



**SELF CONSUMPTION
OF RENEWABLE
ENERGY BY HYBRID
STORAGE SYSTEMS**

**Training Course on Thermal Energy Storage for Heating,
Cooling and DHW for Buildings**

*Electrothermal storage units for heating using
PCM*

Design, installation and operation

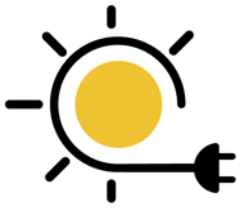
Alexandre LEBLANC, CAMPA

ADENE, Lisbon, Portugal, 1st of April 2022



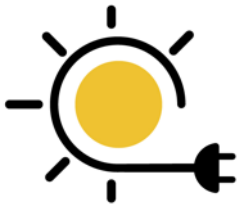
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 766464.

Topics to cover

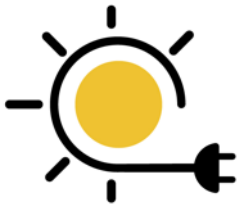


- How to store thermal energy in a home with maximum compacity ?
- Reasons to choose phase change materials
- Integration constrains & investigated solutions
- Prototype building and manufacturing

How to store thermal energy in a home ?



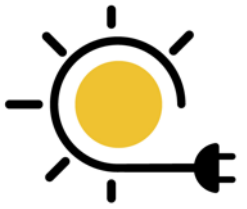
How to improve energy density ?



- Volume for storage is limited
- Storage requires :
 - Core material
 - Insulation
 - Reduce core temperature
 - Actuator for energy flow control
 - Casing

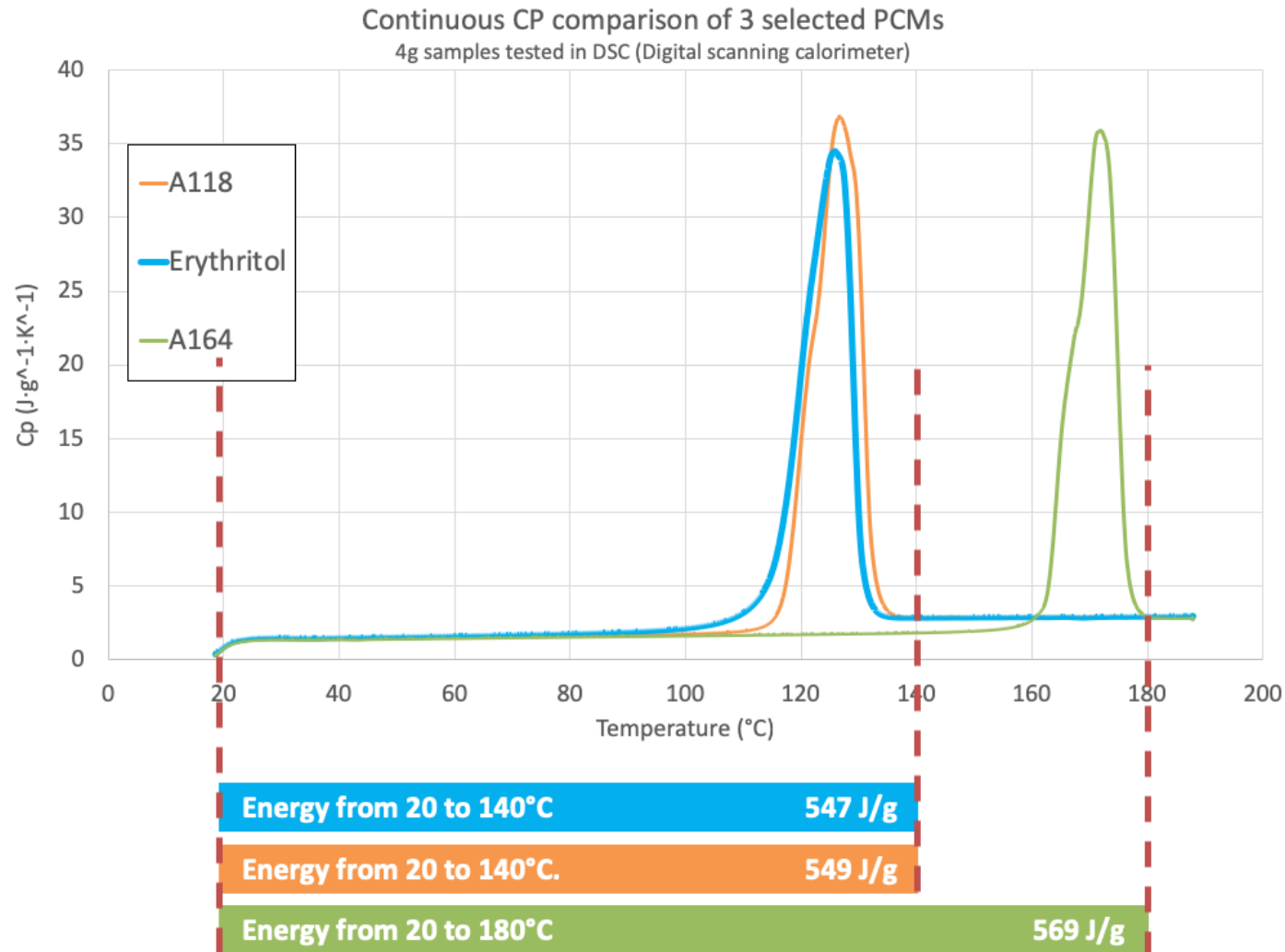
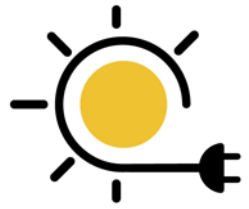
→ Phase change material has been investigated to store heat in a more compact system

Comparison of PCM with other materials

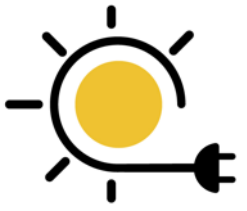


	PCM type	Phase change temperature	Density	Latent heat capacity	Specific heat capacity solid	Specific heat capacity liquid	Starting temperature	End temperature	Casing volume	Filling rate	Sensible heat	Latent heat	Total energy
		(°C)	kg/m3	(kJ/kg)	(kJ/kg K)	(kJ/kg K)	°C	°C	L	%	kWh	kWh	kWh
With Aluminum profile	A164*	164	1500	290	2,42	2,42	20	170	20	100%	3,0	2,4	5,4
	A155	155	900	100	2,2	2,2	20	170	20	100%	1,7	0,5	2,2
	A144	144	880	115	2,2	2,2	20	160	20	100%	1,5	0,6	2,1
	A133	133	880	126	2,2	2,2	20	150	20	100%	1,4	0,6	2,0
	A118**	118	1450	340	2,7	2,7	20	130	20	100%	2,4	2,7	5,1
	A95	95	900	205	2,2	2,2	20	130	20	100%	1,2	1,0	2,2
	A82	82	850	155	2,21	2,21	20	130	20	100%	1,1	0,7	1,9
	Erythritol	118	1426	334	1,4	2,7	20	130	20	100%	1,3	2,6	4,0
	Water	95	1000	0	4,8	4,8	20	95	20	100%	2,0	0,0	2,0
	Cast iron	20	7100	0	0,5	0,5	20	500	20	100%	9,5	0,0	9,5
	Aluminum	20	2700	0	0,9	0,9					0,0	0,0	
	Bricks	20	2250	0	0,84	0,84	20	500	20	100%	5,0	0,0	5,0
	Glass	20	2600	0	0,72	0,72	20	250	20	100%	2,4	0,0	2,4
	Lava stone	20	2900	0	0,7	0,7	20	400	20	100%	4,3	0,0	4,3
	PX82	82	694	116	1,6	1,6	20	100	20	100%	0,5	0,4	0,9
GR82	82	800	58	1,5	1,5	20	100	20	100%	0,5	0,3	0,8	
RT82	82	880	176	1,6	1,6	20	100	20	100%	0,6	0,9	1,5	

Comparison of selected PCMs

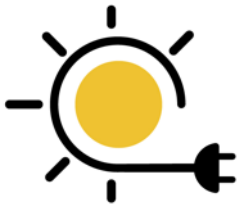


Constraints using phase change materials



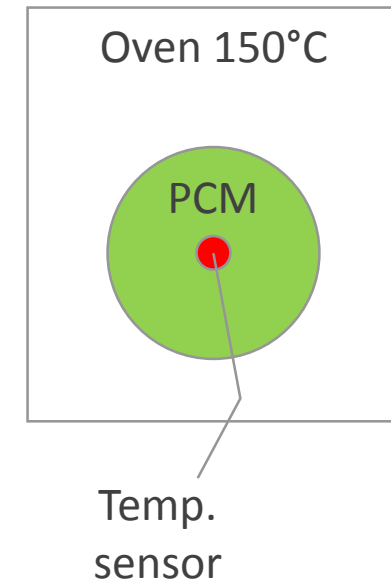
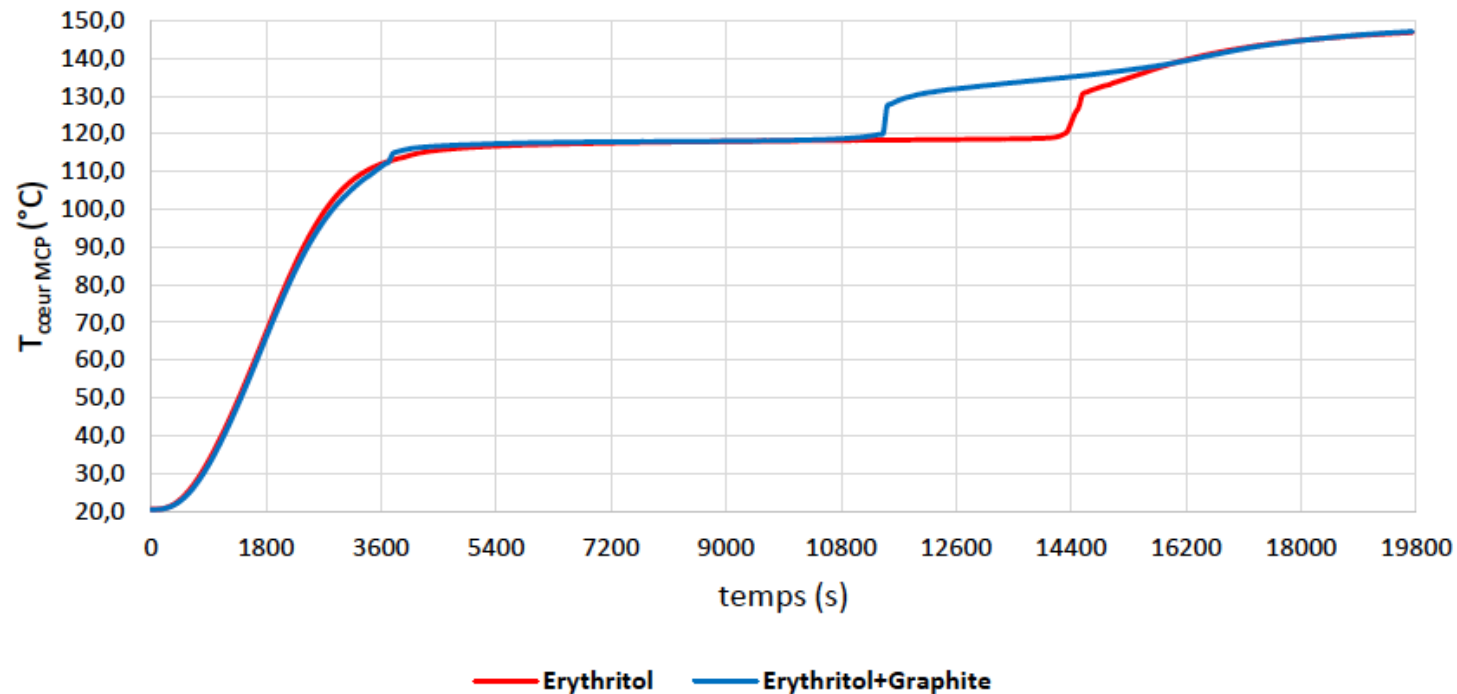
- Thermo-mechanical dilatation
- Low heat conductivity

How to improve PCM conductivity ?

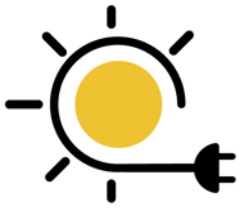


PCM + 3% of expanded graphite foam

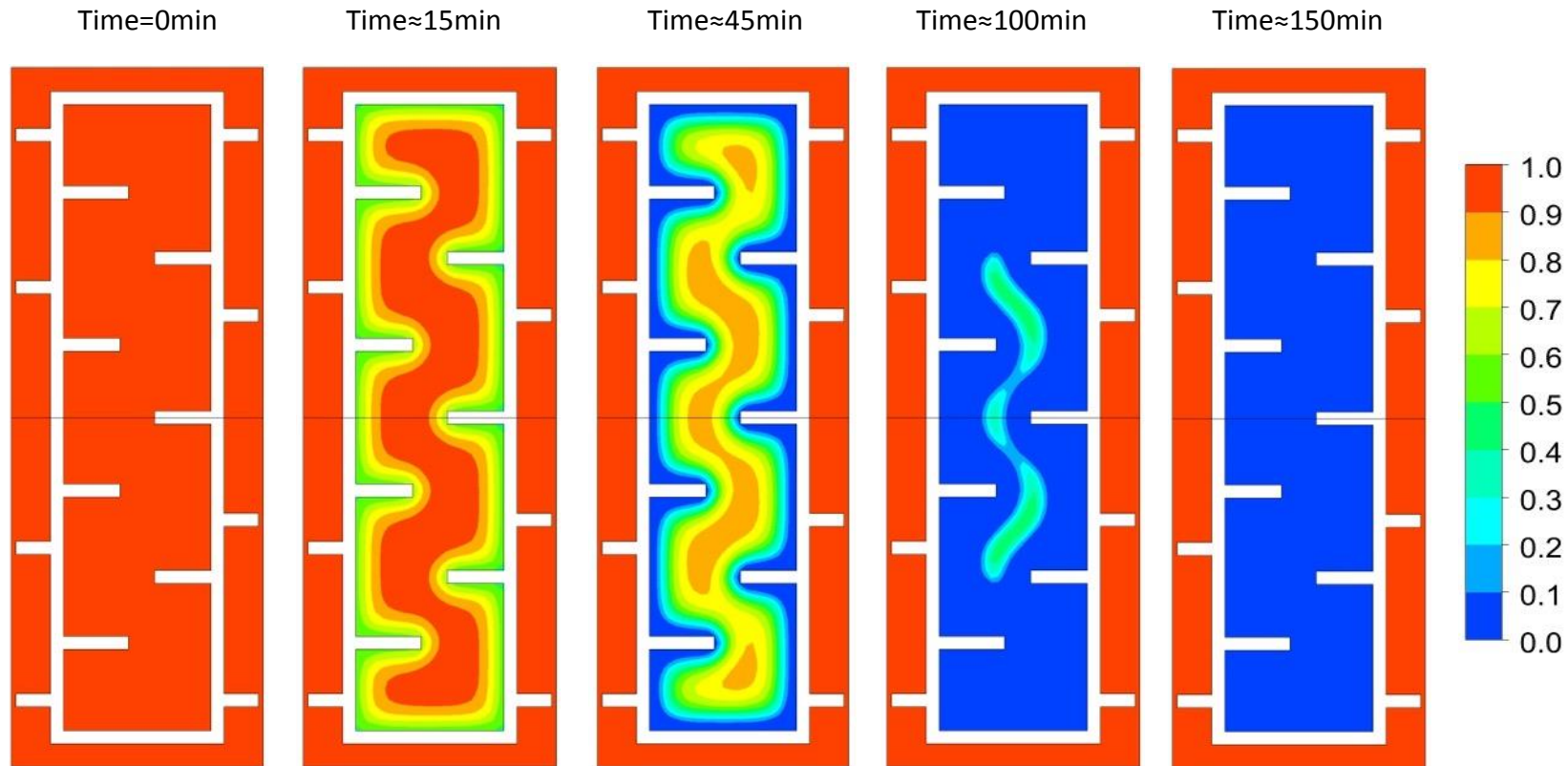
Temperature evolution after a heat flow step in a cylindrical geometry



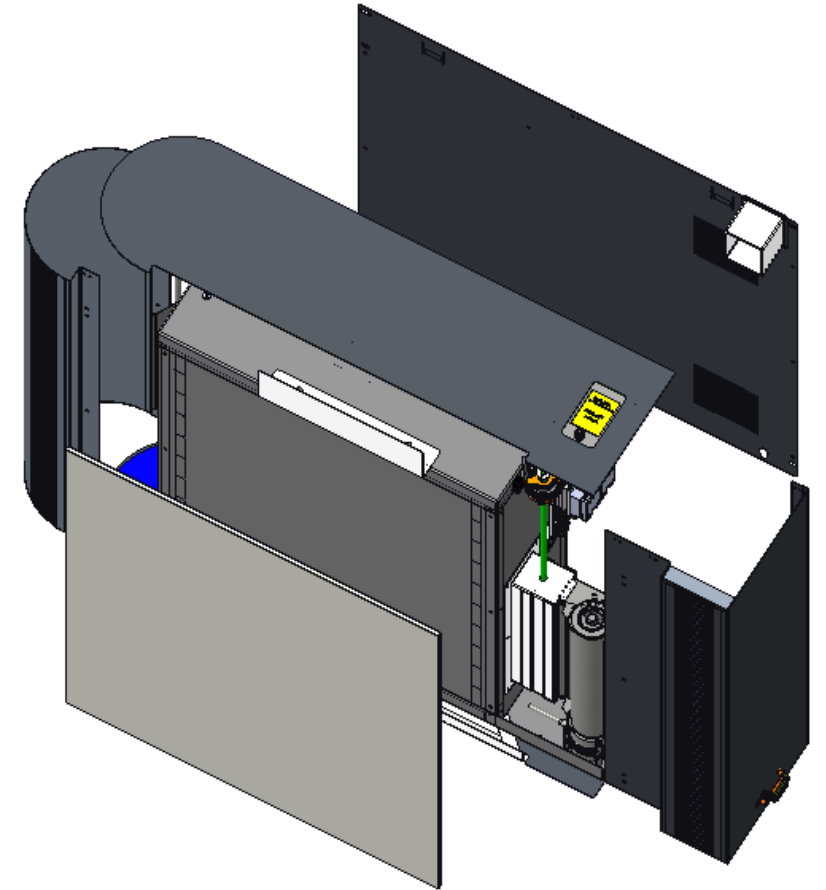
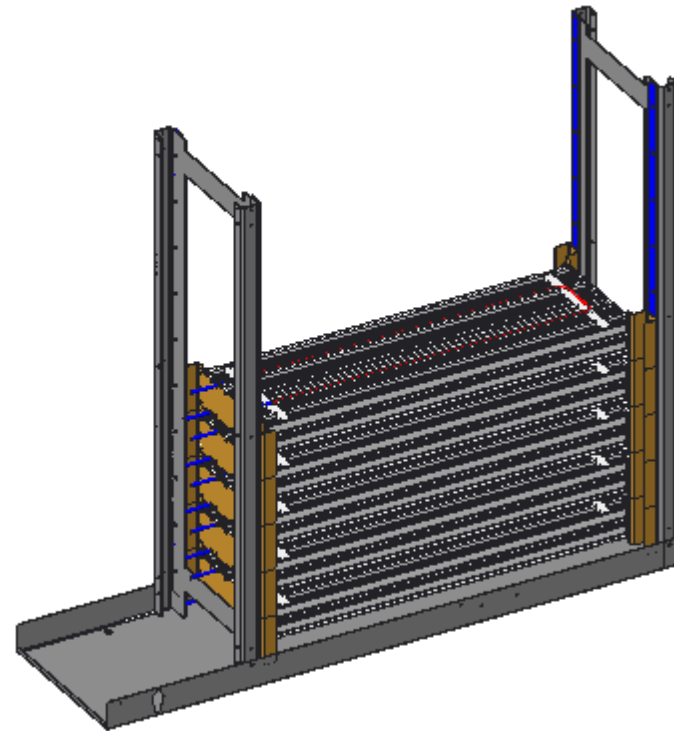
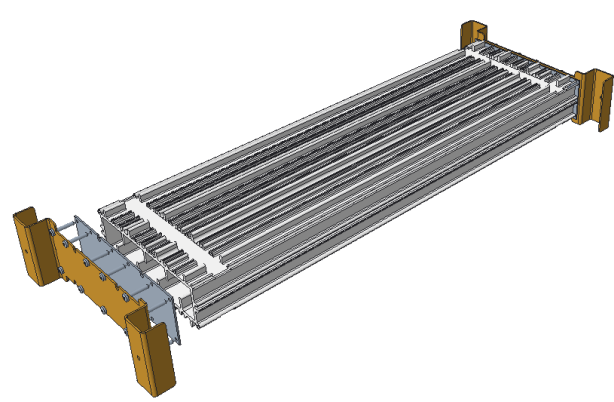
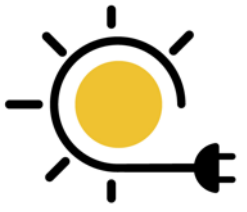
Casing design & optimization



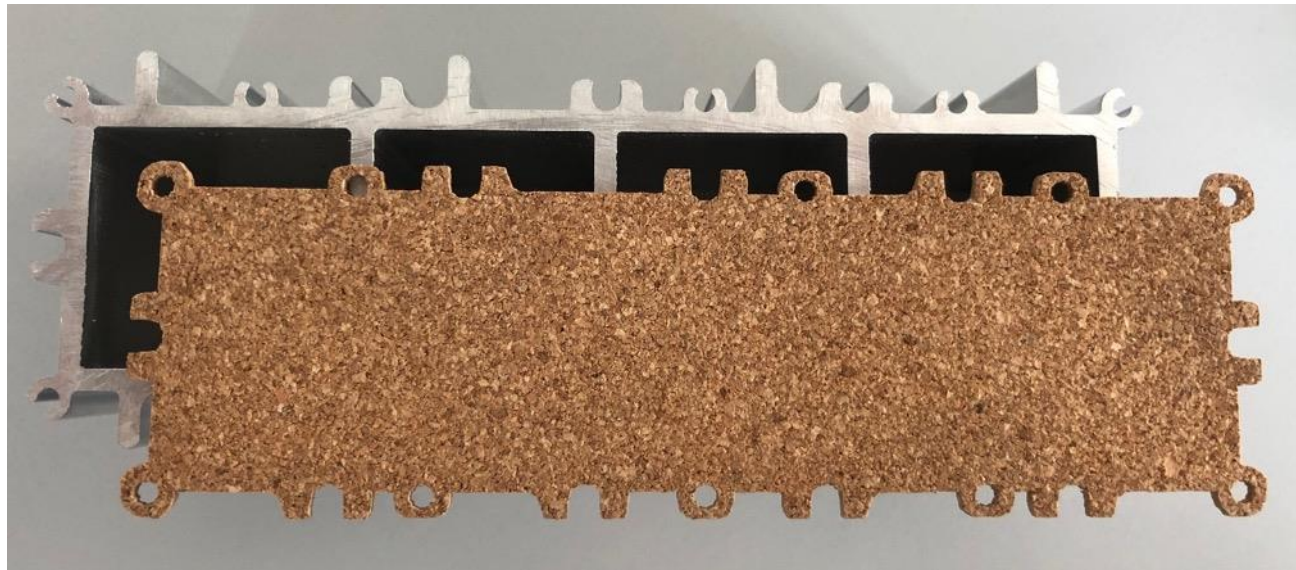
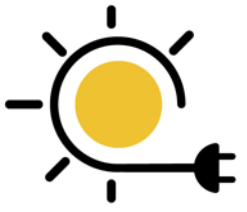
Mass fraction distribution – Discharging Process A53; inlet velocity 2.5m/s

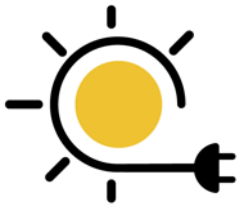


Appliance design

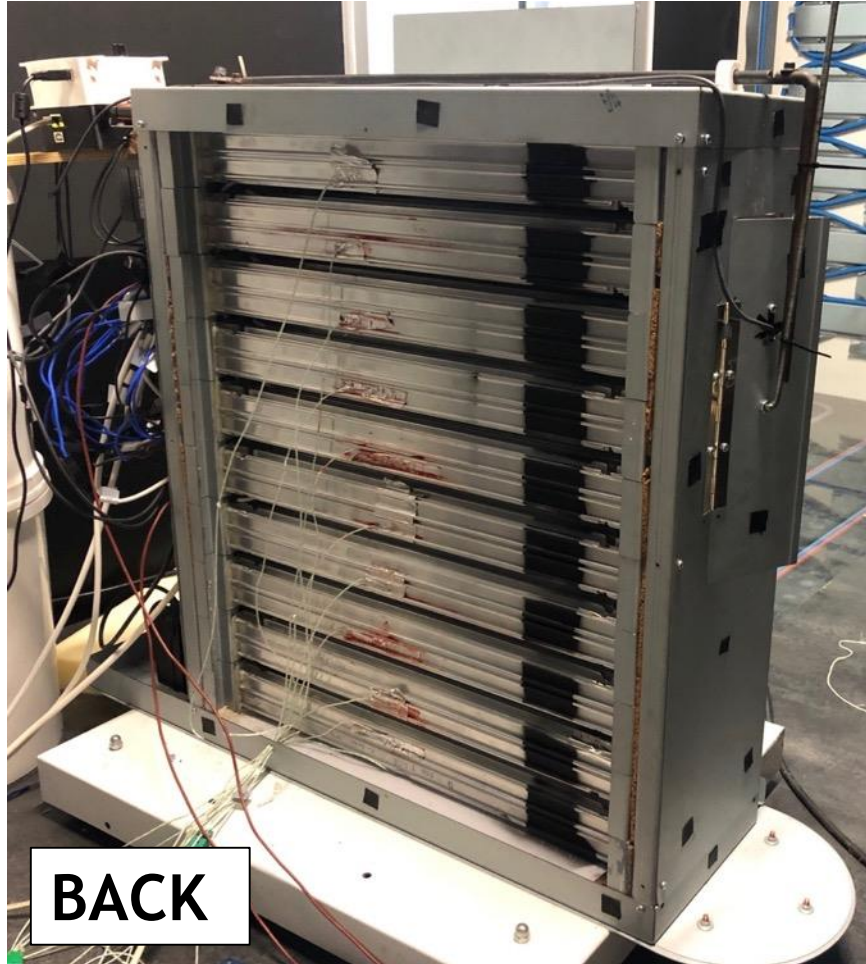
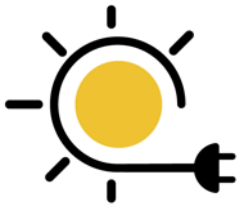


Casing manufacturing

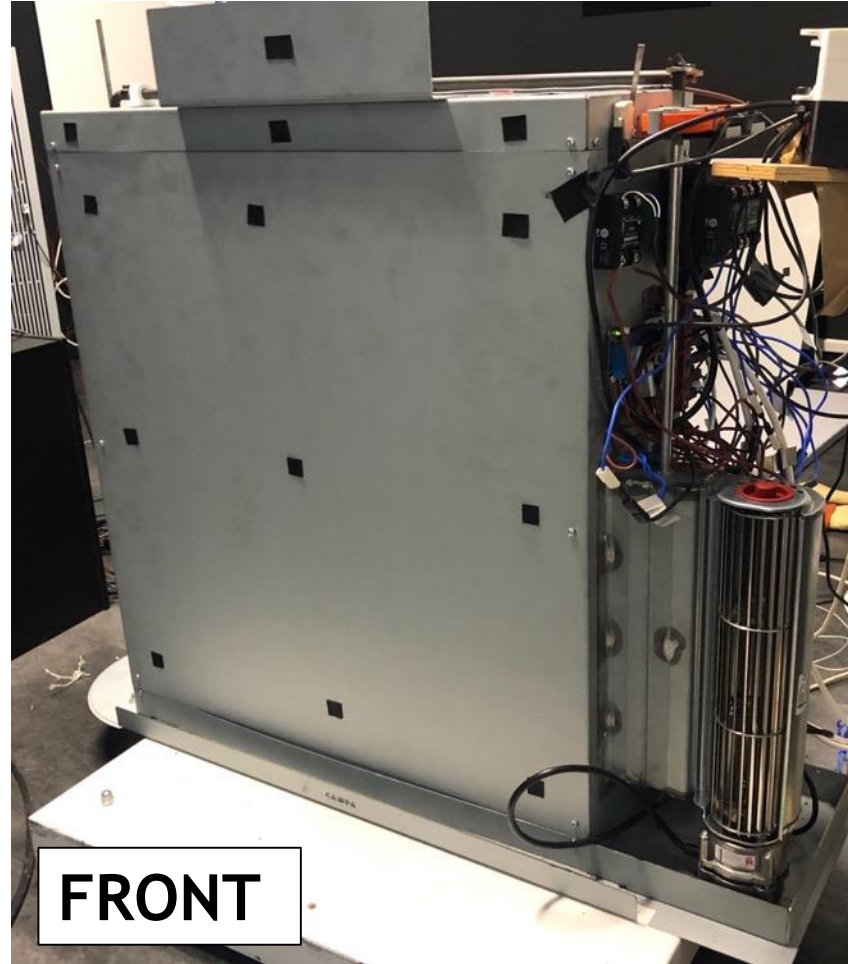




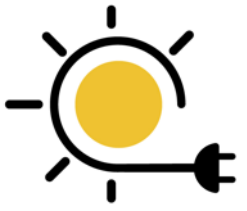
Prototyping



BACK



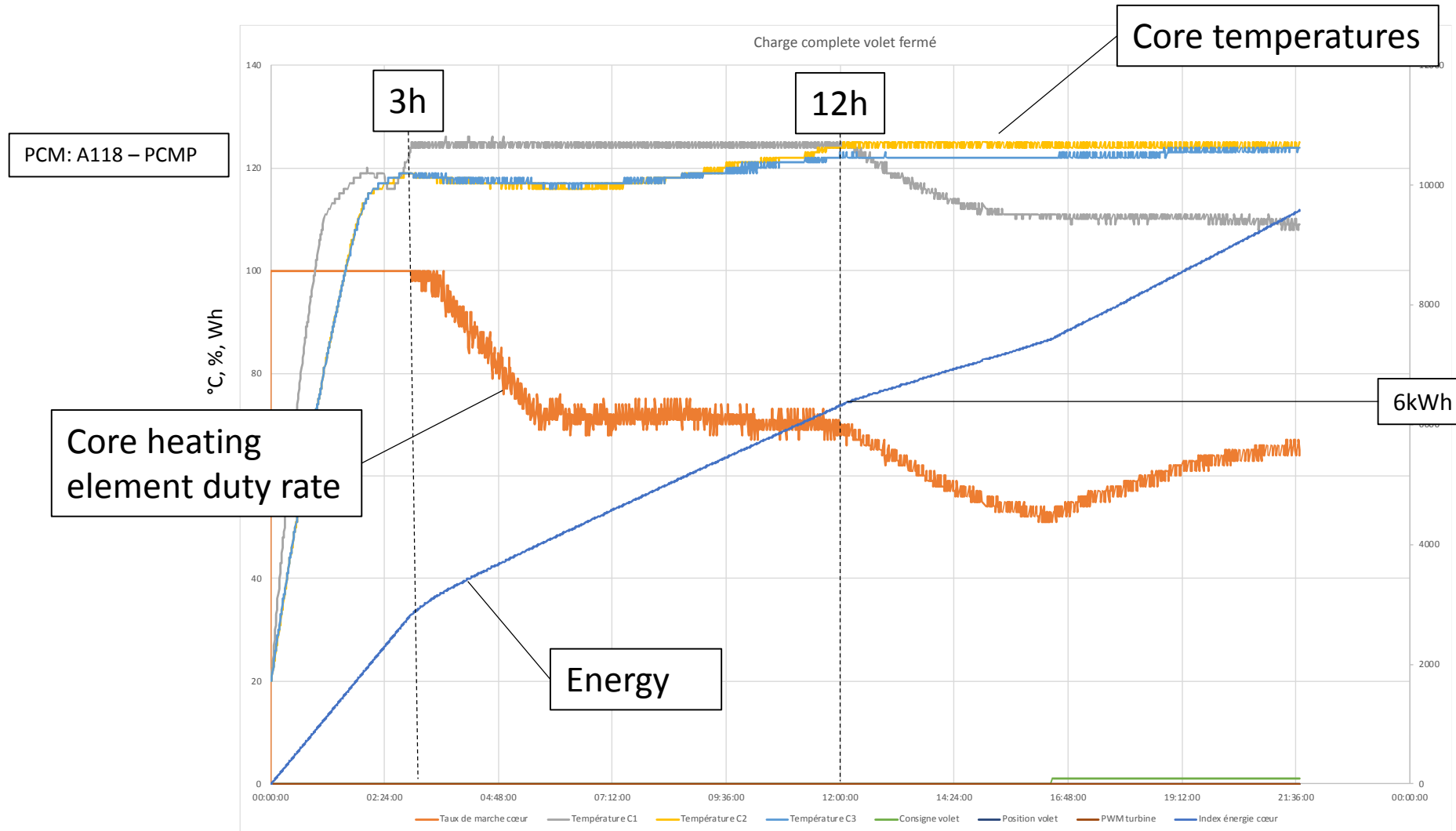
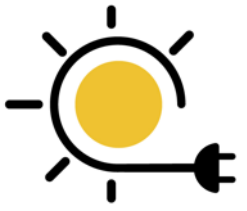
FRONT



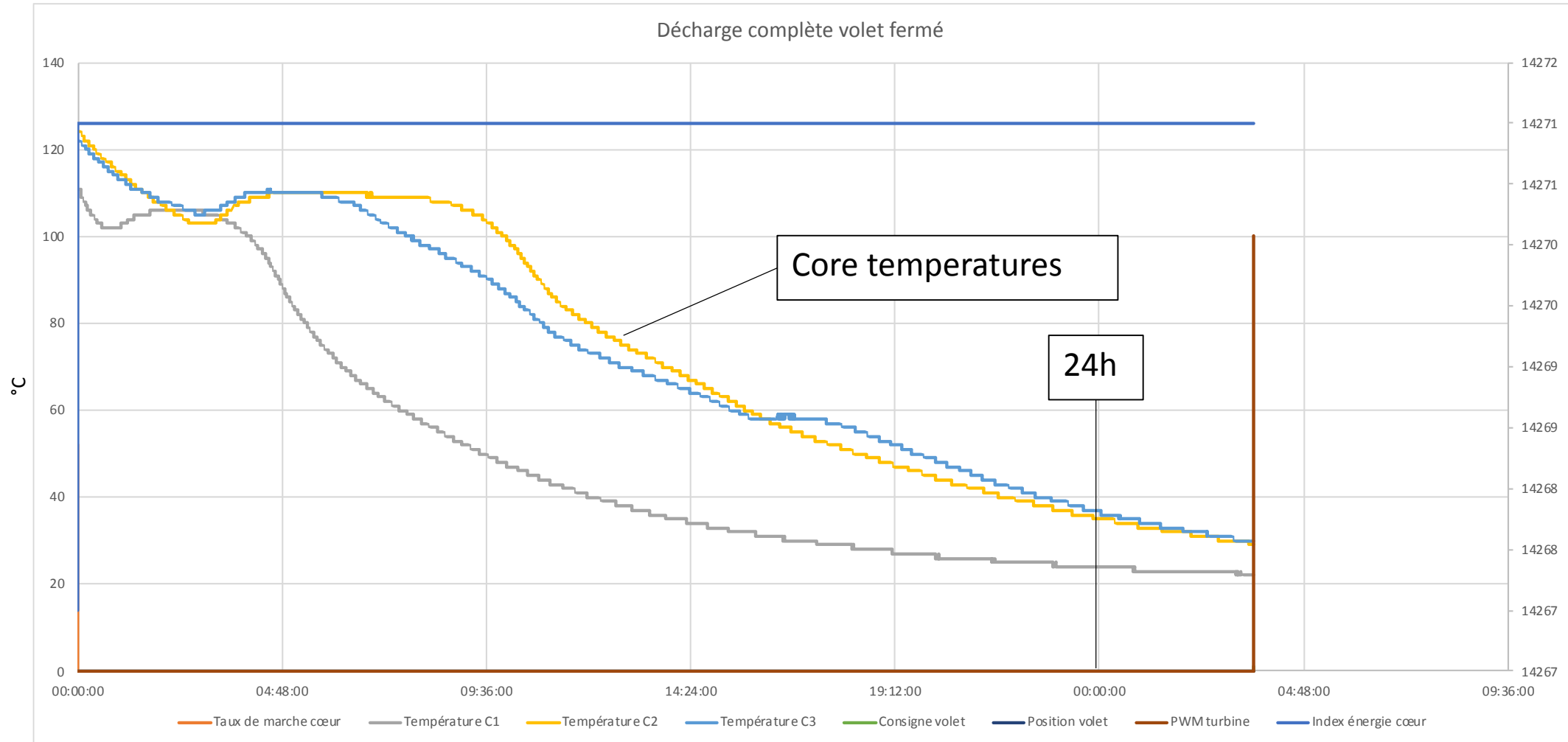
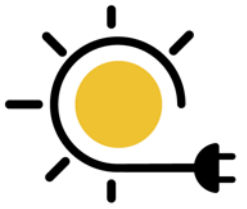
Test details :

- Safety tests
 - Electric & thermal
 - Overheat
 - Overvoltage
- Performance tests
 - Full charge up
 - Free discharge
 - Precise temperature room control

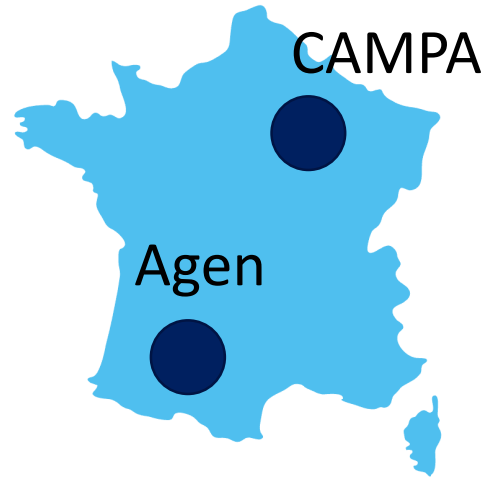
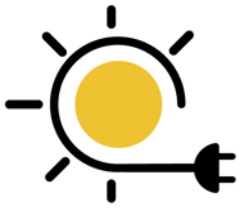
Prototype testing @CAMPA – Full charge



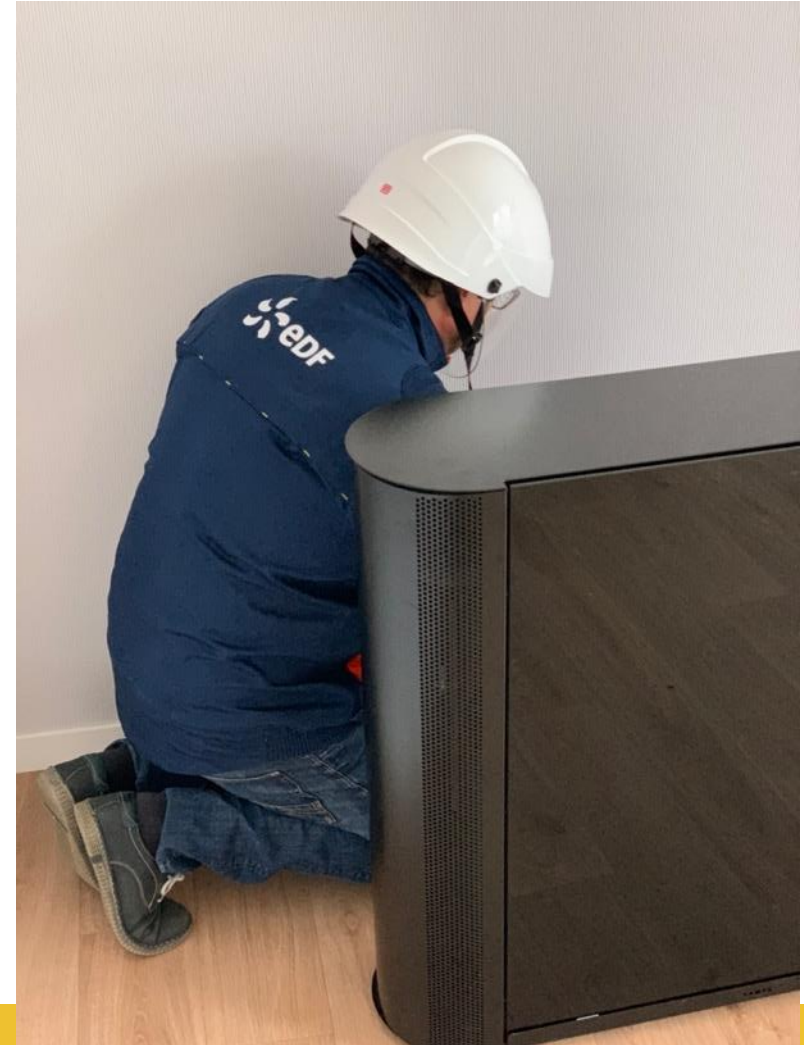
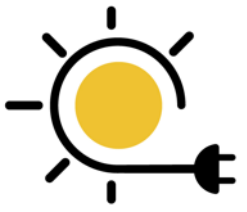
Prototype testing @CAMPA – Full discharge



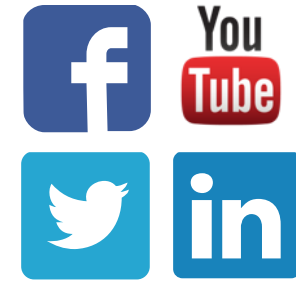
Commissioning



Demo site B demonstration



Thank you!



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for life



FENIX.TNT
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KÖNIG METALL


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