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MArket uptake of an innovative irrigation Solution based on LOW WATer-ENergy consumption

Large Power Photovoltaic Irrigation Systems

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Universidad Politécnica de Madrid

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No640771

IT IS WELL BORN….

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Horizon 2020

… TO BE GRATEFUL

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IT IS WELL BORN ….

caprari pumping power

OMRON

RKD

komet INNOVATIVE IRRIGATION

DOMUS ingeniería energética

SISTEMES ELECTRÒNICS PROGRÉS, S.A.

MARTIFER SOLAR

AIMCRA

elaia

eic EURO-MEDITERRANEAN IRRIGATORS COMMUNITY

POLITÉCNICA

UNIVERSIDADE DE ÉVORA

uniss UNIVERSITÀ DEGLI STUDI DI SASSARI

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ANTECEDENTS

The cost of electricity for farmers and irrigator communities

- FENACORE : increment of costs 627% - 1255%
- 40% - 50% of the total cost of the crop; in South Africa up to 20%
- 2nd consumer of electricity in Spain

Potential Market

- Southern Europe: 14 millions Ha -16GW – 24.000M€
- Northern Africa (Grid + diesel): 1,5GW – 2.250 M€

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Why we know about PV and quality?

PV pumping

RSP (EC, 1993):

- 600 PV pumps; UPM: quality control

Since 1995:

- Morocco, Algeria, Tunisia: 53 pumps
- Egypt: 5 pumps

Irrigation (MICCIN, 2012):

- Prototype in Villena

Technical quality in the framework of Project Finance – Due diligence

Projects:

- 78 PV plants multiMW – 12 countries - 302 MW

Companies:

- Acciona, Guascor, Conergy, Unión Fenosa, Fotosolar, Atersa, Nobesol, Proener, Epuron, Ateia, Element Power, Gehrlicher, Solon, Gadir, Cadmos, Dresser-Rand, Bosch, Gestamp, IM2, Scorpio, Sky Solar, Alten, Lugec, WOK, Abalados

Banks:

- Santander, BBVA, BARCLAYS, BANESTO, Pastor, Caja Navarra, Banco de Vasconia, Sabadell Atlántico, Caja Madrid, Guipuzcuano, Caja Rural de Navarra, Bancaja, Caja Murcia, KUTXA, Espírito Santo, Zaragozano, Valencia, Caja Laboral Popular, La Caixa, Caja de Galicia
- West LB, Caixa Geral, HSH Nordbank AG, KfW, Leasink, Intesa Sanpaolo, BayernLB,

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TECHNOLOGY TRANSFER

OF

PV IRRIGATION

WHAT IS TECHNOLOGY TRANSFER?

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WHAT IS TECHNOLOGY TRANSFER?

- It is know-how / It is not an eqipment or a software
- It is a relationship / It is not a single seminar
- It is Reasear + Innovation of SMEs
- It is closeness to the reality
- It is to ensure quality to be distinguished

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TECHNOLOGY TRANSFER

OF

PV IRRIGATION

WHAT IS PV IRRIGATION?

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WHAT IS PV IRRIGATION?

What is not:

- MPPT in the frequency converter
- Plug and play from the factory
- To adapt the irrigation network to the PV system
- Cosntant pressure= Oversized PV pumping system to a water pool

The poor current state of the art:

- 4 offers to an Irrigator Coomunity:
  - Size: from 90 kWp to 250 kWp
  - Price: from 1€/Wp to 2,7€/Wp

- They are not cheating; its is a new knowledge!

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WHAT IS PV IRRIGATION?

What is:

- To solve the problems associated to PV power intermittences
- To match PV generation to the water needs
- To integrate the PV system in the existing irrigation network
- To ensure the reliability for 25 years

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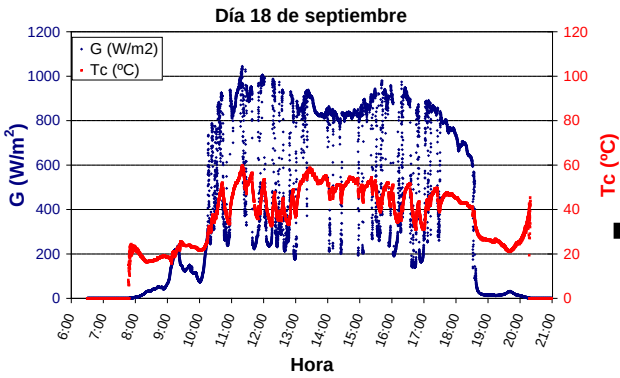
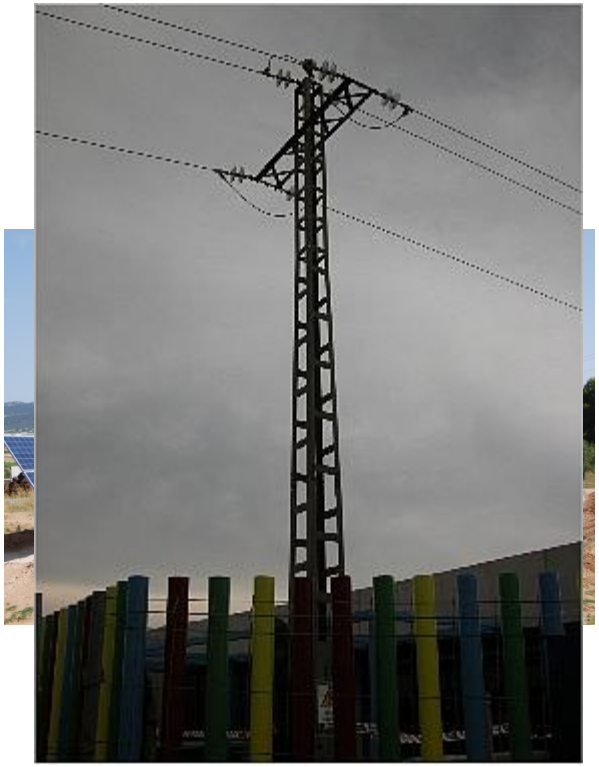
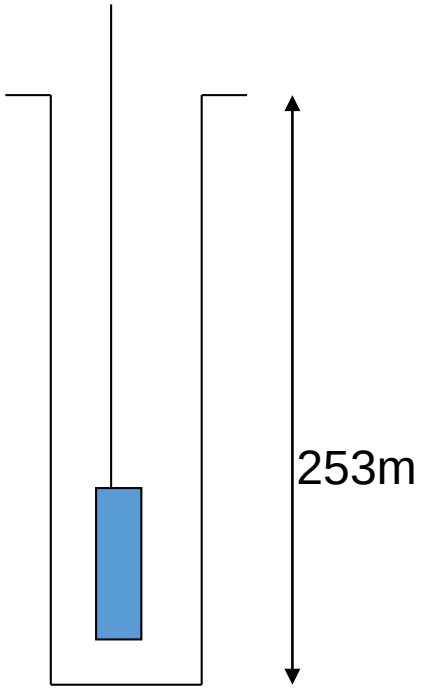
The problem of PV power intermittence:







Destabilization and abrupt stop of the frequency converter:

- Water harm: reduces the life time of the hydraulic part
- Overvoltage: reduces the life time of the frequency converter and motor-pump

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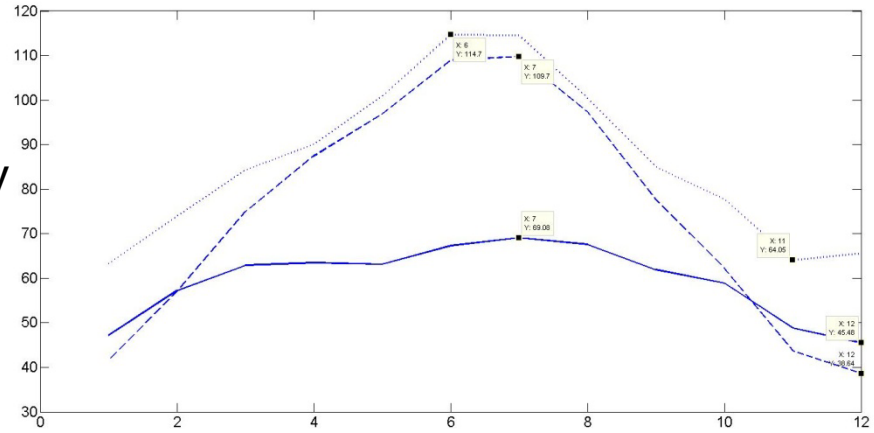
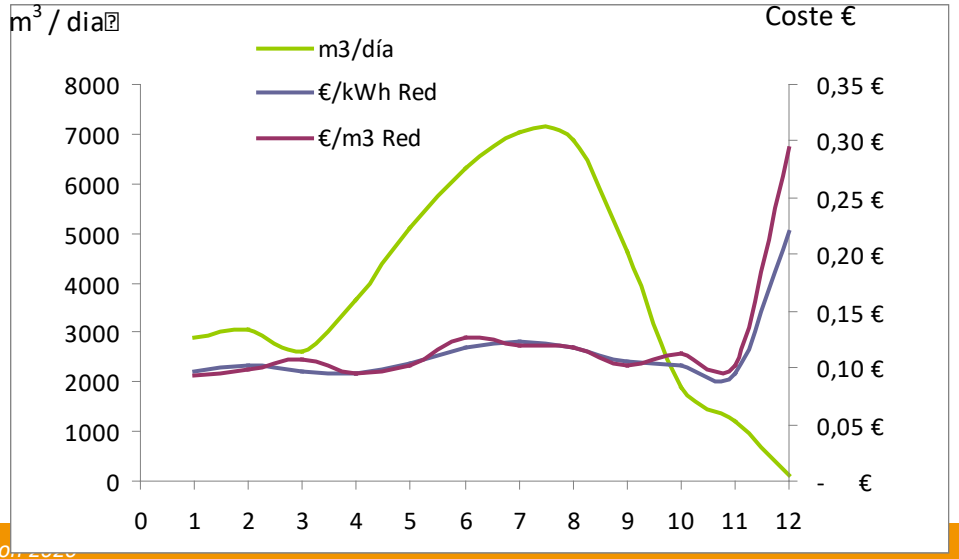
Match PV generation and irrigation needs:

North-South Tracker:

m³/day





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¿QUÉ ES RIEGO FOTOVOLTAICO?

Integrate the PV system in the existing irrigation network

Reduce the degree of novelty:

- The farmer continues doing the same
- Incentive to reduce water consumption

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Ensure reliability for 25 years

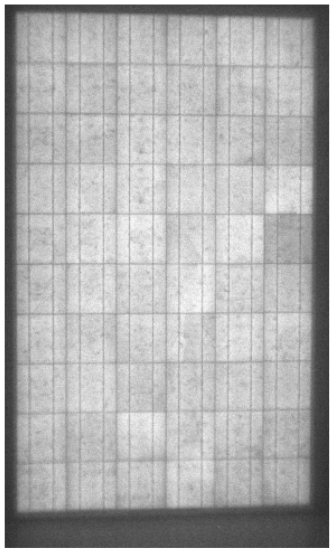
Quality systems = reliability:

- Technical specifications
- Quality control
- To be included in contracts

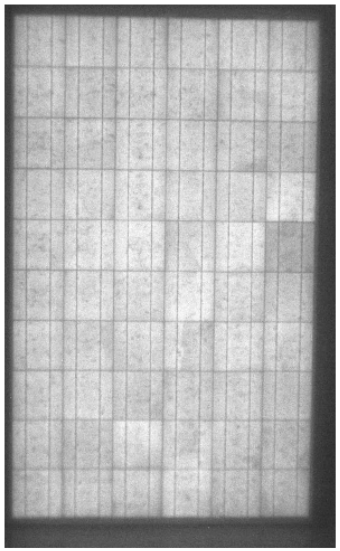
Tracker:

- Proven

Módulo N1041303028116



Electroluminiscencia inicial



Electroluminiscencia tras 7 días a -1000V

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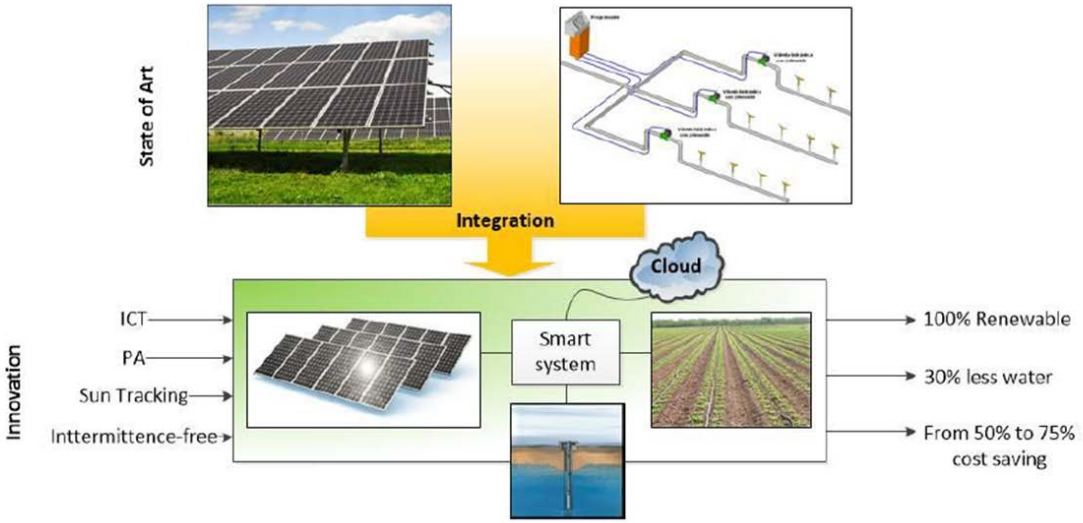
METODOLOGY:

- 5 demonstrators:
  - Alicante (Spain): 360 kWp
  - Valladolid (Spain): 160 kWp
  - Alentejo (Portugal): 140 kWp
  - Marrakech (Morocco): 120 kWp
  - Sardinia (Italy): 40 kWp
- Technical and economical validation
- Market penetration:
  - Technical visits to the demonstrators
  - Trade exhibitions
  - Accreditations and technical specifications



Technology transfer:

- Transfer to at least 20 SMEs
- At least 5GW in Southern Europe in 2020
- International seminars

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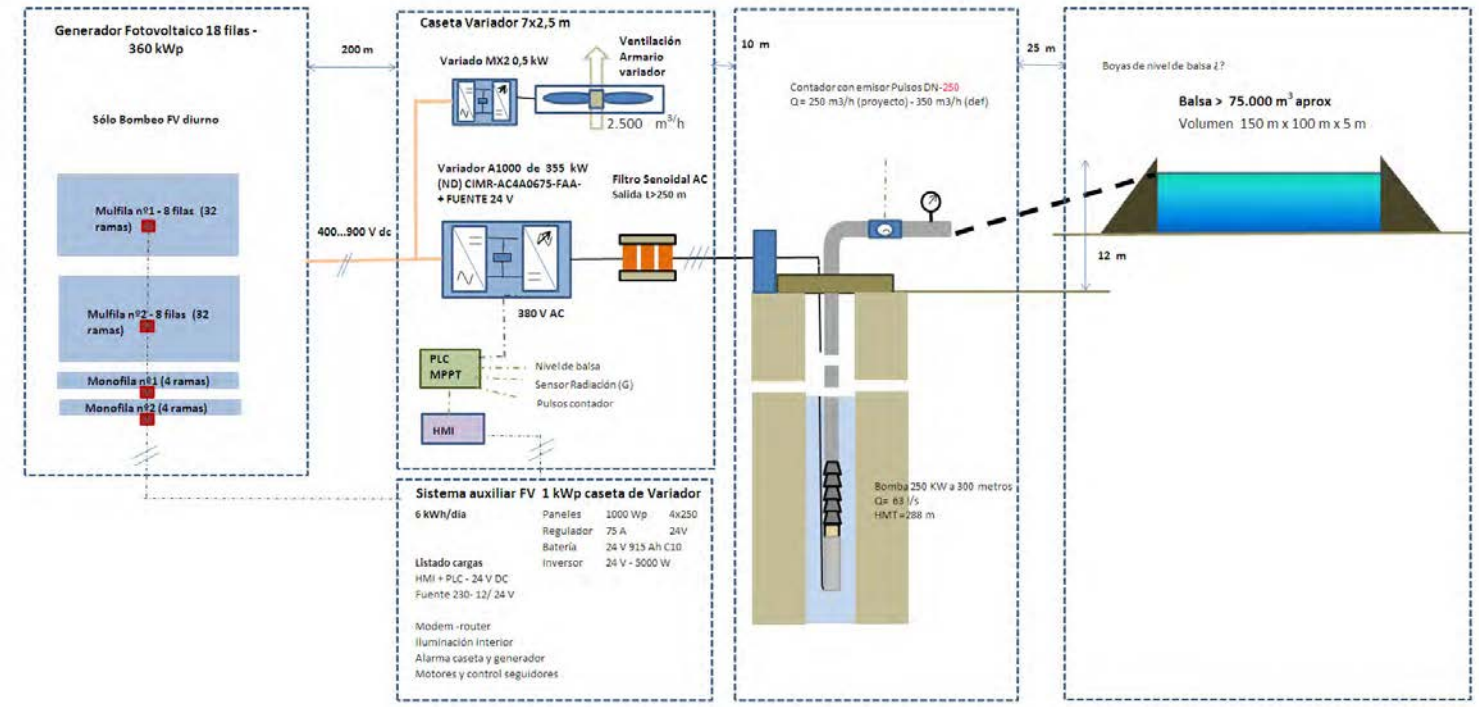
Villena (360 kWp): only PV, Pumping to a water pool

650.000 m^3/year
288 m
63 l/s



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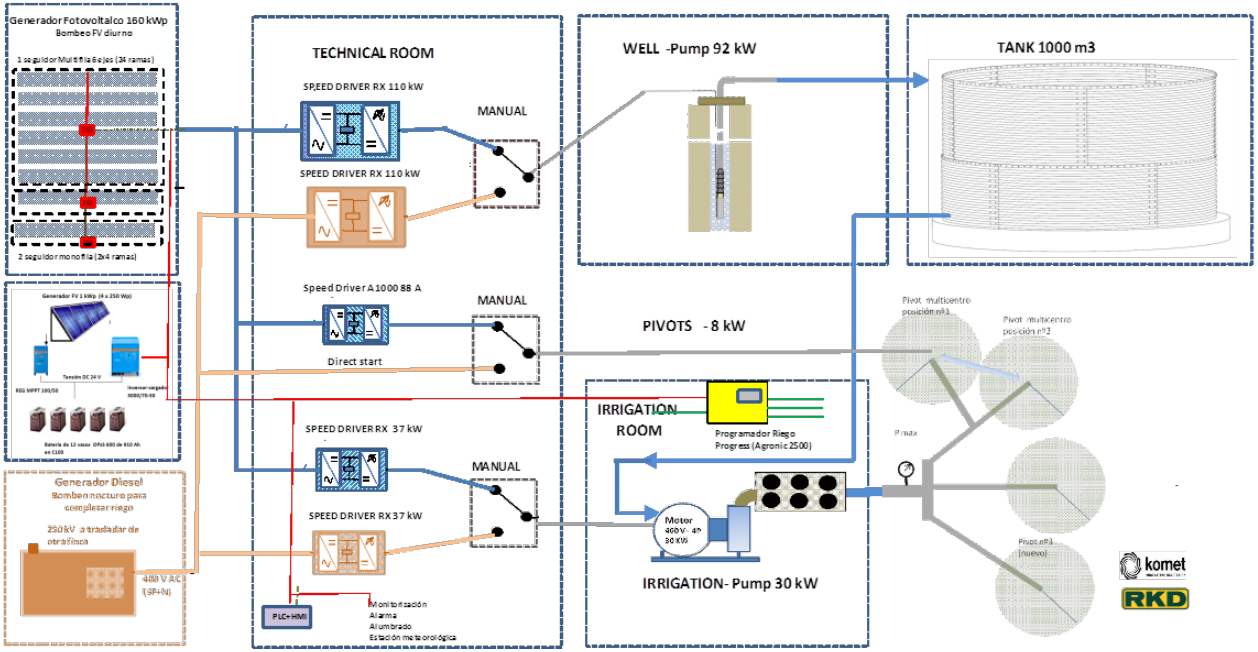
Valladolid (160 kWp): only PV, pivot with low pressure sprinklers, constant pressure



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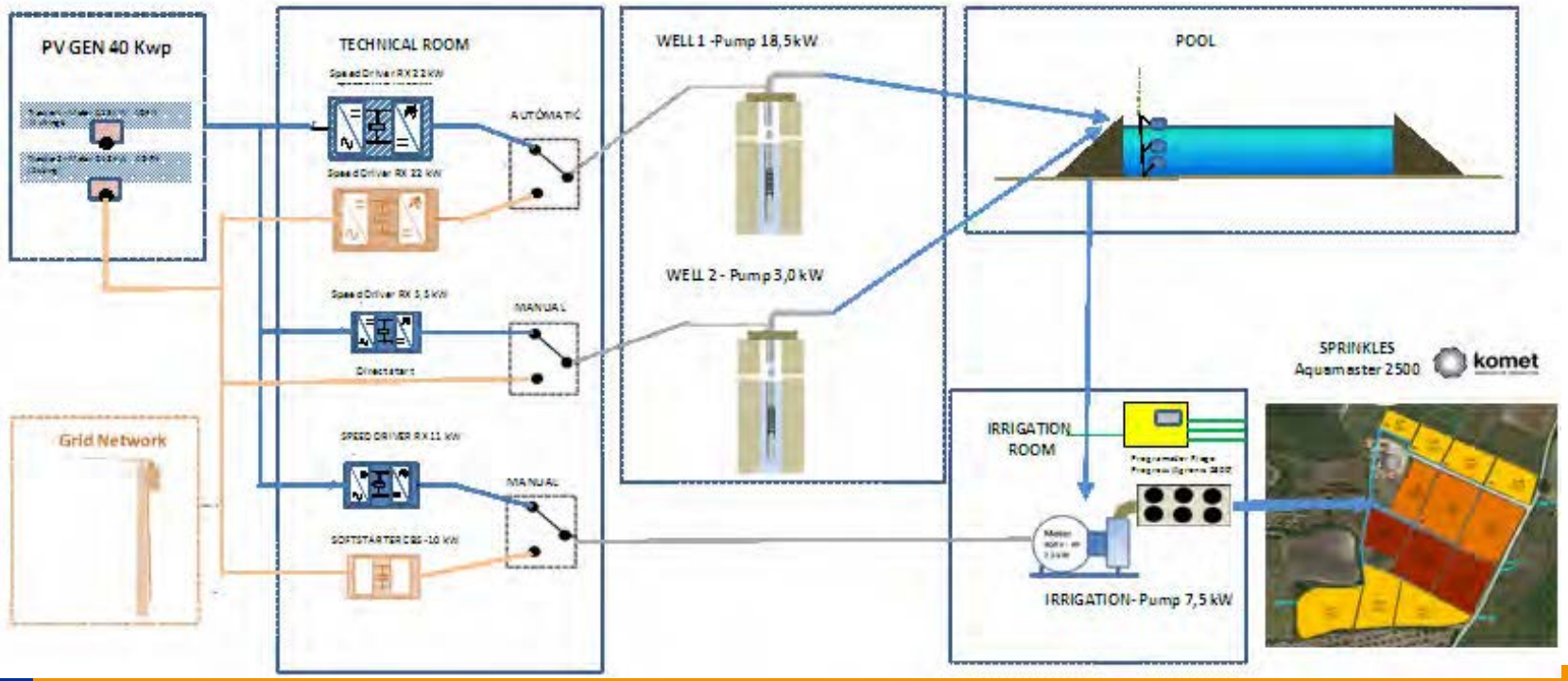
Uri (40 kWp): only PV, to a water pool and sprinklers at constant pressure



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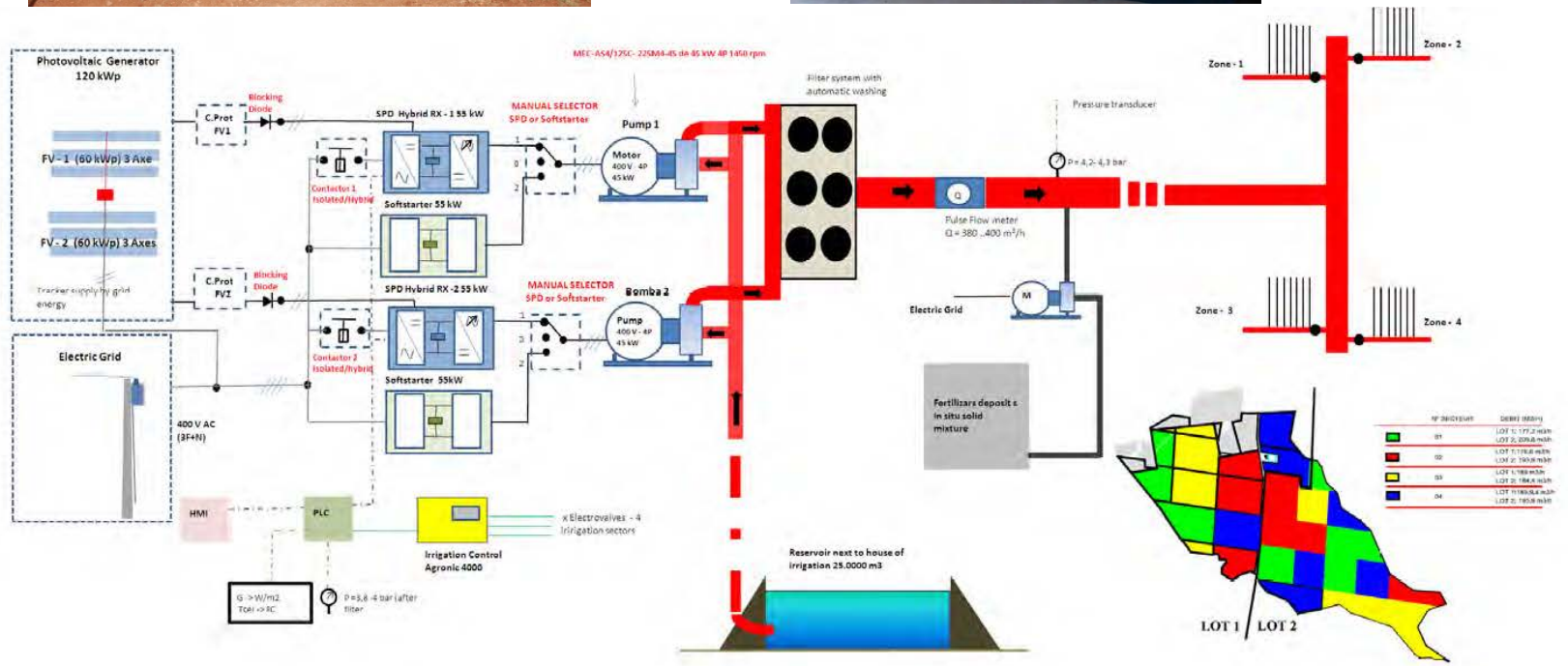
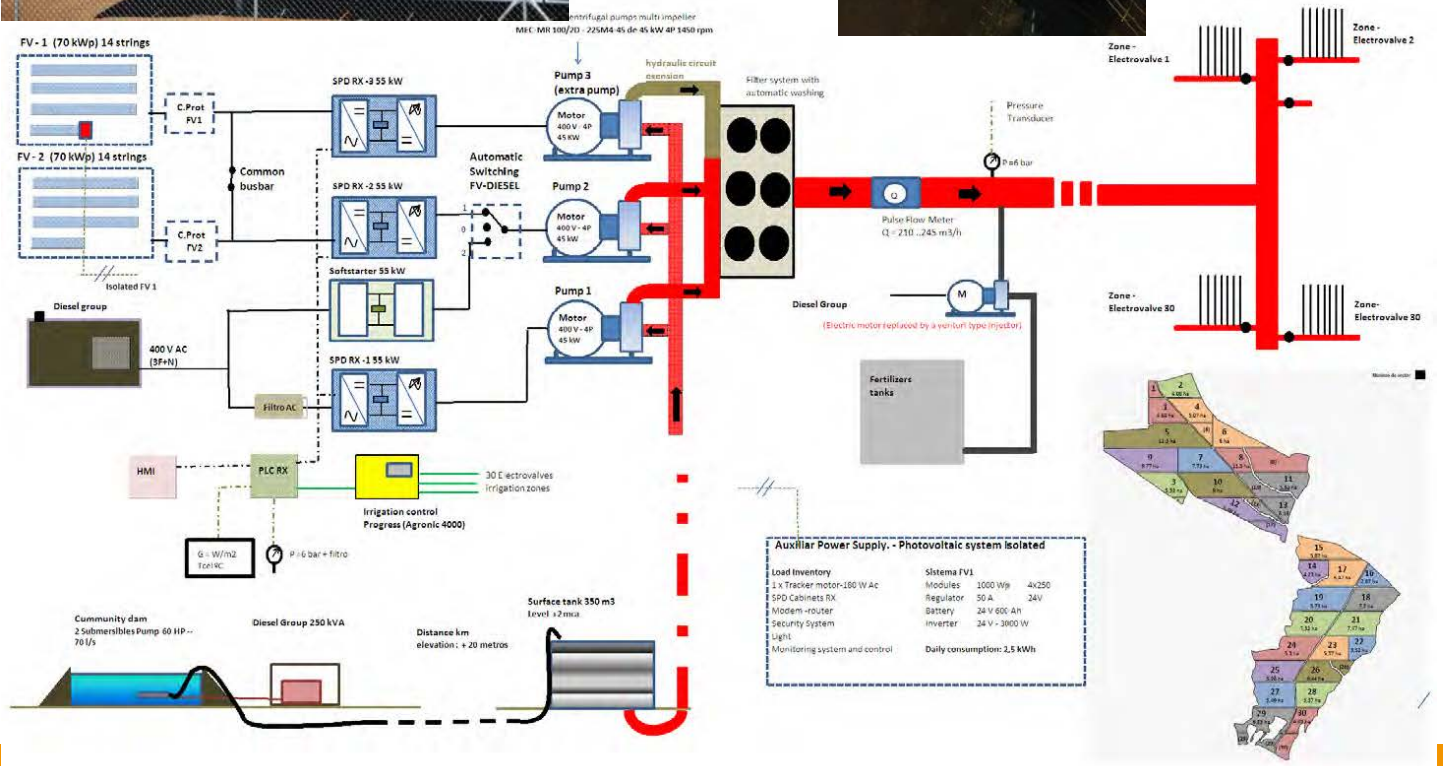
Tamalelt (120 kWp): hybrid PV-grid, drip irrigation, constant pressure



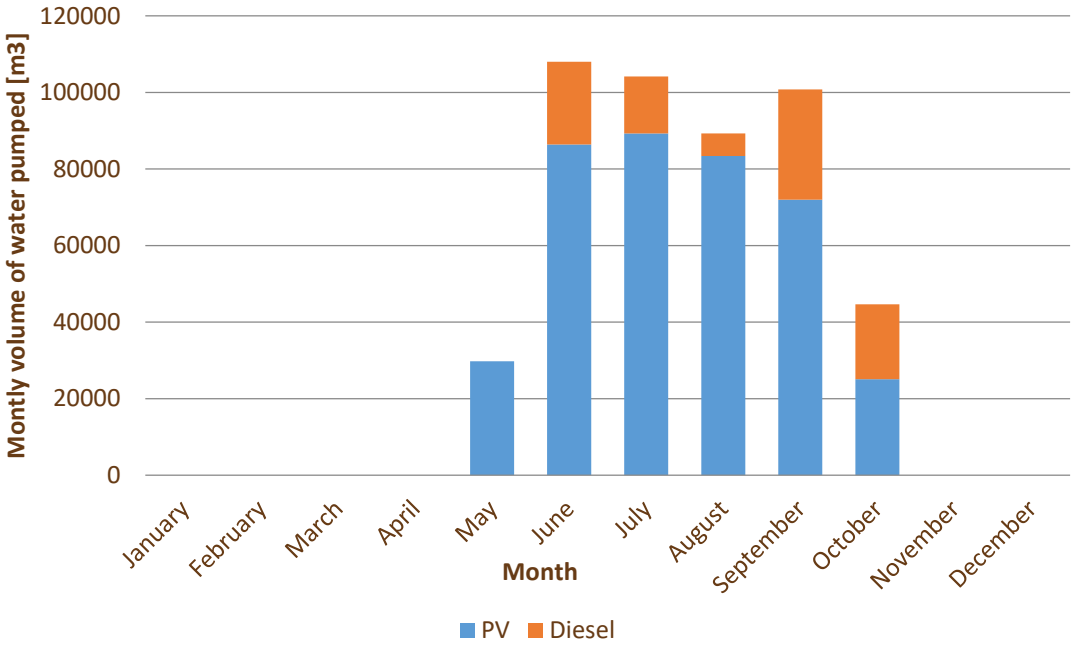
Alter do Chao (140 kWp): hybrid PV-disesel, drip irrigation, constant pressure



This pr
research and innovation programme under grant agreement No640771

Results

Technical



Portugal (2016): 476.640 m^3; 81% FV;

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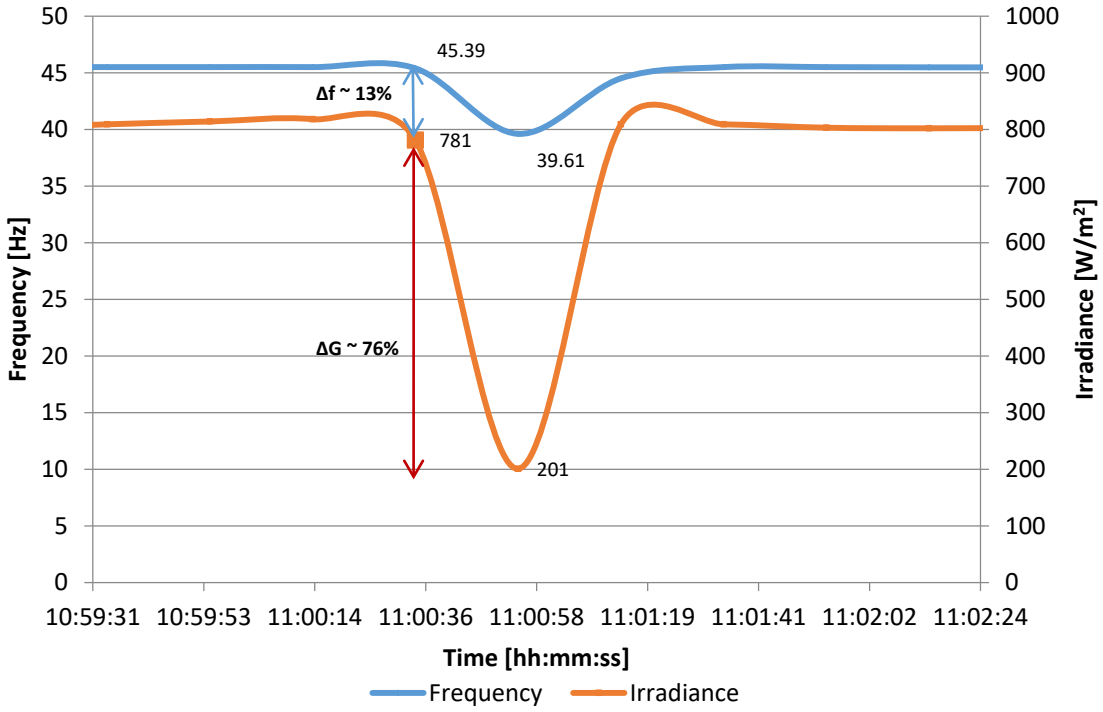
Results

Technical



Villena: 10:59:31 to 11:02:24 19 October 2017

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Results

Economic

Energy cost		Alter do Chão	Saving [%]	Villena	Saving [%]	Alaejos	Saving [%]	Cerdeña	Saving [%]	Tamellalt	Saving [%]
Previous| 25 years	€/kWh	0,33		0,21		0,23		0,54		0,21 €	
PV| 25 years	€/kWh	0,13	*-61%*	0,04	*-79%*	0,08	*-64%*	0,18	*-66%*	0,07 €	*-68%*

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Results

Economic

Financial Indicators		Alter do Chão [%]	Villena [%]	Alaejos [%]	Sardinia [%]	Tamellalt [%]
Annual ELECTRICITY / DIESEL consumption | before PV system	kWh or L	41.246	598.147	58.671	30.033	273.102
Annual ELECTRICITY / DIESEL consumption | after PV system	kWh or L	7.866	0	9.423	0	42.765
dif	kWh or L	**33.380** -81%	**598.147** -100%	**49.248** -84%	**30.033** -100%	**230.337** -84%
ELECTRICITY / DIESEL cost	€/kWh or €/L	**0,580 €**	**0,105 €**	**0,460 €**	**0,270 €**	**0,104 €**
Average annual inflation rate [25 years][1]	%	4,5%	4,4%	4,4%	4,4%	4,8%
Annual Saving						
Average Annual Saving [2017 - 2041] [2]	€	30.924	100.850	35.466	11.633	40.345
Financial Indicators						
Payback Period	years	**9**	**7**	**9**	**8**	**7**
NPV	€	**355.119**	**1.337.243**	**420.826**	**142.068**	**452.594**
IRR	%	**11%**	**16%**	**11%**	**13%**	**16%**
CAPEX	€	**170.277**	**433.098**	**200.351**	**57.778**	**148.704**
WACC	%	**3%**	**3%**	**3%**	**3%**	**4%**

[1] *the average annual inflation rate includes the estimated inflation rate [source: http://www.inflation.eu/] + an additional spread of 2%*

[2] *31% is the higher ICT rate in Morocco with the exception of the ICT rate applicable to leasing companies and credit institutions [37%]*

Source: Consortium Information - November 2017

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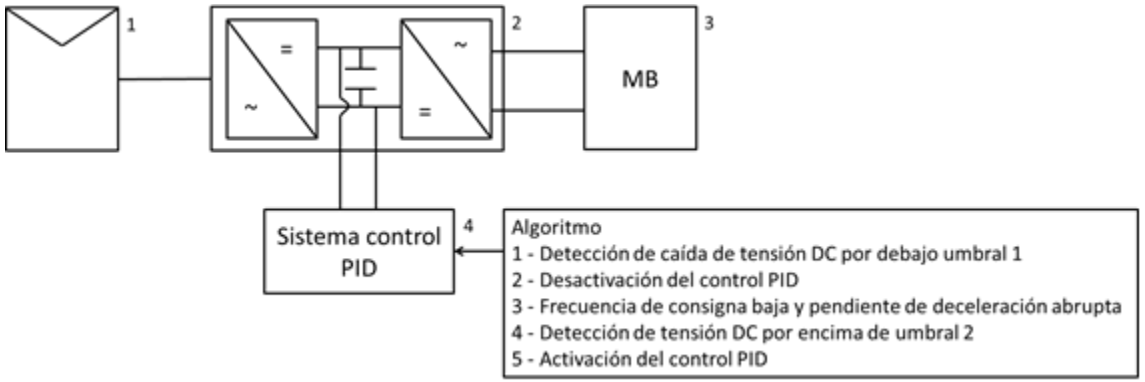
THREE PATENTS

Procedure and control device for PV pumping systems



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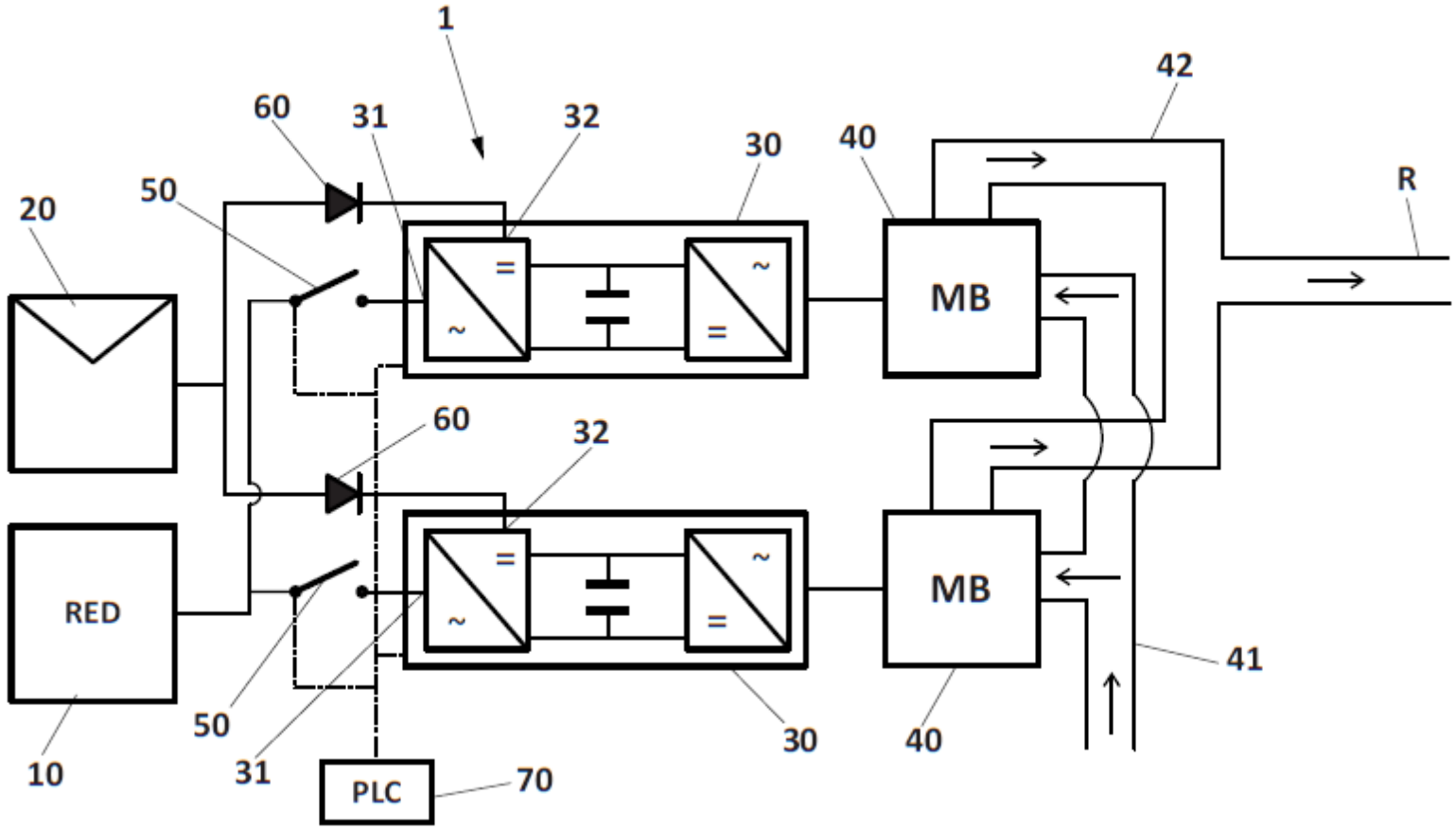
THREE PATENTS

Electrically hybridized PV pumping irrigation systems



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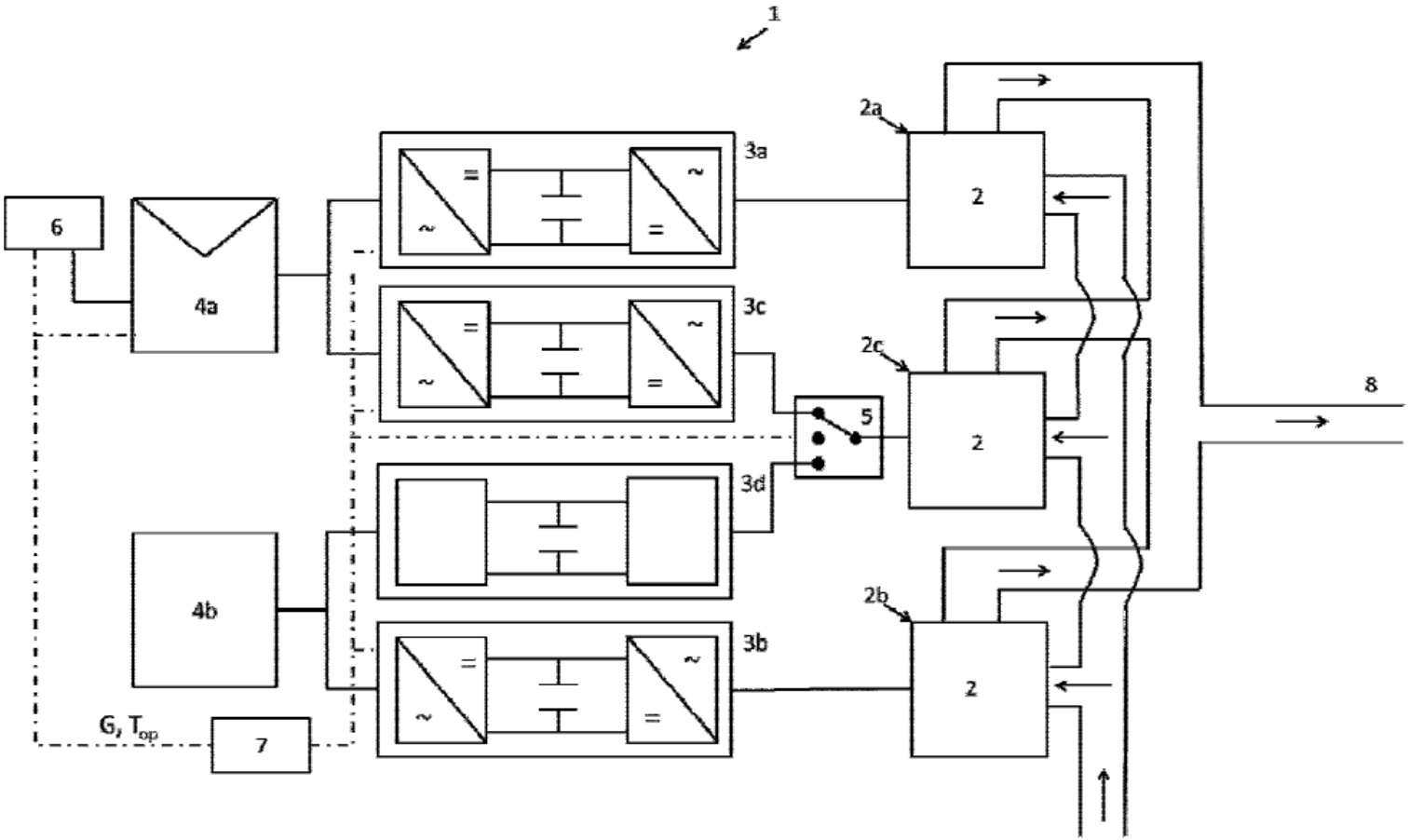
THREE PATENTS

Hydraulically hybridized PV pumping irrigation systems



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