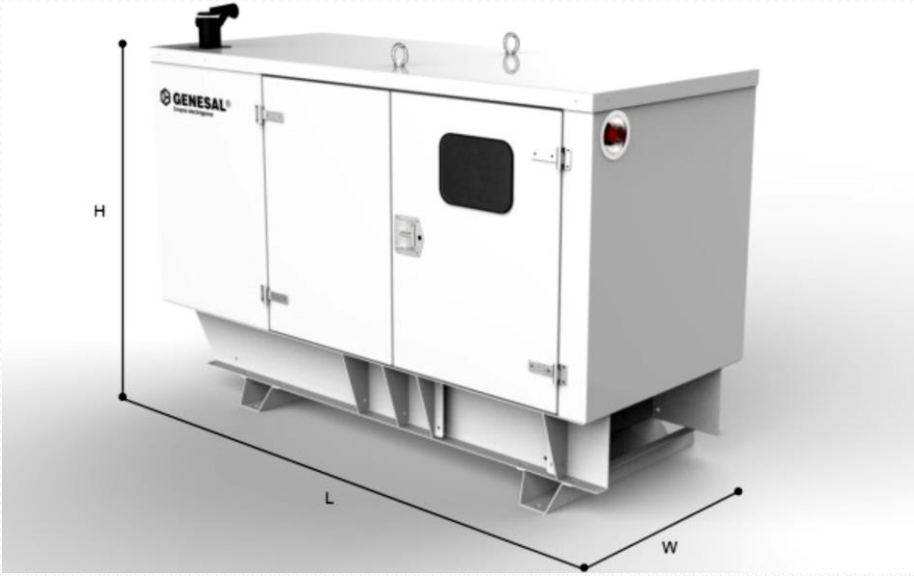


Producer	Schneider Electric
Model	XW MPPT 80 600
Battery nominal voltage	24 and 48 V
Voltage panels	195 to 550 V
Maximum voltage	600 V
Battery voltage	16 to 67 VDC
Load current	35A (28 A @STC)
Maximum charge current	80 A

- 24 Units

Producer	Tab+
Model	12 OPzS 1500
Voltage	2 V
Ah C10	1613

Producer	Schneider Electric
Model	Conext XW+ 5548 NA
Power at 25ºC	5500 W
Power at 40ºC	4500 W
Frequency at exit	50 / 60 Hz
Input voltagee intrare	42 / 60 V (48 nominal)
Maximum input current	150 A



Genesal Generator XS Power Gen22KC

- 16 kW
- 4 l/oră
- 3108 €

Investiţia. Indicatori economici

Prodct	Price per unit(€)	Total (€)
Photovoltaic panels (68)	214	14552
VFD	2210.68	2210.68
Structure	50	3400
Cables and auxiliary elements	0.264	5565.12
Personal	0.119	2508.52
Proiectare	2200	2200
Total	≈ 1.444 €/Wp	30436.32

Investiţia iniţială a sistemului de 21 kW

Product	Price per unit (€)	Total (€)
Photovoltaic panels (52)	214	11128
MPPT (4)	921.4	3685.6
Batery (24)	458.4	11001.6
Inverter (3)	2375.24	7125.7
Structure	50	2600
Monitoring panel	764.22	764.22
Cables and auxiliary elements	0.384 €/Wp	6190.08
Personal	0.158	2546.96
Design	2800	2800
Total	≈ 2.968 €/Wp	47842.16

Initial investment of the 16 kW system

	21 kW		16 kW	
	Initial cost(€)	O&M (€/year)	Initial cost(€)	O&M (€/year)
Total	**25727.8**	**385.92**	**42495.2**	**637.43**

	Energy consumptionk Wh	Current generator			
		€ / kWh	Cost combustibil	O&M	Cost total
Anual	11770	0.878	10332.74	200	10532.74
Total	**235400**	**0.878**	**206654.8**	**4000**	**210654.8**

Current generator costs in 20 years

	O&M Cost 21 kW	O&M Cost 16 kW	Fuel cost	Fuel cost	21 kW PV panels (€)		16 kW PV panels (€)	
					Total Cost GA	Total Cost GS	Total Cost GA	Total Cost GS
Annual	385.92	637.43	1123.08	784	1509	1169.92	1760.51	1421.43
Total	**7718.4**	**12748.6**	**22461.6**	**15680**	**30180**	**23398.4**	**35210.2**	**28428.6**

Costs generated by systems in 20 years

LCOE	SA	PFGA 21 kW	PFGS 21 kW	PFGA 16 kW	PFGS 16 kW
€/kWh	0.895	0.338	0.506	0.743	0.684

LCOE per sistem

Annual revenue	21 kW (€)		16 kW (€)	
	GA	GS	GA	GS
	9023.74	9362.82	8772.23	9111.31

Venit per sistem

Given the revenue generated by each system, the following amortization period results:
PFGA 21 kW - 4 years (5658.64 € profit); 150038.00 € profit after 20 years;
PFGS 21 kW - 4 years (3906.96 € profit); 153712.08 € profit after 20 years;
PFGA16 kW - 6 years (4791.22 € profit); 127602.44 € profit after 20 years;
PFGS16 kW - 6 years (3717.70 € profit). 131276.04 € profit after 20 years.

Taking into account a 5% rate for net current value,
Resulting in a different amortization period:
PFGA21 kW - 4 years (1561.42 € profit); ($ 82019.43 profit after 20 years);
PFGS21 kW - 5 years (6991.79 € profit); (83137.11 € profit after 20 years);
PFGA16 kW - 7 years (2917.24 € profit); (61479.22 € profit after 20 years);
PFGS 16 kW - 7 years (1771.28 € profit). (62596.90 € profit after 20 years).

RIR %	21 kW		16 kW	
	GA	GS	GA	GS
	28.24	26.58	17.46	17.03

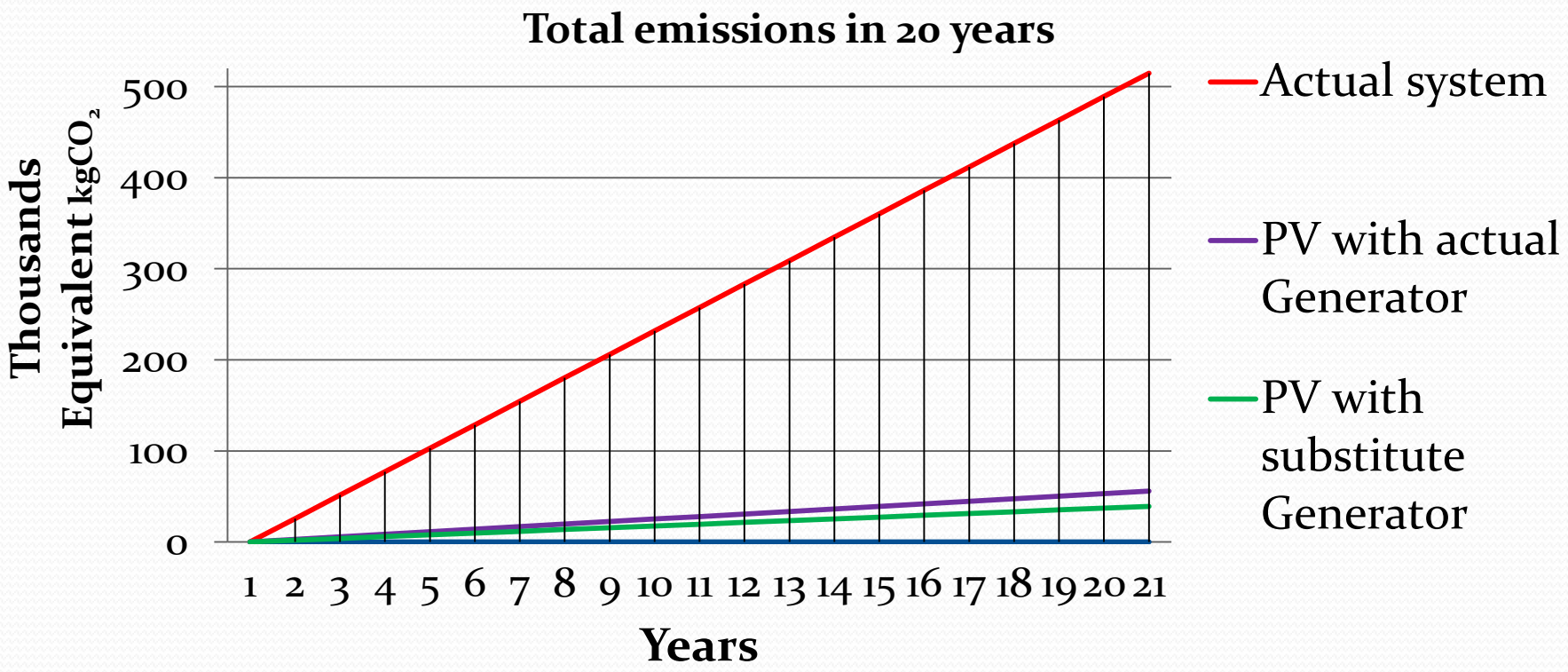
Rata interna de retur

The main economic and technological disadvantages and disadvantages in irrigation

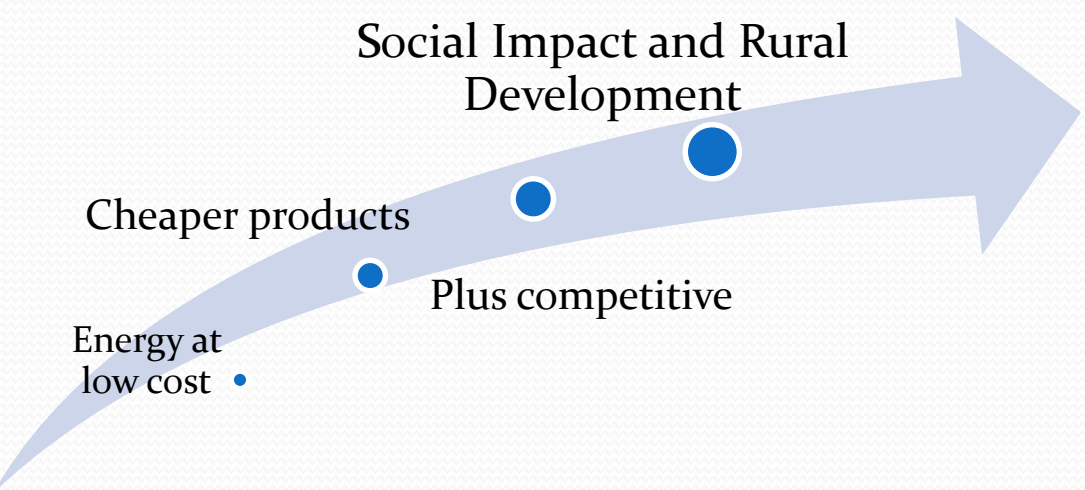
First plant		The second installation	
Benefits	Disadvantages	Benefits	Disadvantages
➢ Changing the frequency from 50 Hz to 40 Hz can extend the irrigation period. ➢ Network losses are lower due to the small number of equipment; ➢ Low initial cost as well as a small O & M cost.	➢ Can not provide energy requirements under low irradiation conditions; ➢ Large number of photovoltaic panels.	➢ Ensure energy needs at any time of day due to batteries; ➢ Low number of photovoltaic panels.	➢ High network losses due to the large number of equipment; ➢ Batteries generate an extra cost when they change (10 years); ➢ Initial cost, high O & M.

Impact on the environment

Total	Annual equivalent emissions		
	Actual Generator	PFGA	PFGS
	27739.59	**2798**	**1953**



Social Impact and Rural Development



- Marketing
- School Trips

Conclusion

It has come to the conclusion that the 21kW photovoltaic plant equipped with the frequency converter is optimal in this situation due to:

- Possibility to extend the irrigation period by changing the frequency from 50 Hz to 40 Hz;
- Initial investment is low (30436.32 €);
- Fast depreciation (4-5 years);
- Poor pollution of the generator.

Thank you for your attention

Corneliu Zediu