

DHW production with a PV supported heat pump

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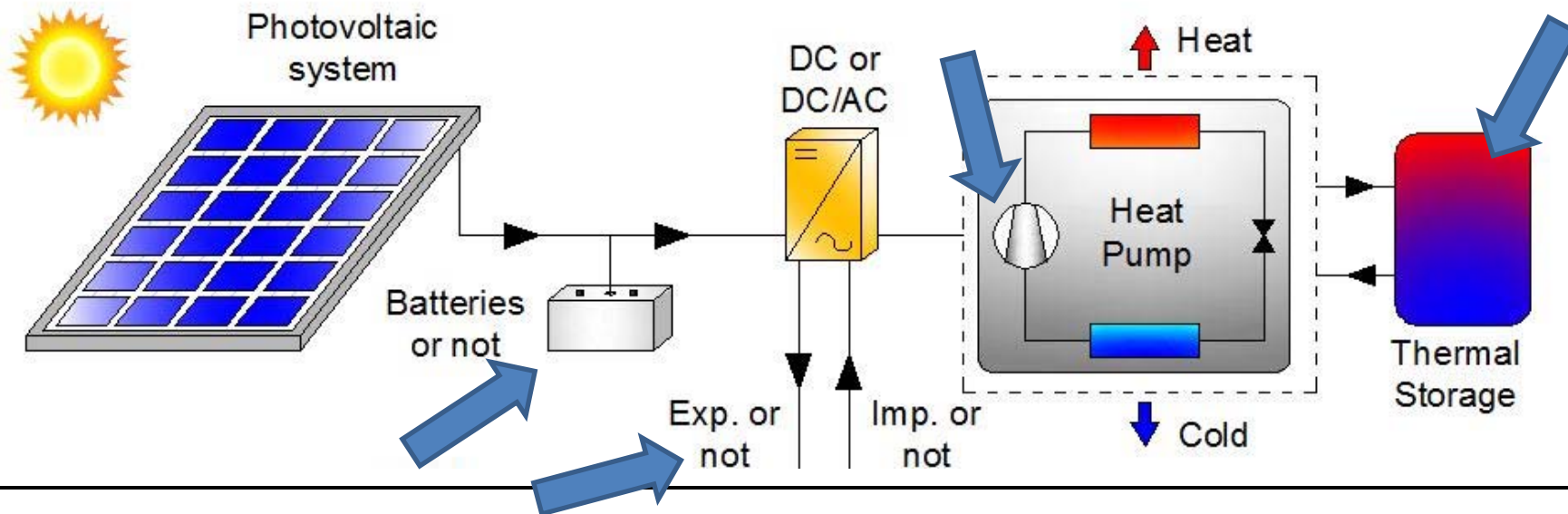
Simón Aledo Vives

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Prointer, S.L.



INTRODUCTION



DESING CHARACTERISTICS:

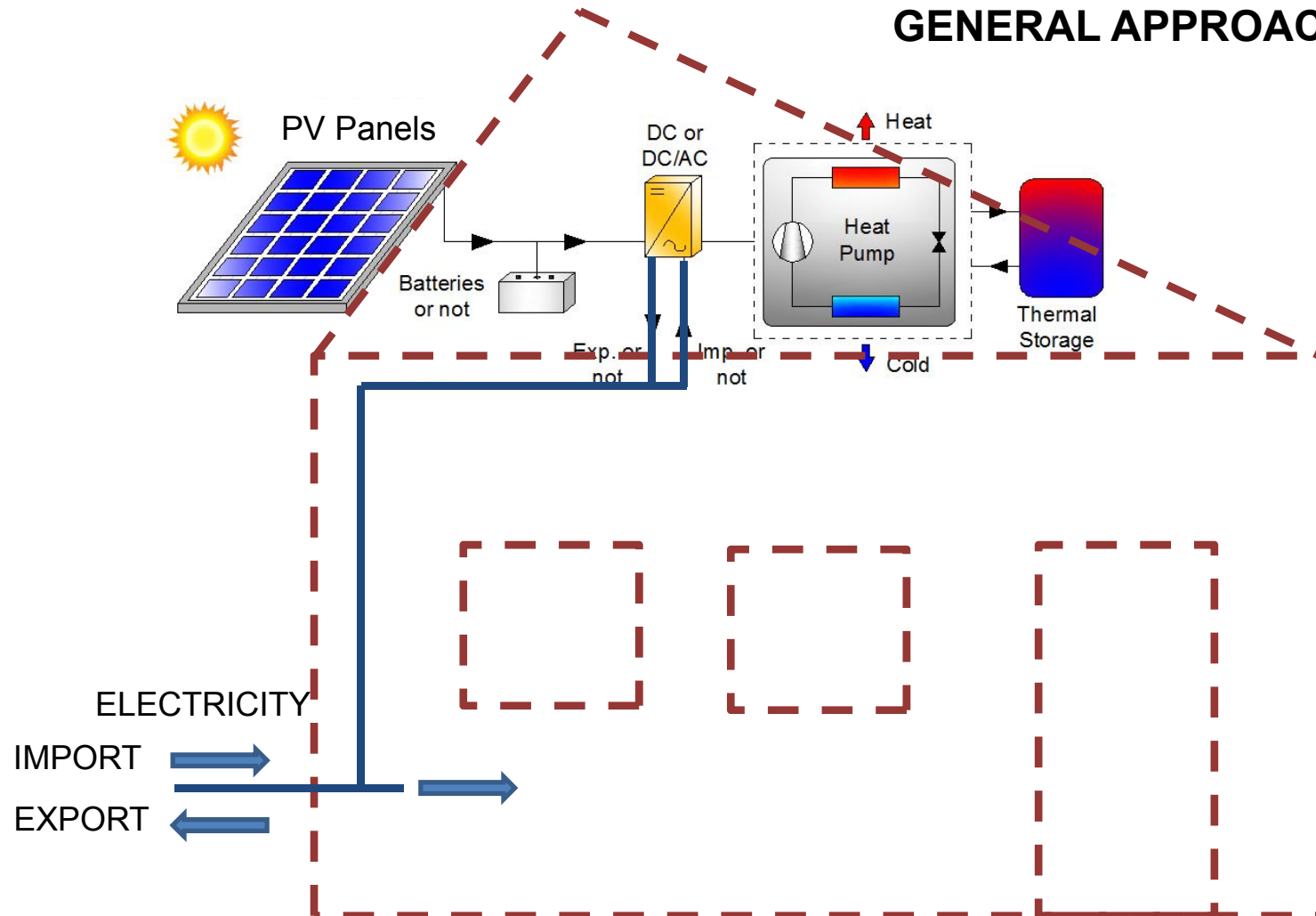
- EXPORT ELECTRICITY: YES/NO
- BATTERIES: YES/NO
- THERMAL STORAGE: YES/NO
- COMPRESOR: INVERTER, W=CONSTANT
- IMPROVED CONTROL (SOLAR): YES/NO

DIMENSIONS:

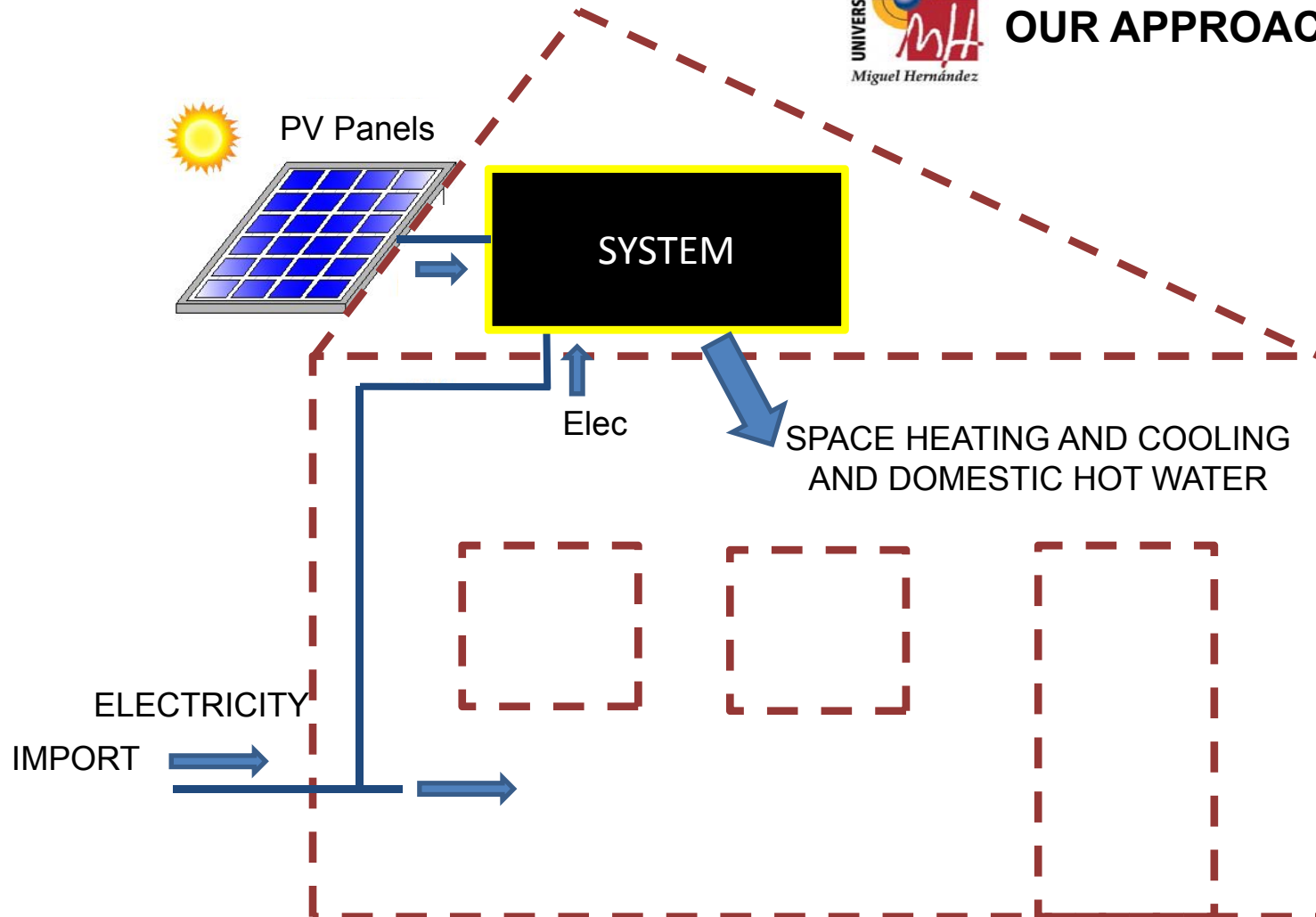
- NUMBER OF PV PANELS: W_p
- COMPRESOR POWER: kW
- BATTERIES CAPACITY: Ah
- STORAGE CAPACITY: L

INTRODUCTION

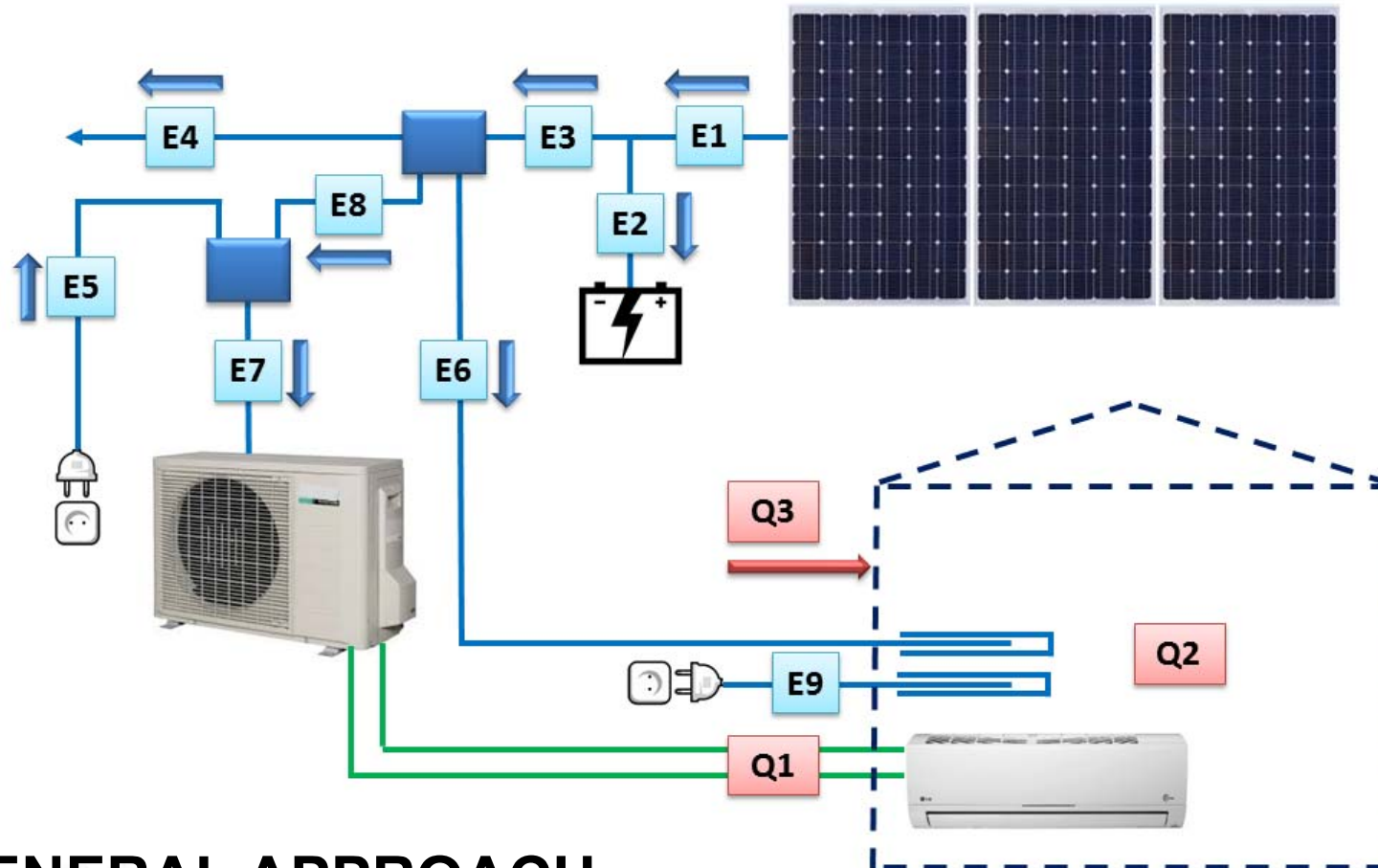
GENERAL APPROACH



INTRODUCTION

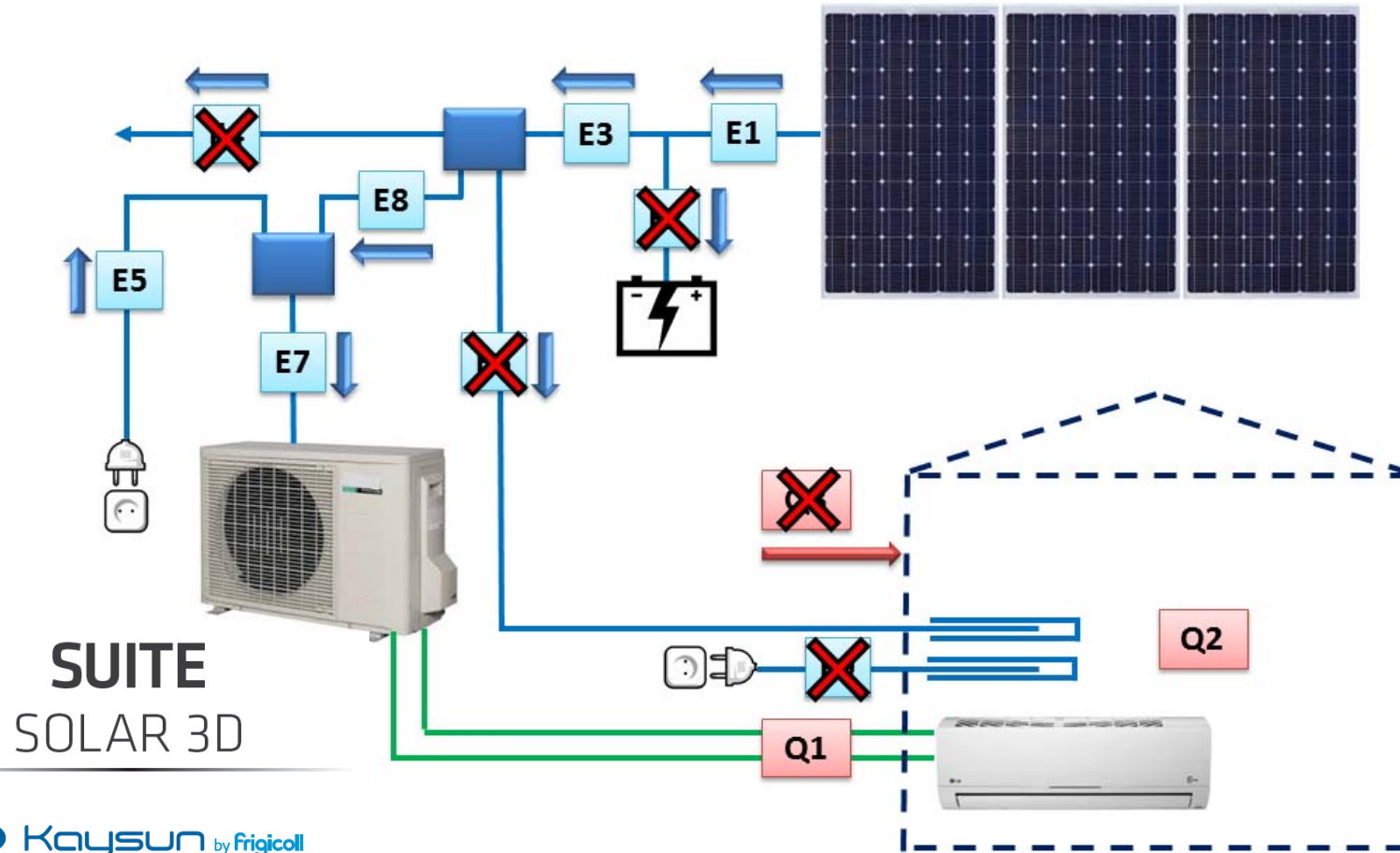


SOLAR AIRCONDITIONERS



GENERAL APPROACH

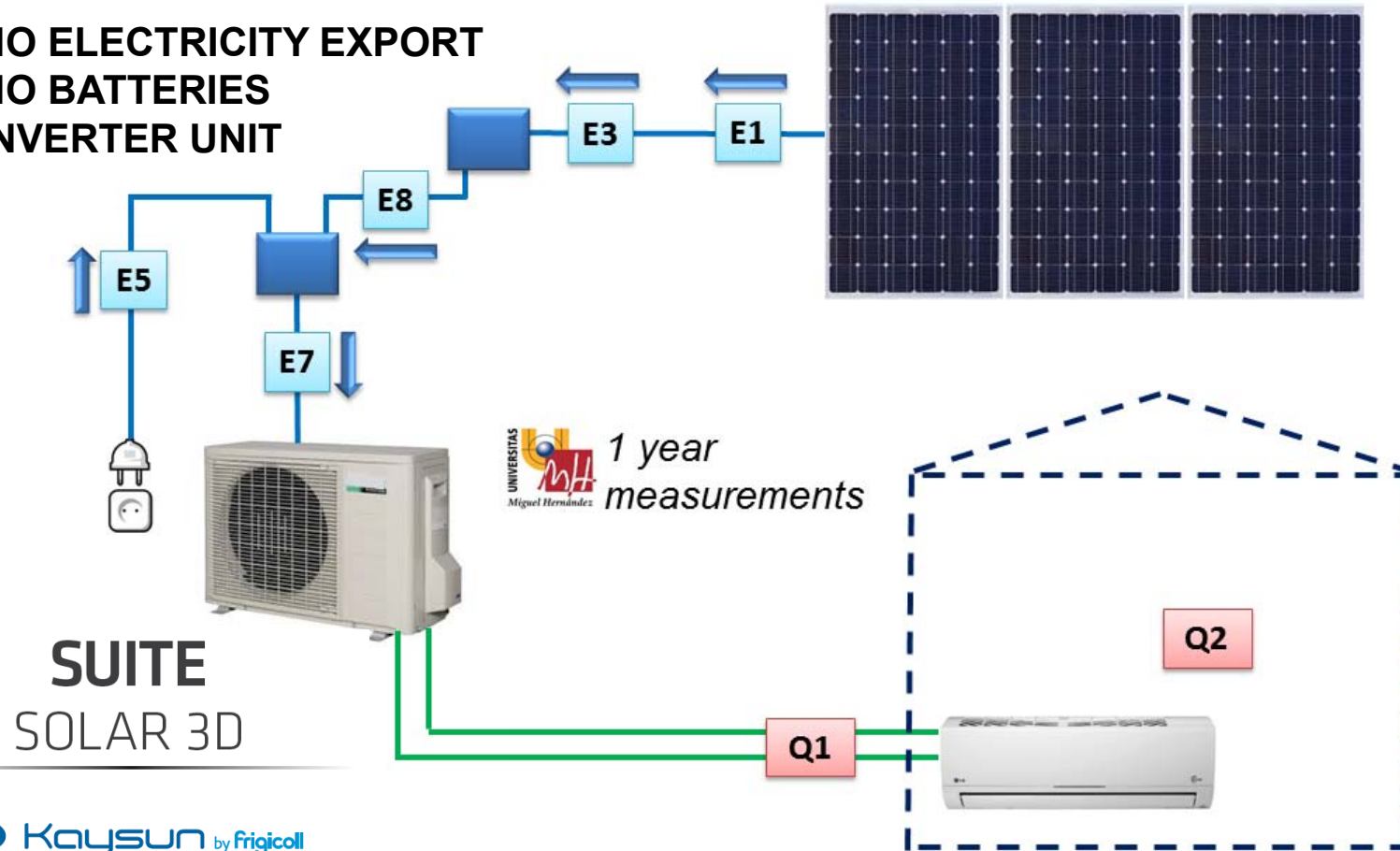
SOLAR AIRCONDITIONERS

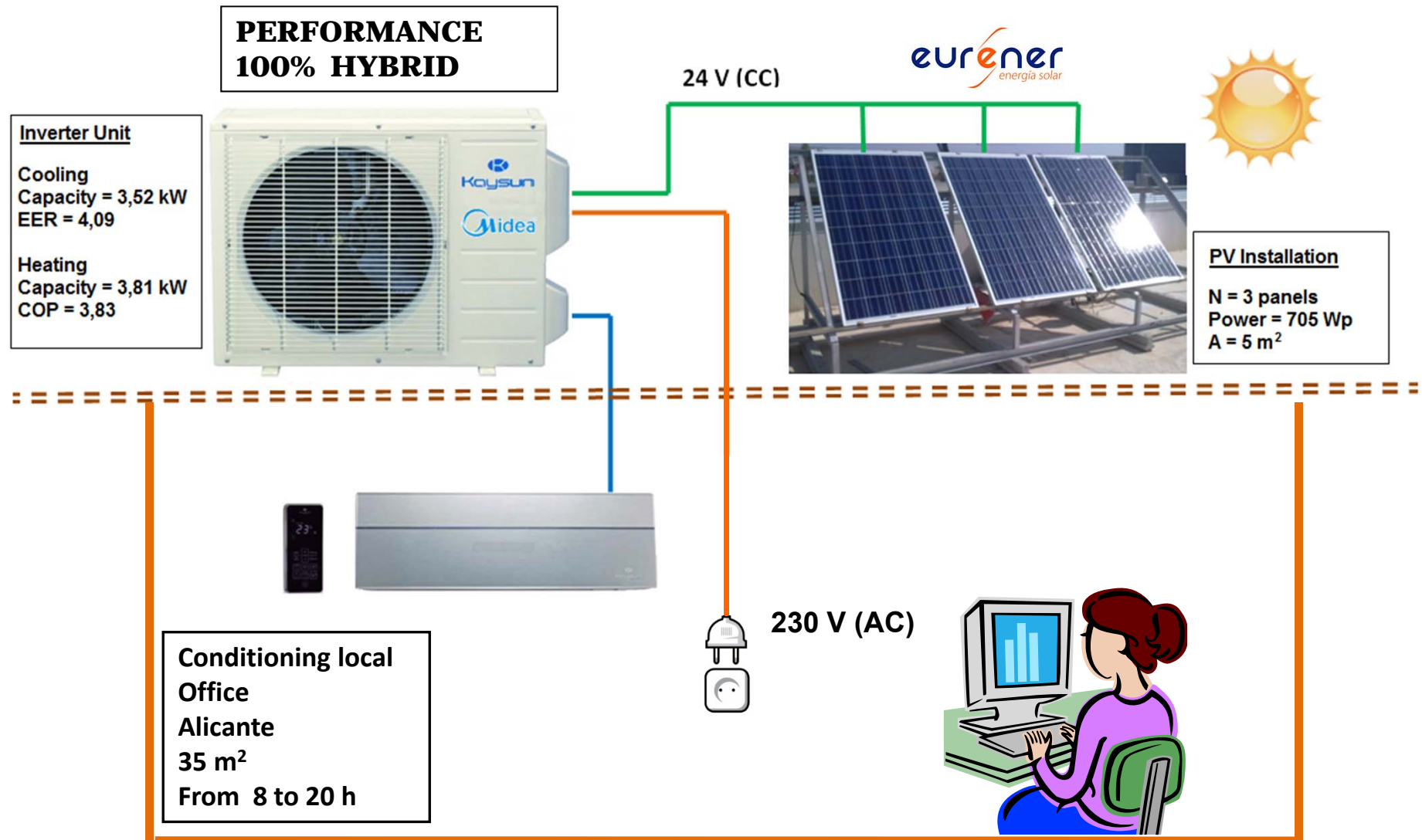


Kaysun by Frigicoll

SOLAR AIRCONDITIONERS

- NO ELECTRICITY EXPORT
- NO BATTERIES
- INVERTER UNIT







310V DC



SUITE
SOLAR 3D

 Kaysun by Frigicoll

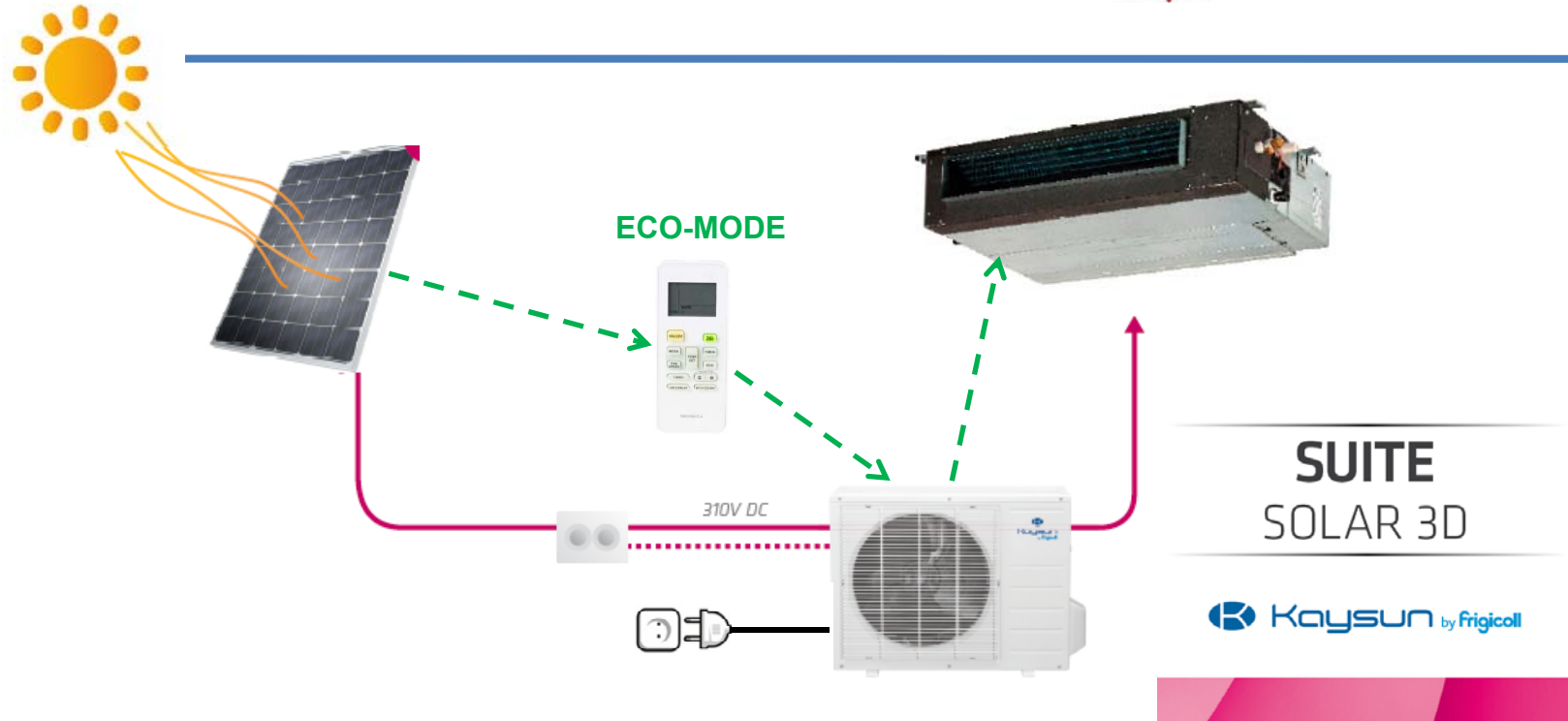
SOLAR CONTRIBUTION (SC%): **54%**
PRODUCTION FACTOR (PF%): **70%**
EFFICIENCY (SPF): **9,6**

DESING CHARACTERISTICS:

- EXPORT ELECTRICITY: YES/NO
- BATTERIES: YES/NO
- THERMAL STORAGE: YES/NO
- COMPRESOR: INVERTER, W=CONSTANT
- IMPROVED CONTROL (SOLAR): YES/NO

DIMENSIONS:

- NUMBER OF PV PANELS: 705 Wp
- COMPRESOR POWER: 1 kW



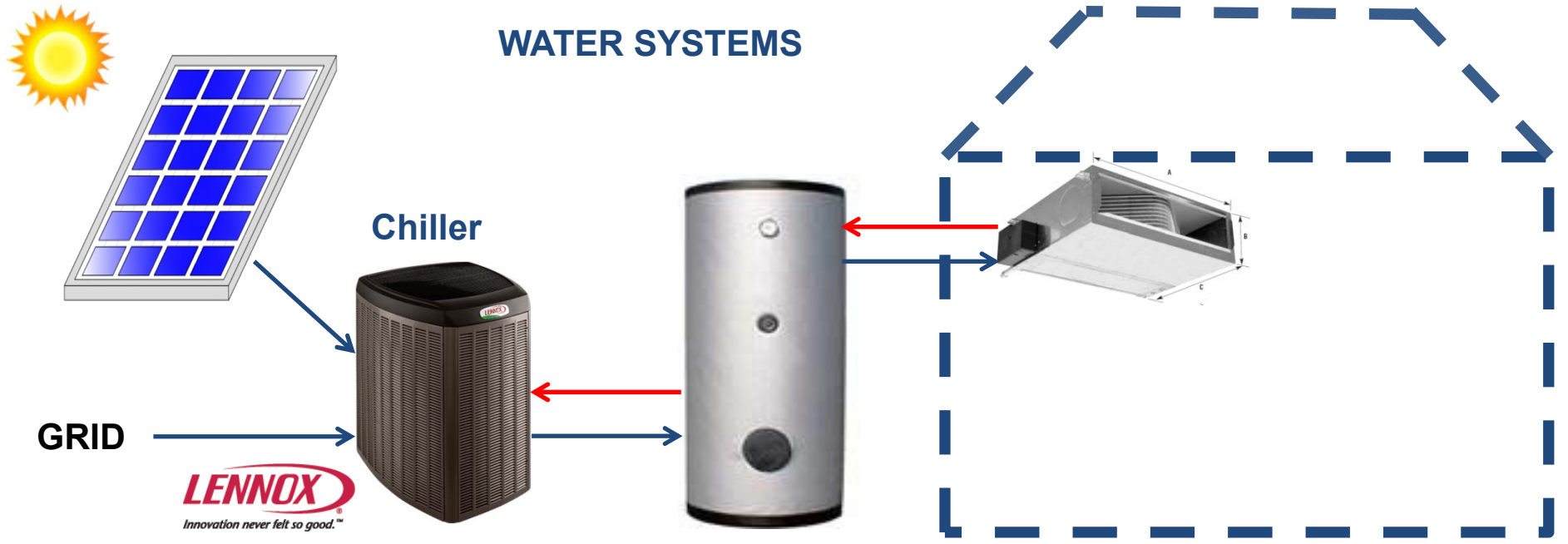
DESING CHARACTERISTICS:

- EXPORT ELECTRICITY: YES/NO
- BATTERIES: YES/NO
- THERMAL STORAGE: YES/NO
- COMPRESOR, INVERTER, W=CONSTANT
- IMPROVED CONTROL (SOLAR): YES/NO

DIMENSIONS:

- NUMBER OF PV PANELS: ¿? Wp
- COMPRESOR POWER: ¿? kW
- BATTERIES: ¿? Wh

WATER SYSTEMS



DESING CHARACTERISTICS:

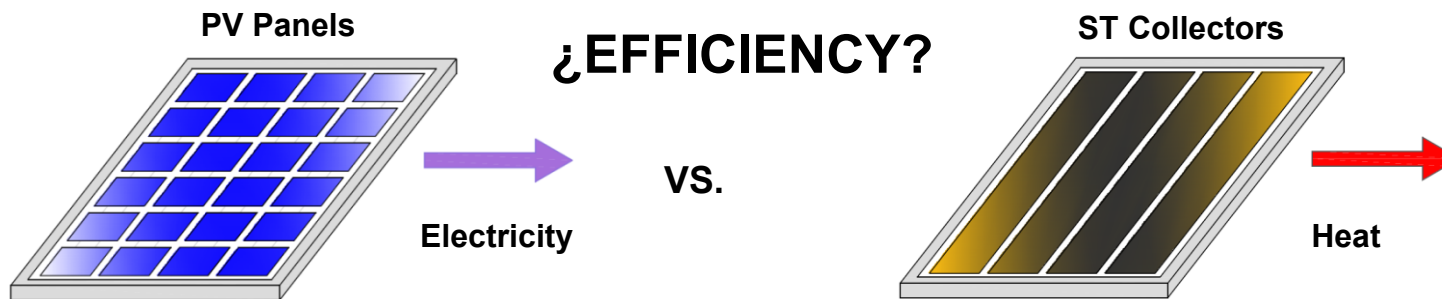
- EXPORT ELECTRICITY: YES/NO
- BATTERIES: YES/NO
- THERMAL STORAGE: YES/NO
- COMPRESOR: INVERTER, $W=CONSTANT$
- IMPROVED CONTROL (SOLAR): YES/NO

DIMENSIONS:

- NUMBER OF PV PANELS: ζ ? W_p
- COMPRESOR POWER: ζ ? kW
- BATTERIES: ζ ? Wh
- STORAGE CAPACITY: ζ ? Liters

DHW production with a PV supported heat pump

ALTERNATIVE TO SOLAR THERMAL???



¿EFFICIENCY?

VS.

¿COST?

¿RELIABILITY?

¿DURABILITY?

¿EASY TO INSTALL?

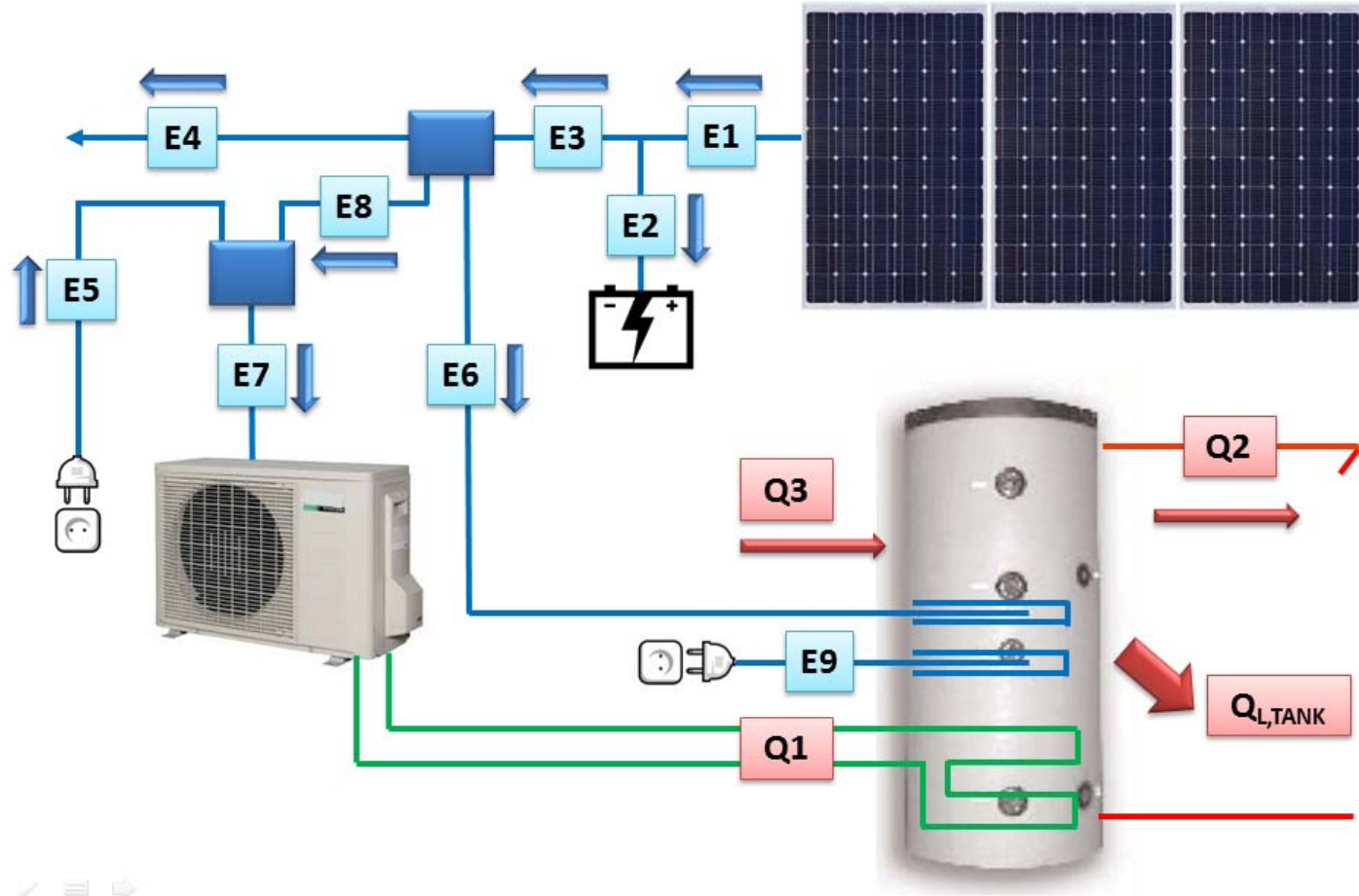
¿LIFE COST ANALYSIS?

Domestic Hot Water in Residential buildings:

- Easy to install
- Water temperature less than 60°C



DOMESTIC HOT WATER SYSTEMS



PROTOTYPE UMH-DHW1

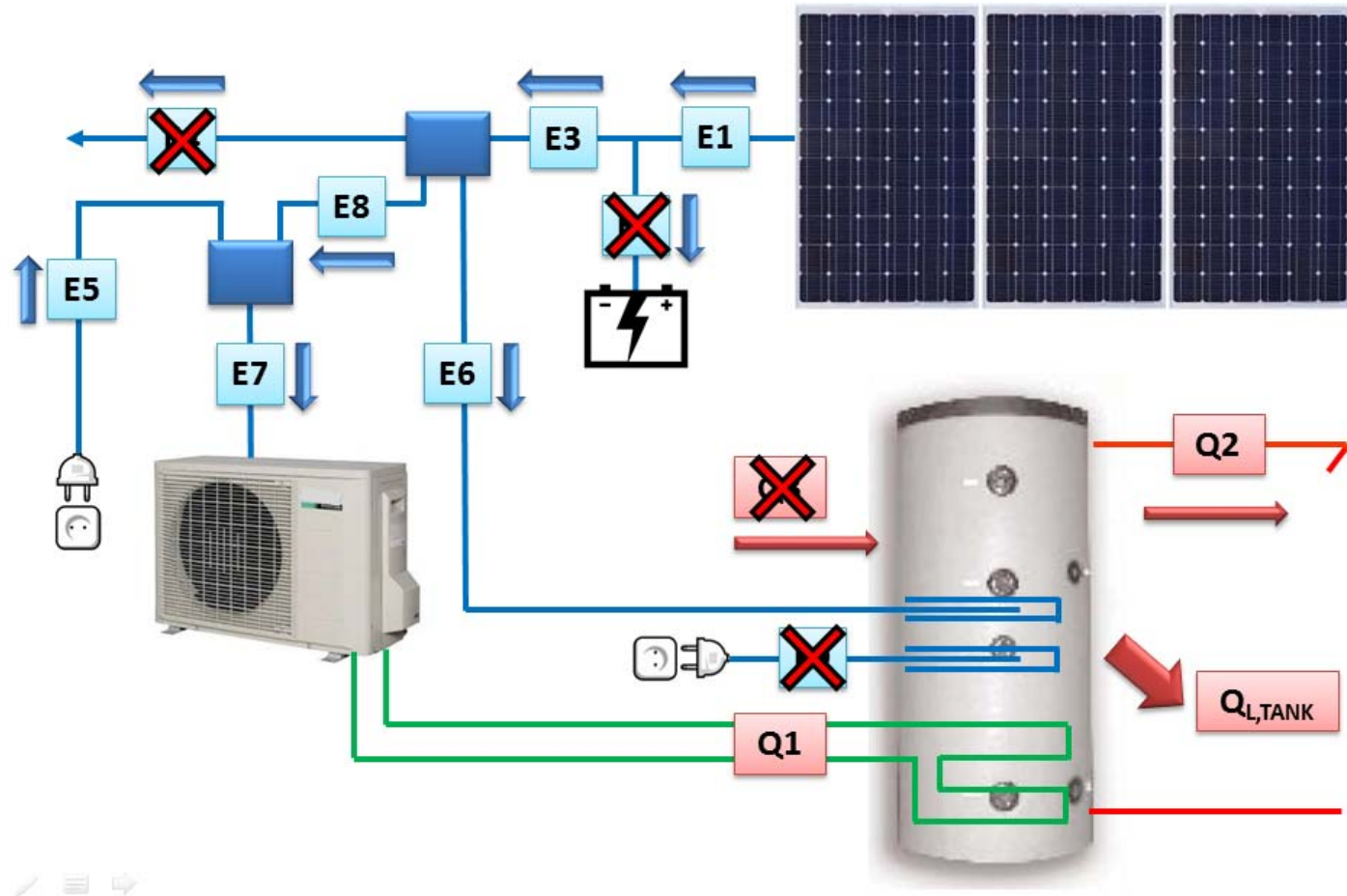
DHW consumption of a 4 member family

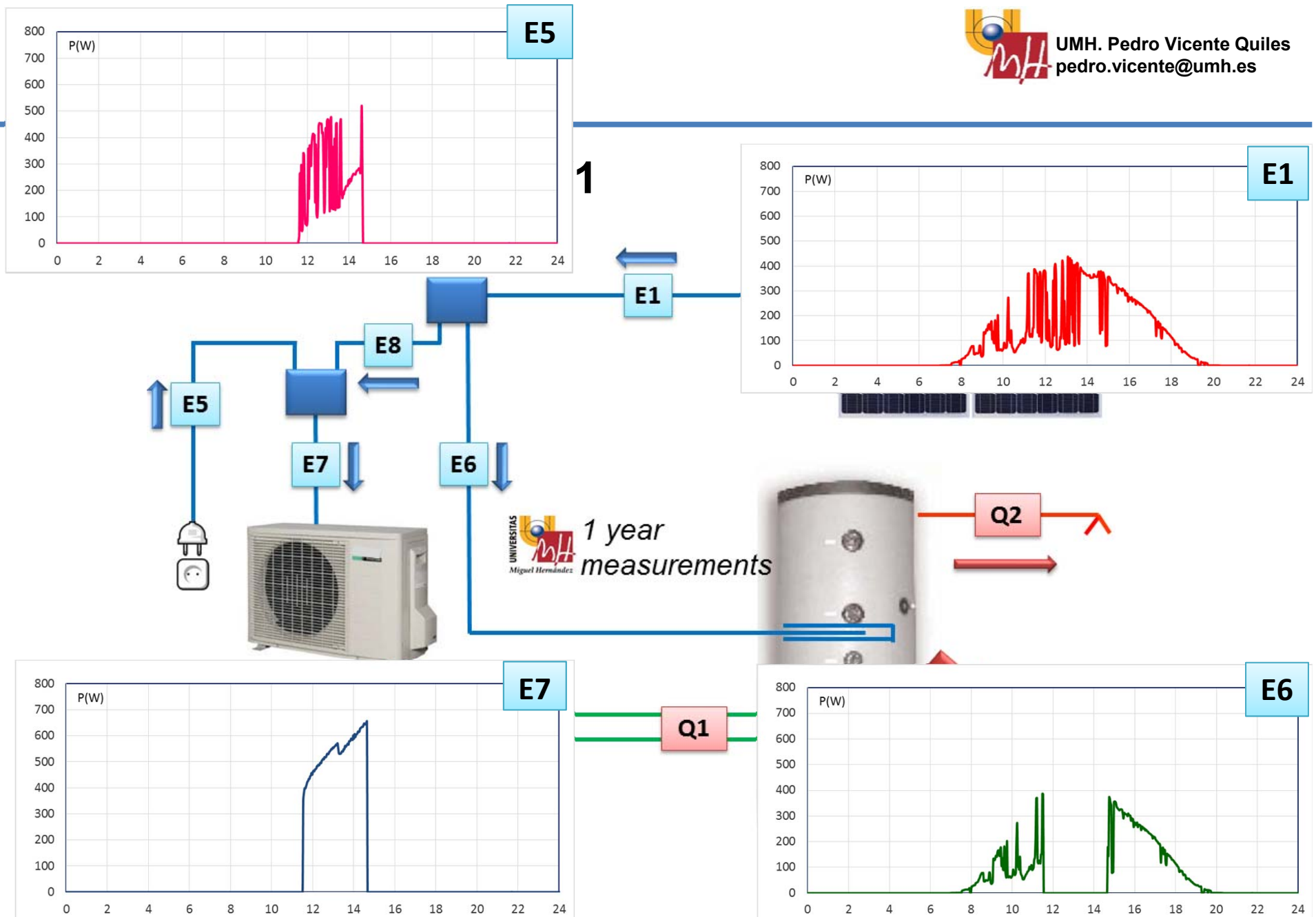
$$P_{PV}=470W_p$$

$$P_{HP}=1.5kW$$



PROTOTYPE UMH-DHW1



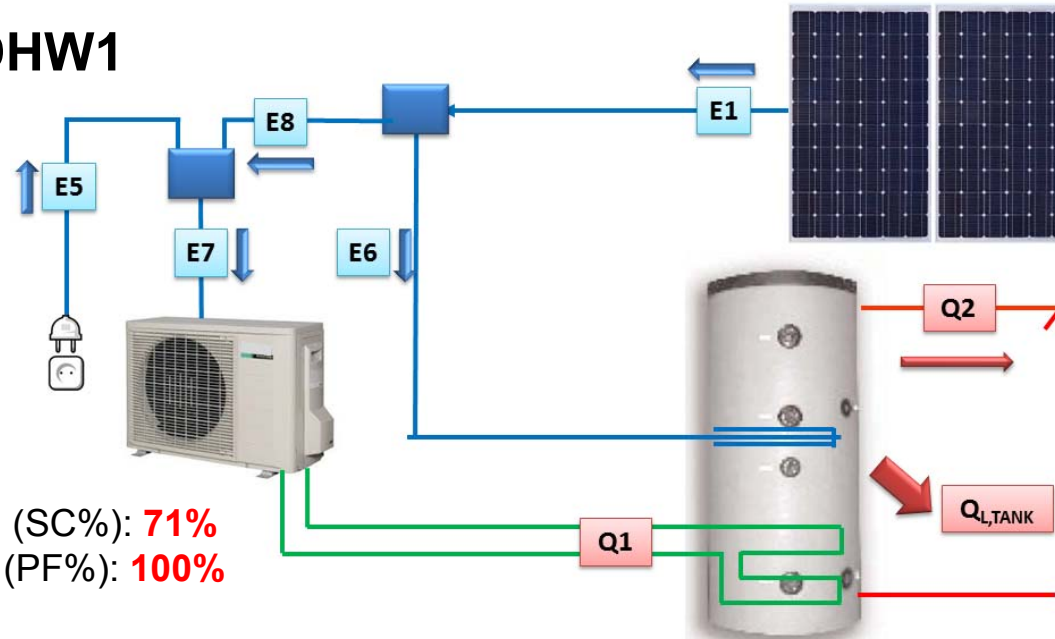


Experimental Results

MONTHLY RESULTS

Month	Vol. (L)	Q _s (Kwh)	E _{L-TANK} (Kwh)	E _W (Kwh)	Q _W (Kwh)	E _T (kWh)	E ₁ (kWh)	E ₂ (kWh)	E ₃ (kWh)	E _{1-E2} (kWh)	Q ₁ (kWh)	Q _{1-Q2} (kWh)	COP _{HP}	COP _{SIST}	T _{M-TAN} (°C)	T _{M-HP-ON} (°C)	E _{SOLAR} (kWh/m ²)	SC (%)
January	123,49	5,56	2,15	0,01	7,71	2,30	2,02	0,90	0,61	1,40	6,94	7,55	3,01	8,38	11,40	16,83	5,20	69,11
February	131,67	6,70	2,21	0,42	8,34	2,68	2,08	1,23	0,60	1,44	8,38	8,99	3,30	8,01	13,66	16,28	3,16	62,00
March	133,26	6,92	1,99	0,03	8,93	2,38	2,37	0,88	0,88	1,49	8,54	9,42	3,60	10,68	15,61	19,37	6,17	72,91
April	128,23	6,68	1,74	0,07	8,51	2,03	2,38	0,68	1,22	1,87	7,31	8,74	3,67	12,81	18,73	23,78	6,77	78,16
May	125,73	6,38	1,71	-0,01	8,08	1,96	2,19	0,87	1,10	1,09	7,17	8,27	3,67	9,54	19,53	24,16	5,88	71,61
June	130,83	6,33	1,86	-0,01	7,88	1,77	2,21	0,81	1,24	0,97	6,48	7,72	3,63	8,36	23,78	27,88	3,90	73,21
July	133,61	6,69	1,19	0,01	7,88	1,68	2,39	0,71	1,41	0,98	6,39	7,80	3,80	11,07	26,34	30,32	6,53	77,21
August	133,64	6,66	1,14	0,02	7,82	1,64	2,33	0,76	1,33	0,88	6,48	7,78	3,82	10,24	28,80	30,73	6,23	74,37
September	129,97	6,42	1,20	-0,01	7,62	1,67	2,14	0,80	1,27	0,87	6,34	7,61	3,81	9,56	25,76	29,85	5,86	72,89
October	128,28	6,31	1,44	0,02	7,77	1,80	2,18	0,76	1,13	1,04	6,41	7,36	3,33	8,82	22,12	26,82	3,82	74,20
November	129,06	5,74	1,77	0,02	7,53	2,03	1,62	1,13	0,72	0,89	6,54	7,26	3,23	6,41	16,09	20,29	4,14	58,83
December	123,80	3,67	2,08	0,01	7,70	2,23	1,82	1,04	0,72	1,20	6,78	7,30	3,04	7,23	12,02	16,82	4,88	64,81
TOTAL	47281,70	2318,98	604,95	16,32	2940,25	734,27	787,88	320,73	373,80	414,08	2577,64	2951,44	3,51	9,17	19,41	23,61	2089,71	71,07
AVERAGE	128,86	6,36	1,68	0,04	8,05	2,01	2,16	0,88	1,02	1,13	7,06	8,08	3,61	8,17	18,41	23,61	6,73	71,07

PROTOTYPE UMH-DHW1



SOLAR CONTRIBUTION (SC%): **71%**
 PRODUCTION FACTOR (PF%): **100%**
 EFFICIENCY (SPF): **9,1**

DESING CHARACTERISTICS:

- EXPORT ELECTRICITY: YES/NO
- BATTERIES: YES/NO
- THERMAL STORAGE: YES/NO
- COMPRESOR: INVERTER, $W=CONSTANT$
- IMPROVED CONTROL (SOLAR): YES/NO

DIMENSIONS:

- NUMBER OF PV PANELS: 470 Wp
- COMPRESOR POWER: 0.5 kW
- STORAGE CAPACITY: 200 L

PROTOTYPE UMH-DHW2

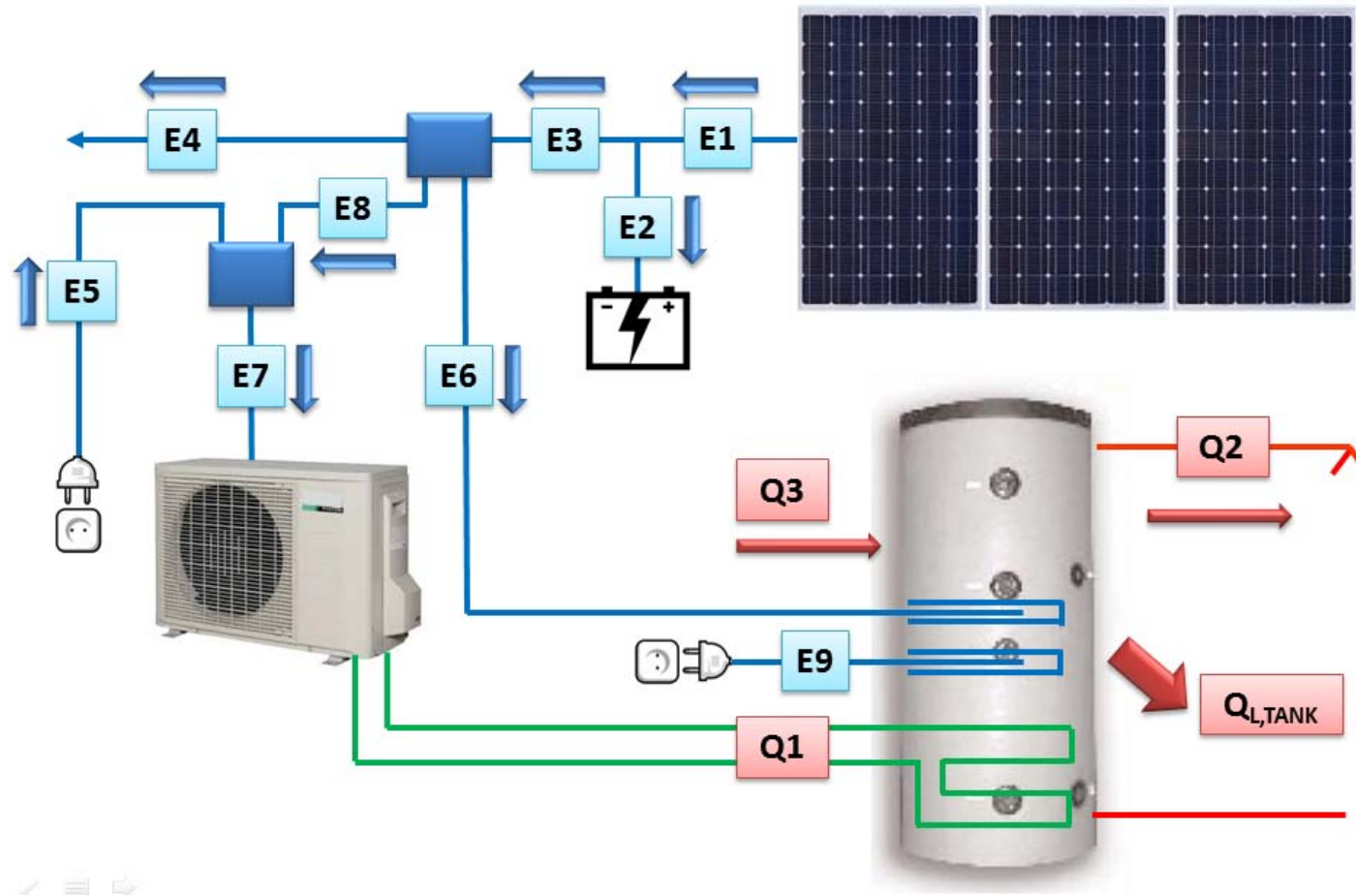
DHW consumption of a 4 member family

$P_{PV}=470W_p$

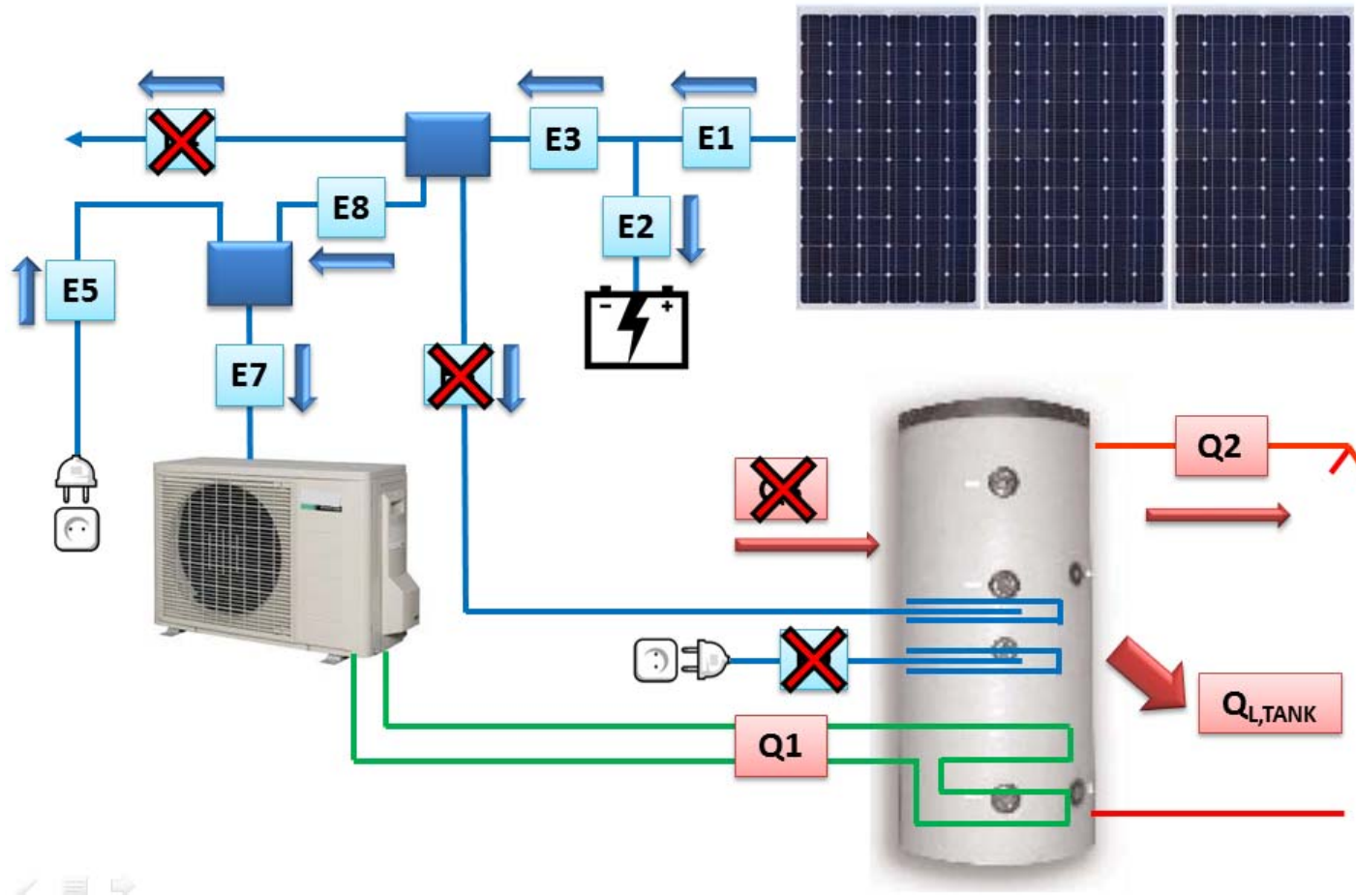
$P_{HP}=1.5kW$



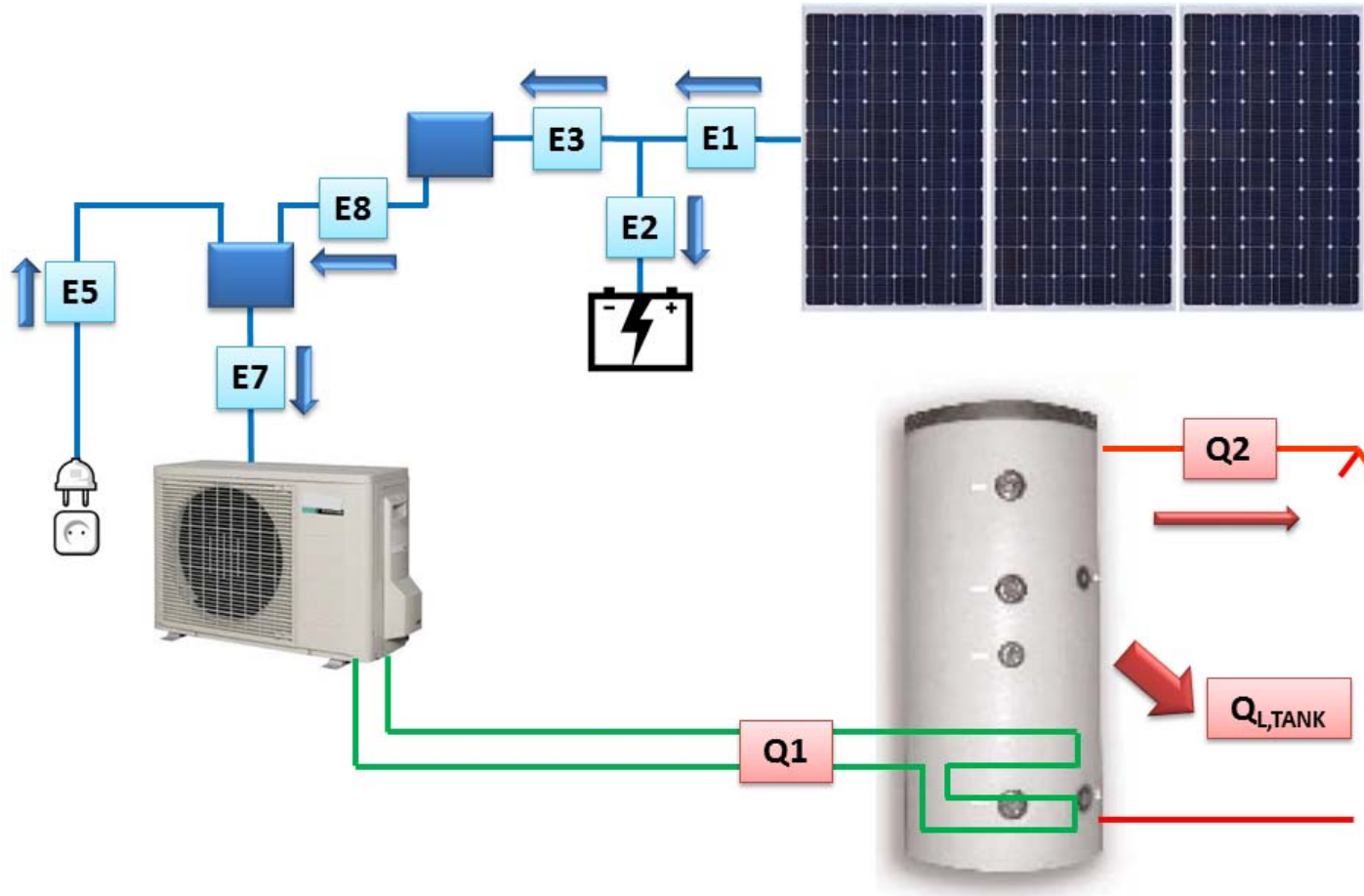
GENERAL APPROACH



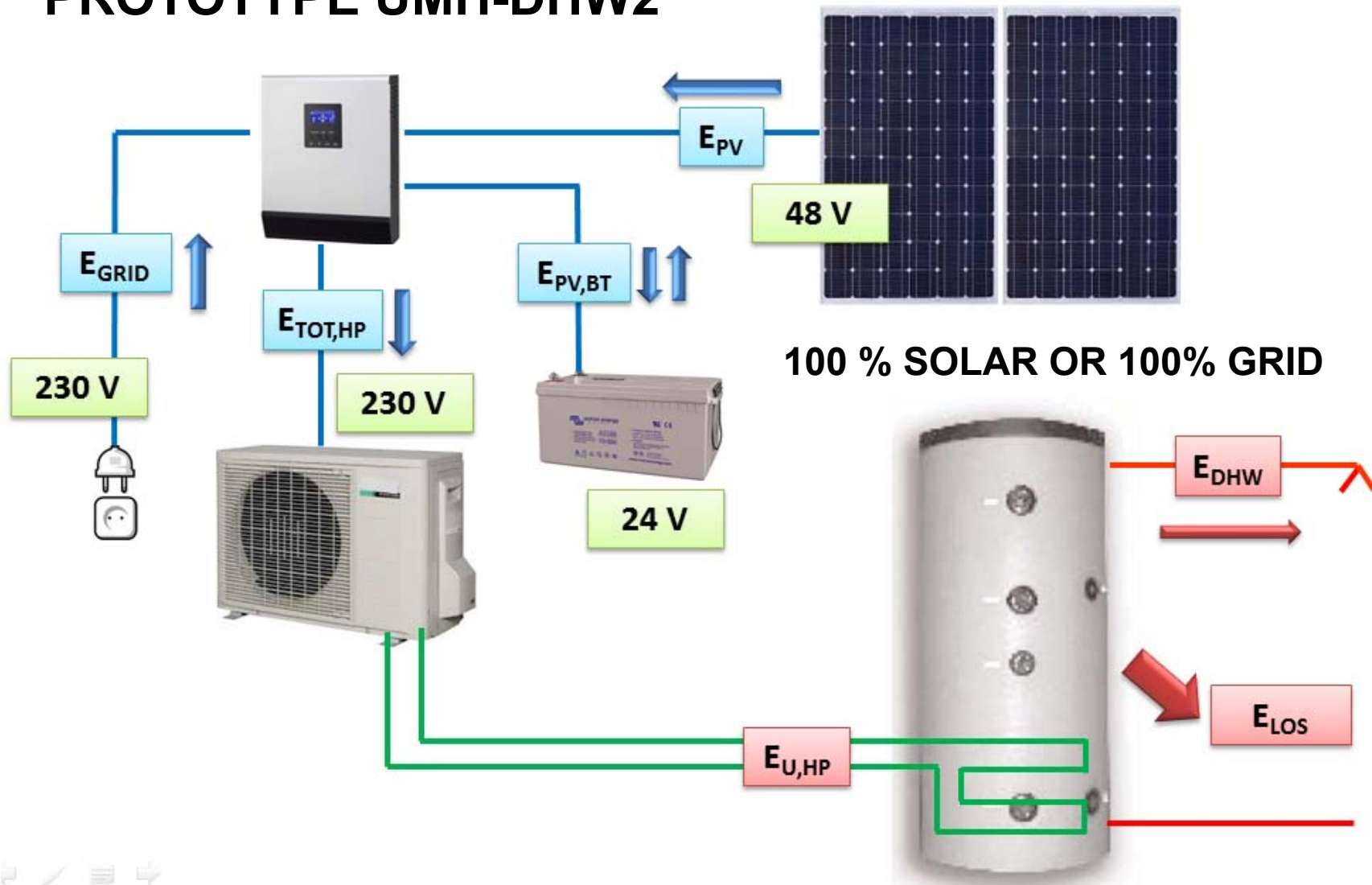
PROTOTYPE UMH-DHW2

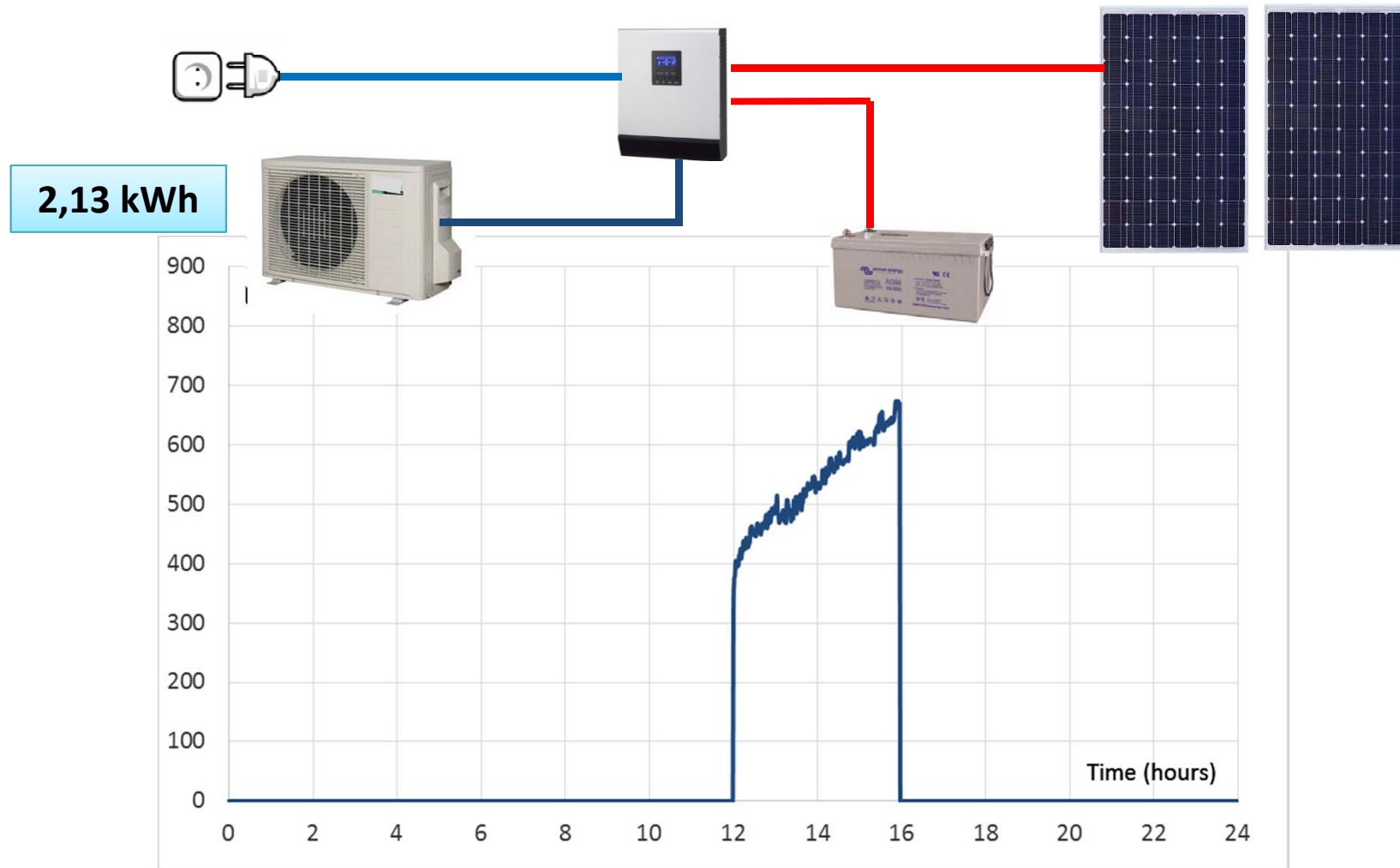


PROTOTYPE UMH-DHW2

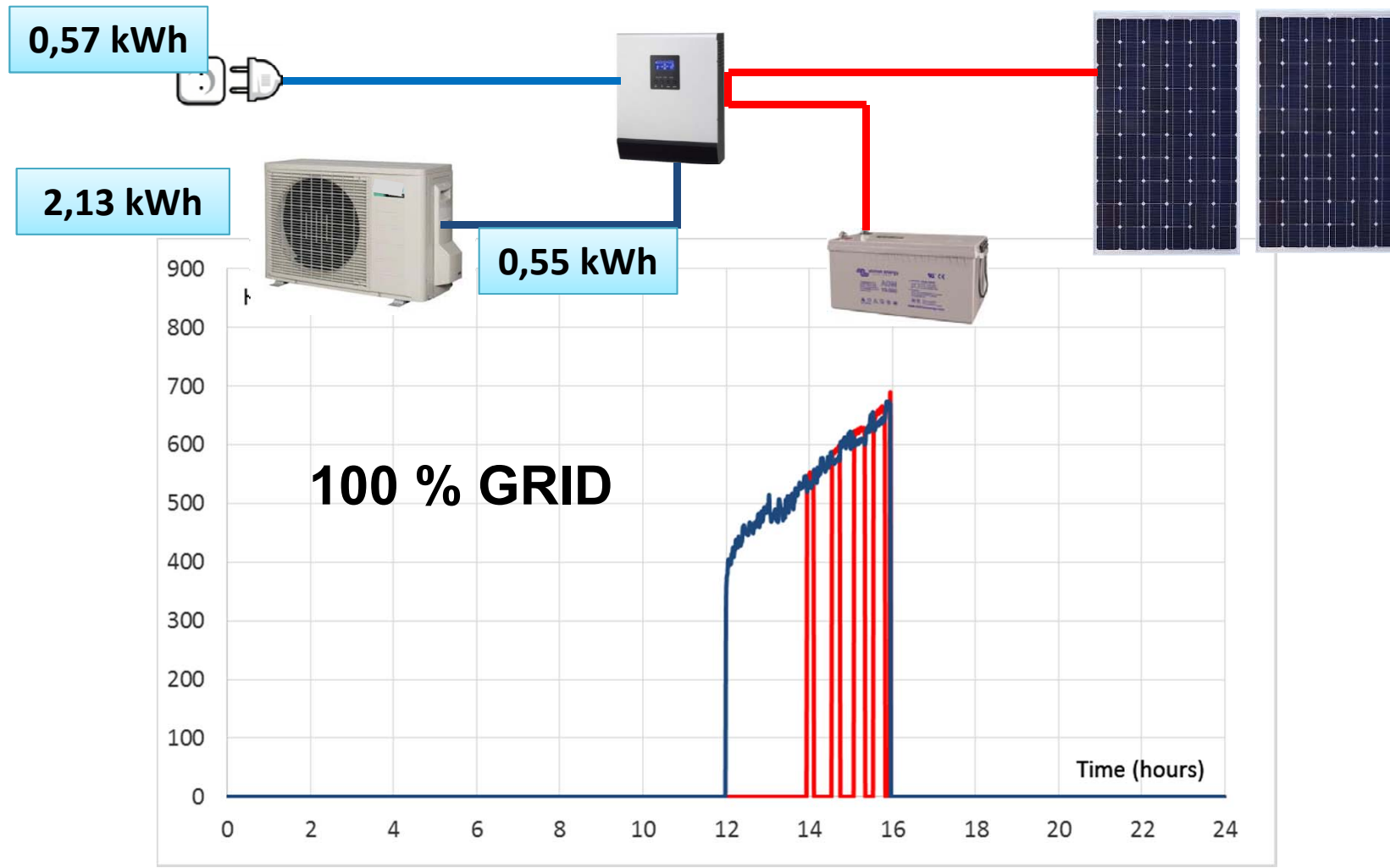


PROTOTYPE UMH-DHW2

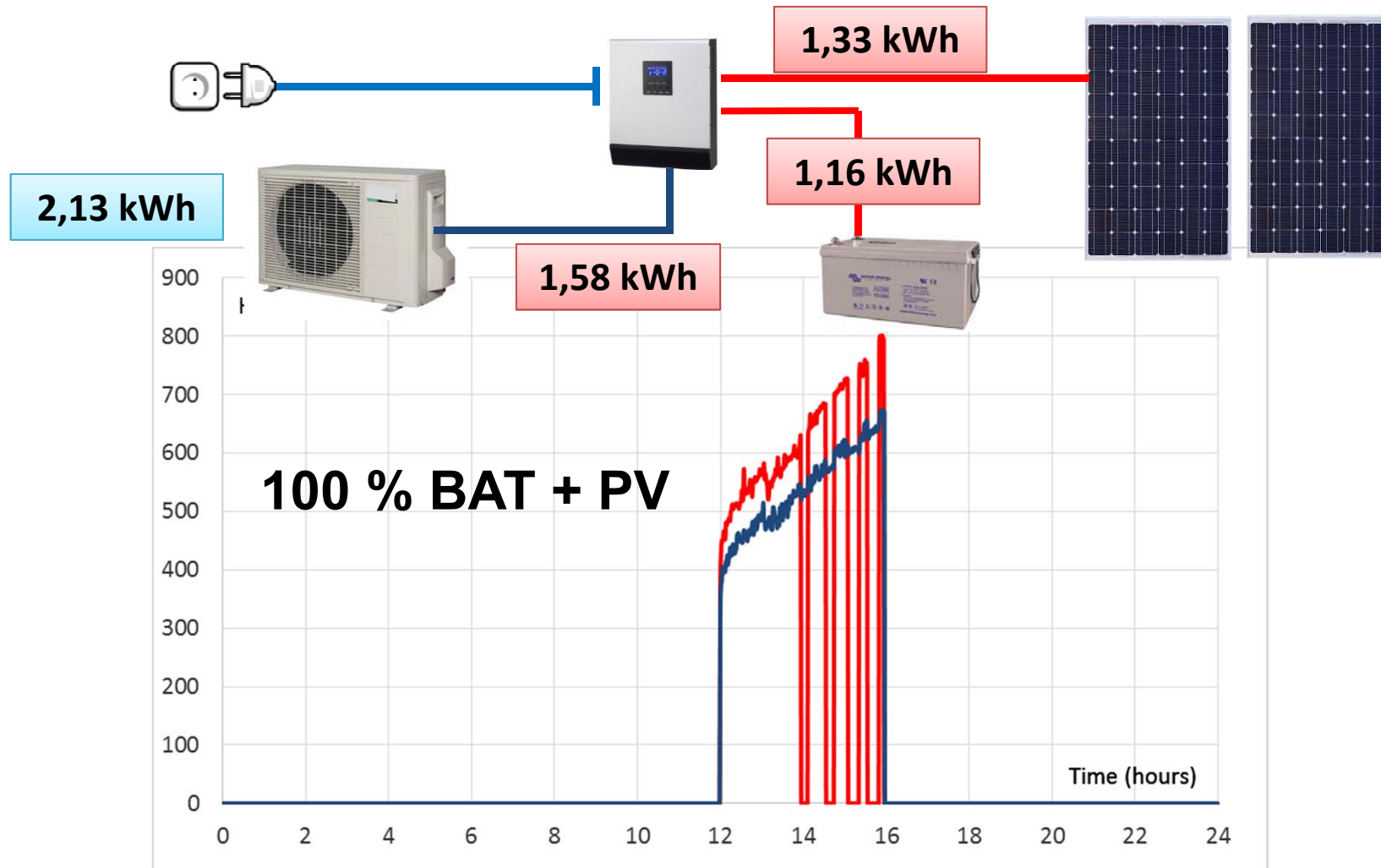




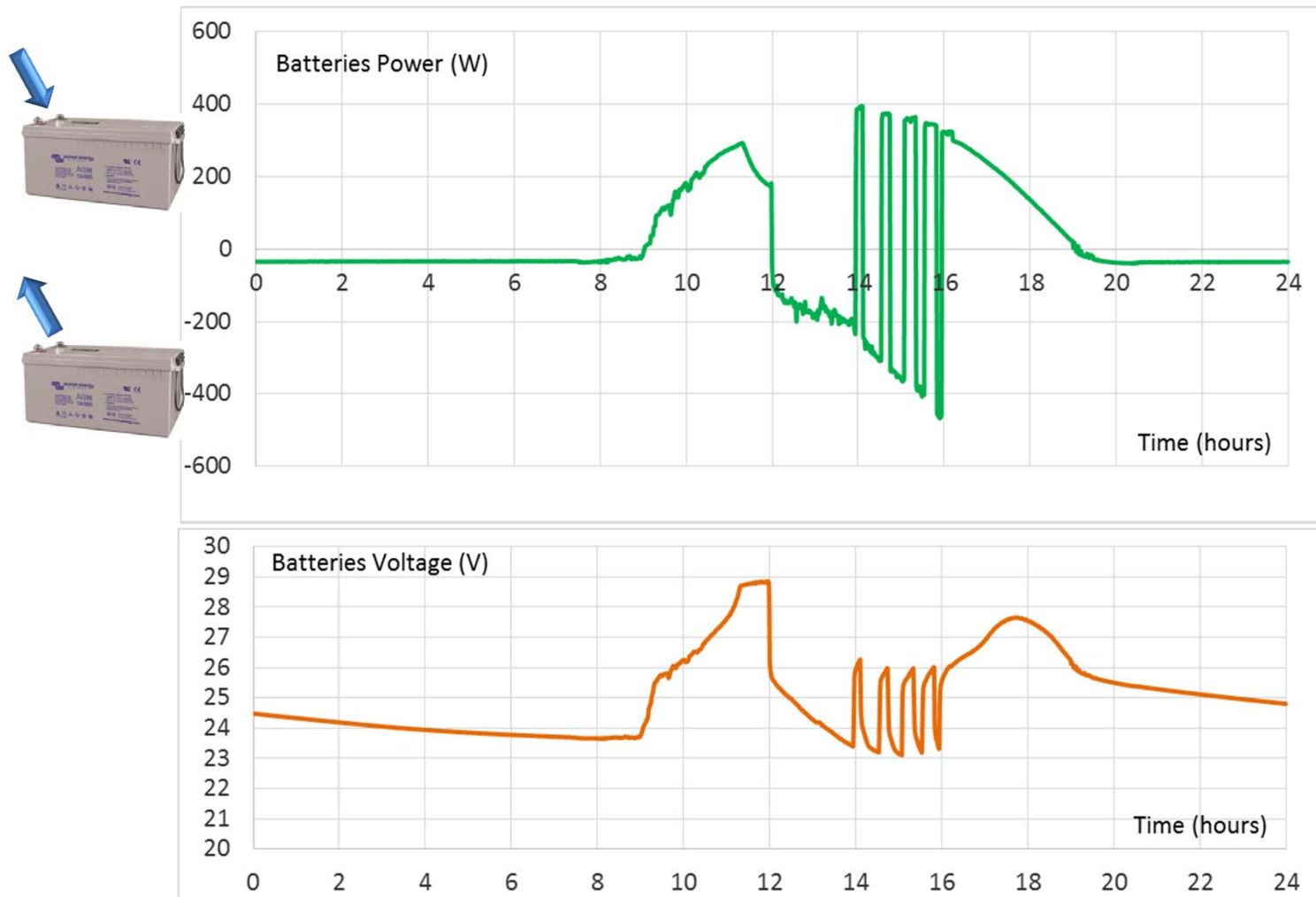
16/SEP/2015



16/SEP/2015

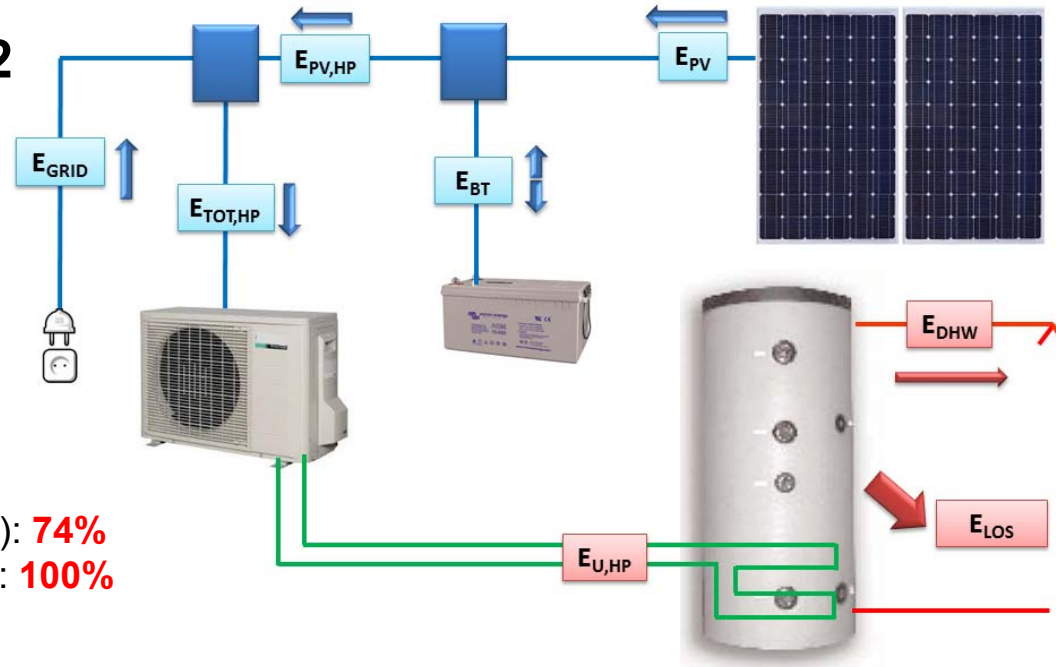


16/SEP/2015



16/SEP/2015

PROTOTYPE UMH-DHW2



16/SEP/2015!!!!!!

SOLAR CONTRIBUTION (SC%): **74%**
 PRODUCTION FACTOR (PF%): **100%**
 EFFICIENCY (SPF): **10,8**

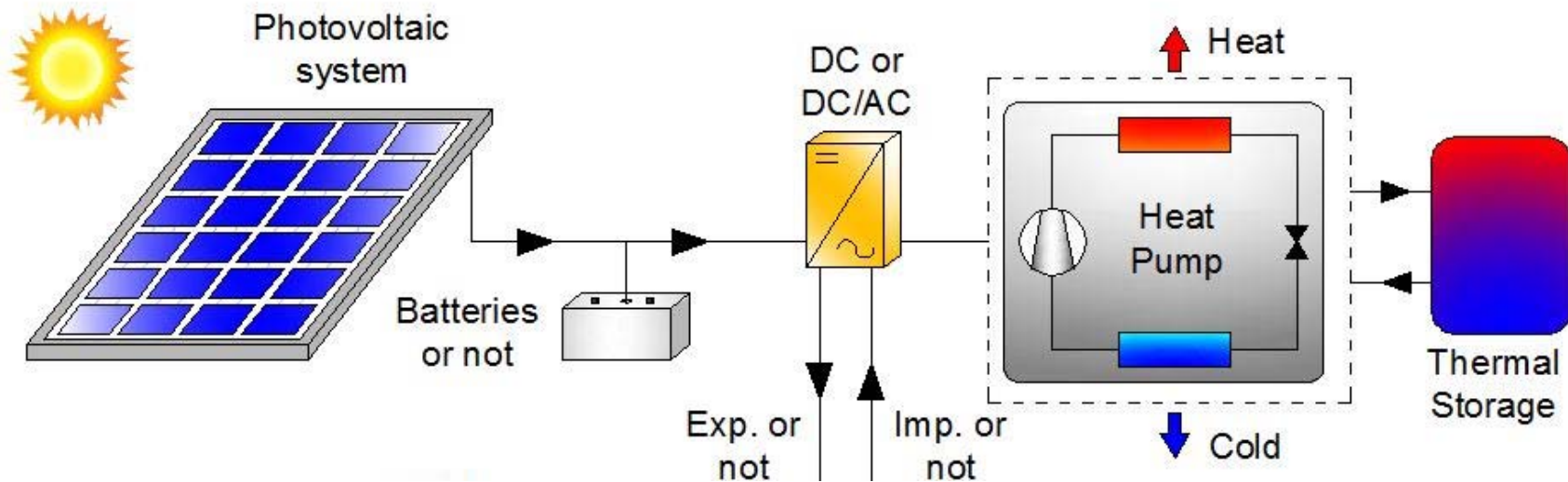
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- BATTERIES: YES/NO
- THERMAL STORAGE: YES/NO
- COMPRESOR: INVERTER, W=CONSTANT
- IMPROVED CONTROL (SOLAR): YES/NO

DIMENSIONS:

- NUMBER OF PV PANELS: 470 Wp
- COMPRESOR POWER: 0.5 kW
- BATTERIES CAPACITY: 150 Ah
- STORAGE CAPACITY: 200 L

CONCLUSIONS



DESING CHARACTERISTICS:

- EXPORT ELECTRICITY: YES/NO
- BATTERIES: YES/NO
- THERMAL STORAGE: YES/NO
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DIMENSIONS:

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- COMPRESOR POWER: kW
- BATTERIES CAPACITY: Ah
- STORAGE CAPACITY: L

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