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SPICY Deliverable D5.6

Announcement about the manufacturing of Cells

WP	5	Manufacturing implementation
Task	5.6	Announcement about the manufacturing of Cells

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[1] Dissemination level: **PU** = Public, **PP** = Restricted to other programme participants (including the JU), **RE** = Restricted to a group specified by the consortium (including the JU), **CO** = Confidential, only for members of the consortium (including the JU)

[2] Nature of the deliverable: **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

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Deliverable abstract

Announcement about the GEN0 cells manufacturing. Main characteristic: capacity, weight, shape, energy density.

According to the cells specifications (SPICY deliverable D1.2), Gen0 cells have been manufactured.

Four different design have been provided by 3 partners: Cylindrical wound hard packaging cells, prismatic wound hard packaging cells, prismatic stacked hard packaging cells, and prismatic stacked soft packaging cells.

The main characteristics of the cells are described.

Deliverable Review

	Reviewer #1: Willy Porcher.....			**Reviewer #2: .....**		
	Answer	**Comments**	**Type***	**Answer**	**Comments**	**Type***
Is the deliverable in accordance with						
the Description of Work?	☒ Yes ☐ No		☐ M ☐ m ☐ a	☐ Yes ☐ No		☐ M ☐ m ☐ a
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that allows it to be sent to European Commission?	☒ Yes ☐ No		☐ M ☐ m ☐ a	☐ Yes ☐ No		☐ M ☐ m ☐ a
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Table of content

1. Introduction

Taking into account the cells specifications defined in the document D1.2, Gen 0 cells have been manufactured.

4 different designs have been provided by 3 partners:

30 cylindrical wound hard packaging cells manufactured by PROLLION

30 prismatic wound hard packaging cells manufactured by CEA,

29 prismatic stacked hard packaging cells manufactured by TUM,

24 prismatic stacked soft packaging cells manufactured by CEA.

The main characteristics of the manufactured cells are described in this document.

2. Cells Manufacturing

2.1. *Components & Conditioning*

In order to compare the different designs, all the Gen0 cells have common components (electrodes, separator, electrolyte) and have been conditioned with the same protocol. In particular, all the cells have been manufactured with LFP/ graphite electrodes provided by Prollion in October 2015, from the same batch of raw material. To remind, the characteristic of the electrodes (loading, thickness…) are described in D5.5.The separator is a tri-layers Celgard 2325 grade. The electrolyte is a blend of EC: PC: DMC in volume proportion (1:1:3) with 1M of $LiPF_6$ and 2%wt of VC.

The conditioning cycle is described in Annex.

2.2. *Prismatic stacked hard packaging cells*

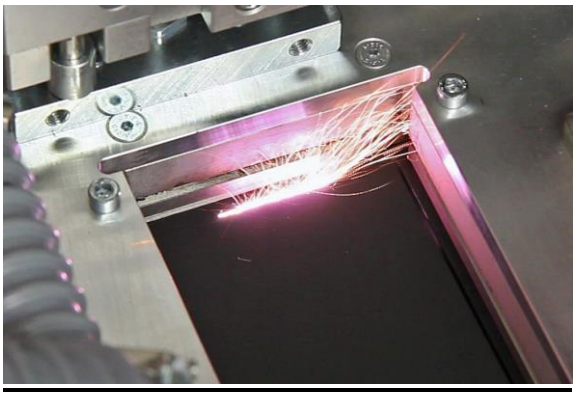
The prismatic stacked hard packaging cells were assembled by TUM. Cells were delivered in May 2016 after some issues as for example the drying of the electrode which has been adapted to the LFP graphite chemistry. 29 cells were delivered.

Prismatic stacked hard packaging cell (TUM); all pictures by Heddergot/TUM and iwb

The process to perform the stacks is fully done with automated equipments

- **Laser cutting of electrodes**

  The electrodes were cut with a laser into single electrode sheets.



- **Z-folding with continuous separator**

  In order to build the cell stack, the electrodes were stacked separately in between the z-folded separator.

- **Welding**

  The stack and the taps were connected with ultrasonic welding. The cans were welded by laser welding.

- **Electrolyte filling and conditioning**

  The cells were manually filled in a dry room and were conditioned subsequently inside a glove box.

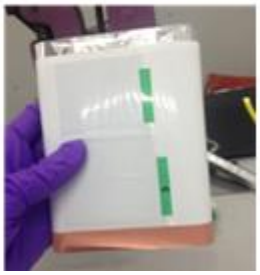
2.3. Wound cylindrical and prismatic hard packaging cells

The wound and prismatic cylindrical hard packaging cells were delivered respectively in January 2016 by Prollion and in March 2016 by CEA. 2 x 30 cells were delivered. Both designs have been manufactured on the same plateform, using the same equipments, except at the winding step. The equipments are designed to produce cells in series, fully automatized, except for the winding of the prismatic cells.

Prismatic and cylindrical wound hard packaging cell (CEA / Prollion); all pictures by Guillaudin/Cea or Avavian/CEA

- **Winding (jelly roll manufacturing)**

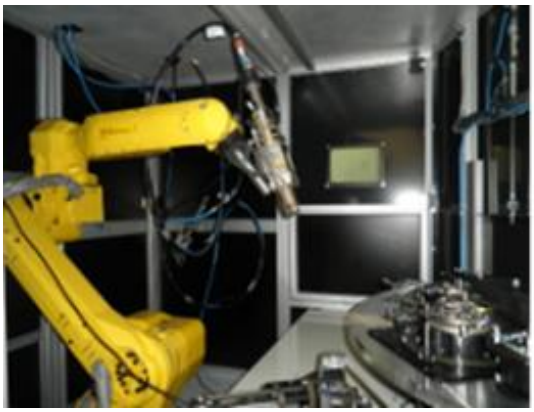
  Electrodes and separator were wound together on a flat or cylindrical core.

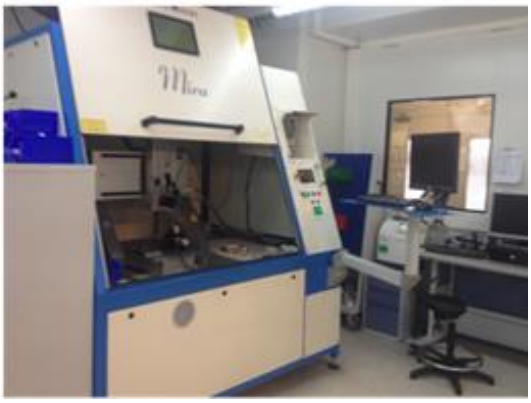


- ***Cell assembly:***

  The cells were assembled using different welding steps. After current collectors, top cap welding was the last assembly step.

  Then, cells were ready to be filled with electrolyte using the little aperture on the cap.





- ***Electrolyte filling and conditioning:***

  The cells were filled using different holders on the same machine and were conditioned outside the dry room.

2.4. Prismatic stacked soft packaging cell

The prismatic stacked soft packaging cells were delivered in June by CEA. They were the most difficult cells to produce and only 24 were successfully assembled. In fact, initially they had to be assembled using an equipment which was finally not purchased as not correctly designed. So most of the assembling was manual steps, needing a lot of manpower.

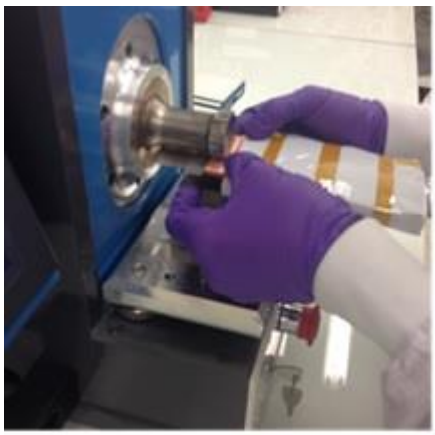
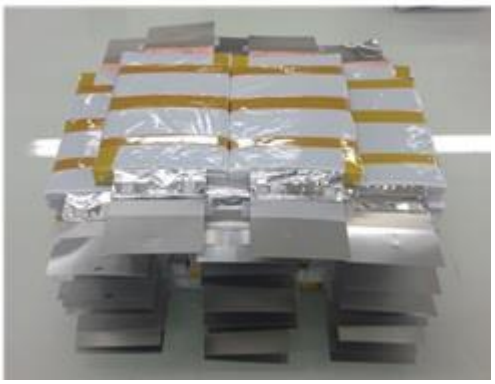
Prismatic and stacked soft packaging cell (CEA); all pictures by CEA

- **Electrodes and separators stacking :**

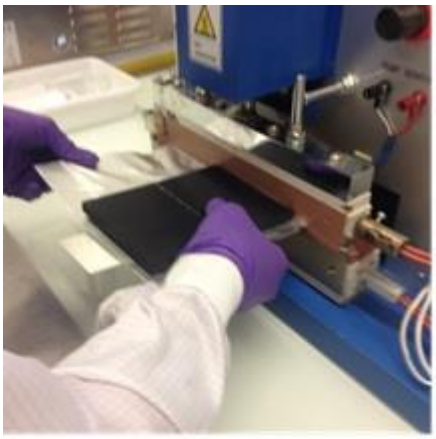
Each component, electrodes and separator of the stack was cut manually with a cutting press, then they were assembled to form the stack containing 38 anodes; 76 separators and 37 cathodes:

- **Welding :**

  Tabs were welded on terminals.

The stacks were placed between two half shells based of aluminium and heat sealed before the filling step.




- ***Electrolyte filling and conditioning:***

  The pouch cells were filled with electrolyte in a glove box and the remaining side was welded. After conditioning, the cells were degassed.

3. Results

3.1. GEN0 cells characteristics

Mean and main characteristics of the produced cells are in Table 1. It can be noticed that electrical values are not directly comparable with the specifications data. Specifications were built with C/5 C-rate, and the characterizations have been lead under C and C/10 C-rate.

It can be concluded with the values obtained at C-rate and C/10- rate that the C/5-rate specifications, which are intermediate, are reached for cylindrical and prismatic hard packaging 17Ah cells. The stacked cells, with prismatic soft and hard packaging provided by CEA and TUM, are a little under the specifications due to the design limitation.

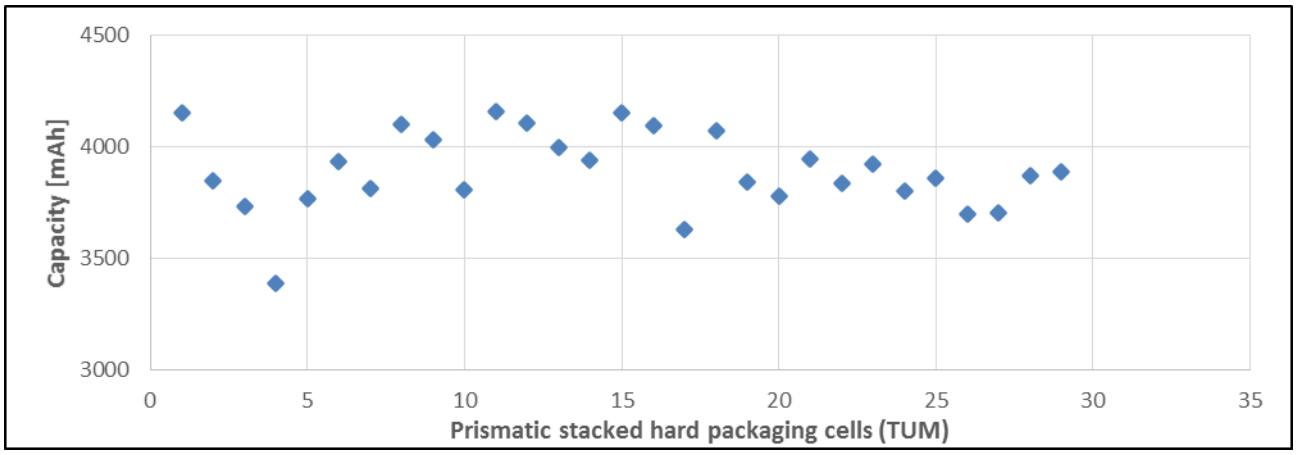
Concerning the specific energy, with a target at 130 Wh/kg with the cylindrical hard packaging, the fact that the electrochemical design was defined for a PHEV explains fully that we obtained a value of 110 Wh/kg. Noted that following the design, results are fairly different, with a casing heavier or cell less compact for a prismatic compared to a cylindrical shape with a rigid packaging. When we consider the soft packaging, with a casing so very light, more than 130 Wh/kg were obtained. For the TUM cell, the packaging is more generic and not optimized to obtain high specific energy values. Also, on a low capacity cells, the casing part is more important, explaining the value obtained.

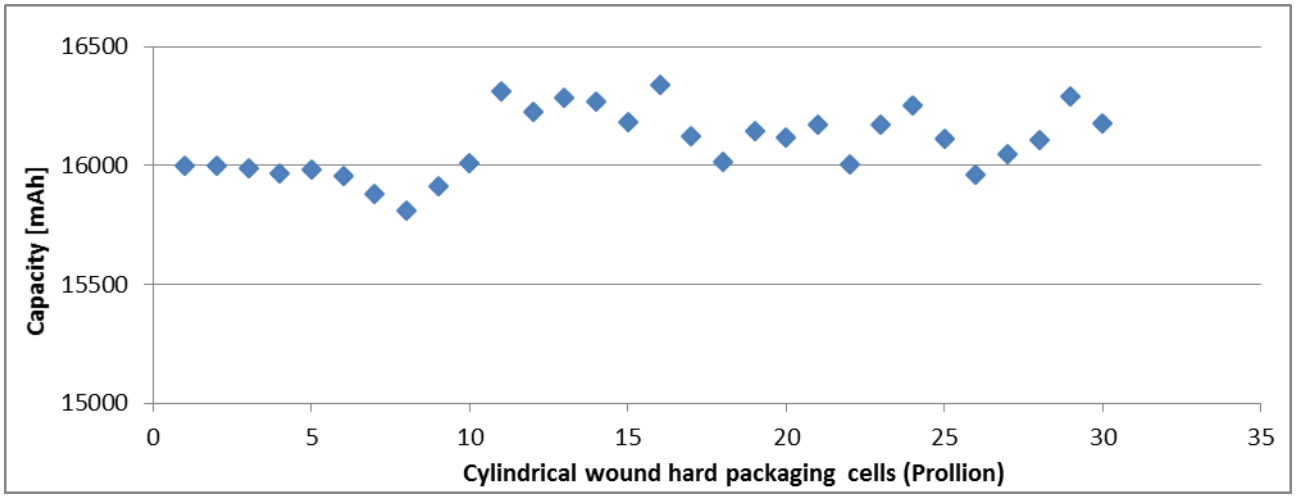
	Average Capacity (Ah)	Minimum Capacity	Weight (g)	Specific energy (Wh/kg)	Comments
Specifications (D1-2)- under C/5 C-rate	16.6	15.8	483 Cylindrical 493 Prismatic Hard P. 400 Prismatic Soft P.	110 Cylindrical 108 Prismatic Hard P. 133 Prismatic Soft P.	
Cylindrical hard packaging @ C @ C/10	16.1 16.8	15.8 16.4	474	106 116	Average on 30 cells
Prismatic hard packaging @ C @ C/10	15.9 17.2	15.2 16.8	542	91 105	Average on 30 cells
Prismatic Soft packaging @ C @ C/10	14.7 16.2	14 15.3	394	115 134	Average on 24 cells
Specifications (D1-2)- under C/5 C-rate	5	/	270	59	
Prismatic Hard packaging @ C	3.9	3.4	278	46	Average on 29 cells

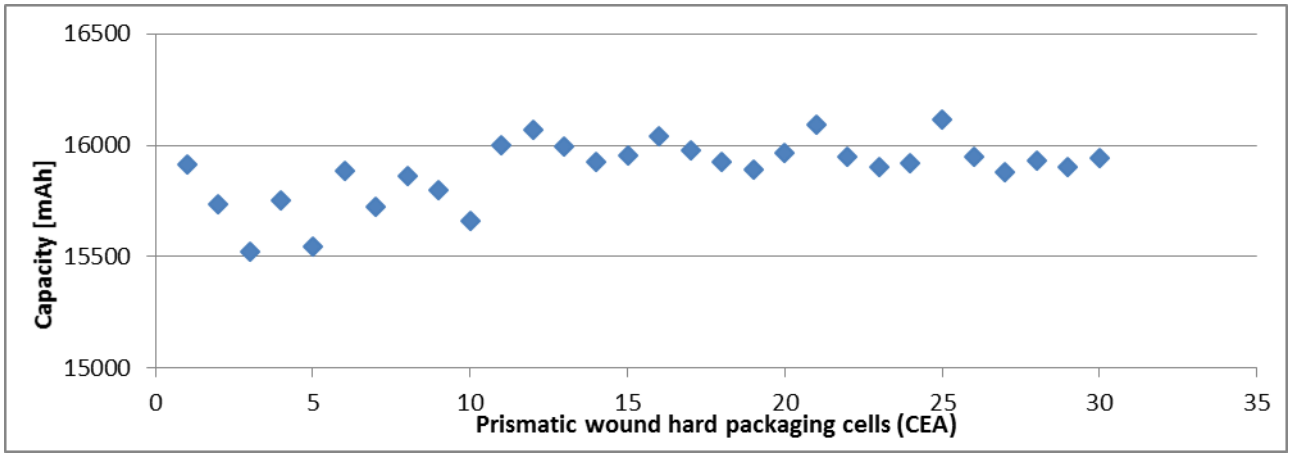
Table 1. Spicy GEN0 Cells main characteristics.

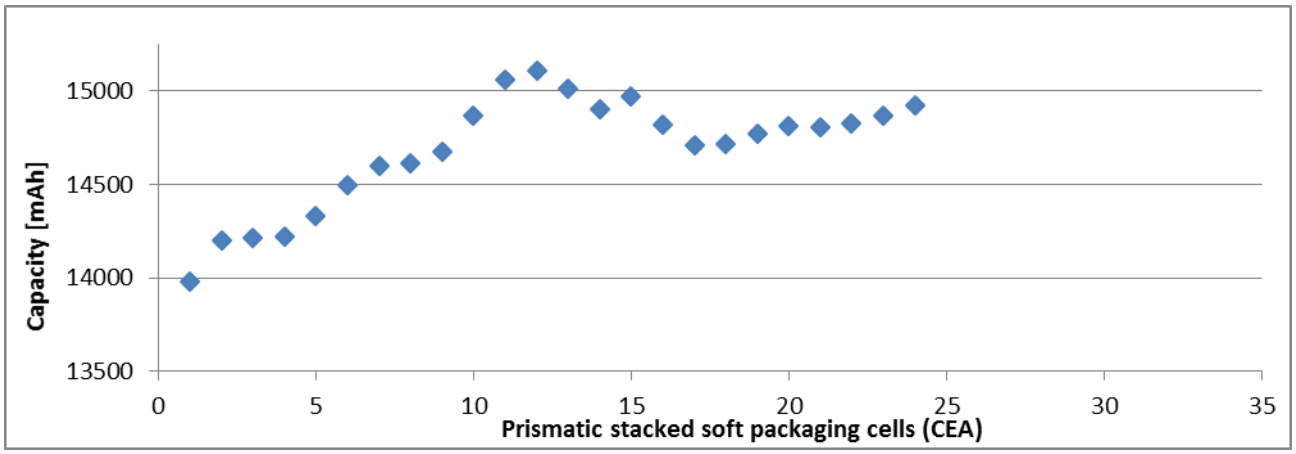
3.2. GEN0 cells capacity distribution

The Gen0 cells capacity distribution are reported in the following figures. The cylindrical hard packaging cells have the better distribution with no more than 2% of deviation. The deviation is of 3.5% for the prismatic wound hard packaging.


4500
4000
3500
3000
Capacity [mAh]
0
5
10
15
20
25
30
35
Prismatic stacked hard packaging cells (TUM)


16500
16000
15500
15000
Capacity [mAh]
0
5
10
15
20
25
30
35
Cylindrical wound hard packaging cells (Prollion)


16500
16000
15500
15000
Capacity [mAh]
0
5
10
15
20
25
30
35
Prismatic wound hard packaging cells (CEA)


15000
14500
14000
13500
Capacity [mAh]
0
5
10
15
20
25
30
35
Prismatic stacked soft packaging cells (CEA)

The stacked cells have the higher deviation, with 6% for CEA cells and 13% for TUM cells. For TUM, the fact that the cells have a lower capacity can certainly explain the result and for CEA, the fact that the process is mainly manual is most probably the reason. However, the general distribution of capacity of the cells is globally good and should enable to have relevant evaluation of these 4 designs.

3.3. Cells characteristics

Reference, capacity, resistance and weight of each cell are reported in the following table for prismatic stacked soft packaging cells manufactured by CEA. The tests and planned locations are also given.

Cell specifications	
Cathode material	LFP
Anode material	Gr
Lower Voltage limit (V)	2,5
Upper Voltage limit (V)	3,6
Maximum Charge current (A)	50
Maximum Discharge current (A)*	100
Temperature opration range	[-10°C,+55°C]**

*30s pulse
** Charge [+5°C,+55°C]
*** 30%SOC
**** Ri measurement : discharge 10s at C/5 then discharge 10s at C and Ri measurement

N°	Cell reference	Cell capacity [mAh] @ 1C	Voltage before delivery [V]***	AC resistance [mOhm]****	Weight [g]	Test	Delivery
1	Spicy-stack-07	13984	3,31	4,478	393	Abuse Test	CIDETEC
2	Spicy-stack-12	14198	3,31	4,47	397	Abuse Test	CIDETEC
3	Spicy-stack-10	14211	3,31	4,962	396	Abuse Test	CIDETEC
4	Spicy-stack-05	14221	3,31	4,322	380	Abuse Test	CIDETEC
5	Spicy-stack-24	14328	3,31	4,28	397	Abuse Test	CIDETEC
6	Spicy-stack-13	14496	3,31	4,074	391	Abuse Test	CIDETEC
7	Spicy-stack-09	14598	3,31	4,323	391	Abuse Test	CIDETEC
8	Spicy-stack-16	14611	3,31	4,611	399	Abuse Test	CIDETEC
9	Spicy-stack-18	14675	3,31	4,19	400	Abuse Test	CIDETEC
10	Spicy-stack-20	14864	3,31	4,096	399	Autopsie	FZJ
11	Spicy-stack-03	15057	3,31	3,859	391	Initial perf.	VITO
12	Spicy-stack-19	15106	3,31	3,655	398	Initial Perf.	VITO
13	Spicy-stack-22	14817	3,31	4,419	398	Life cycling	VITO
14	Spicy-stack-04	14904	3,31	4,704	384	Life cycling	VITO
15	Spicy-stack-14	14967	3,31	4,854	399	Life cycling	VITO
16	Spicy-stack-17	15010	3,31	3,779	399	Life cycling	VITO
17	Spicy-stack-02	14710	3,31	4,36	384	Life cycling	VITO
18	Spicy-stack-25	14713	3,31	4,587	391	Life cycling	VITO
19	Spicy-stack-23	14768	3,31	4,021	394	Life cycling	VITO
20	Spicy-stack-01	14812	3,31	3,978	389	Life cycling	VITO
21	Spicy-stack-06	14806	3,31	4,161	399	Storage	VITO
22	Spicy-stack-11	14822	3,31	4,021	394	Storage	VITO
23	Spicy-stack-08	14868	3,31	4,361	401	Storage	VITO
24	Spicy-stack-21	14923	3,31	4,957	398	Storage	VITO

Reference, capacity, resistance and weight of each cell are reported in the following table for prismatic stacked hard packaging cells manufactured by TUM. The test and location is also given.

Cell specifications	
Cathode material	LFP
Anode material	GR
Lower Voltage limit (V)	2,5
Upper Voltage limit (V)	3,6
Maximum charge current (A)	4 A
Maximum discharge current (A)*	4 A*
Temperature operation range	[0°C, +45°C]

*normal cycling; rate tests up to 12 A

N°	Cell reference	Cell capacity [mAh] @ 1C	Voltage before delivery [V]***	AC resistance [mOhm]****	Weight [g]	Test	Delivery
1	102	4149	3,29	17,8	278,7	Life cycling 5°C	FZJ
2	723	3849	3,29	12,3	278,5	Storage 45°C	KIT
3	725	3732	3,29	29,8	278,6	Abuse tests	CEA
4	726	3389	3,29	16,9	279,2	Life cycling 5°C	FZJ
5	728	3767	3,29	12,3	278,4	Life cycling 5°C	FZJ
6	733	3936	3,29	16,6	278,1	Abuse tests	CEA
7	734	3810	3,29	11,7	278,5	Life cycling 5°C	FZJ
8	737	4098	3,28	11,8	278,9	Abuse tests	CEA
9	742	4031	3,28	16,6	278,5	Abuse tests	CEA
10	778	3806	3,29	10,9	279,7	Life cycling 5°C	FZJ
11	779	4156	3,29	11,2	278,3	Abuse tests	CEA
12	784	4103	3,29	16,4	277,9	Abuse tests	CEA
13	786	3995	3,29	15,2	277,3	Life cycling 5°C	FZJ
14	789	3940	3,29	14,4	278,5	Storage 45°C	KIT
15	790	4154	3,29	14,9	279,4	Autopsy	FZJ
16	791	4092	3,29	15,7	278,5	Autopsy	FZJ
17	794	3629	3,29	18,7	277,9	Initial performance	Cidetec
18	798	4074	3,29	16,2	278,3		FZJ
19	799	3842	3,27	16,0	276,8	Storage 45°C	KIT
20	804	3775	3,28	16,0	277,5	Storage 45°C	KIT
21	805	3945	3,29	16,6	278,2	Life cycling 25°C	TUM
22	808	3836	3,29	16,5	278,6	Storage 45°C	KIT
23	814	3919	3,29	17,3	278,5	Life cycling 25°C	TUM
24	815	3804	3,29	17,8	278,3	Life cycling 45°C	TUM
25	816	3860	3,29	16,5	278,7	Life cycling 45°C	TUM
26	818	3698	3,29	16,5	278,5	Initial performance	Cidetec
27	820	3705	3,29	17,8	278,6	Life cycling 45°C	TUM
28	824	3870	3,29	12,3	279,2	Life cycling 45°C	TUM
29	825	3888	3,29	29,8	278,4	Storage 45°C	KIT

Reference, capacity, resistance and weight of each cell are reported in the following table for cylindrical wound hard packaging cells manufactured by Prollion. The test and location is also given.

Cell specifications	
Cathode material	LFP
Anode material	Gr
Lower Voltage limit (V)	2,5
Upper Voltage limit (V)	3,6
Maximum Charge current (A)	50
Maximum Discharge current (A)*	100
Temperature opration range	[-10°C,+55°C]**

*30s pulse
** Charge [+5°C,+55°C]
*** 30%SOC
**** Ri measurement : discharge 10s at C/5 then discharge 10s at C and Ri measurement

N°	Cell reference	Cell capacity [mAh] @ 1C	Voltage before delivery [V]***	AC resistance [mOhm]****	Weight [g]	Test	Delivery
1	1600133002030	16000	3,3	3,249	474,2	Abuse Test 1	CEA/INES
2	1600133002043	15999	3,3	2,985	472,8	Abuse Test 1	CEA/INES
3	1600133002048	15989	3,3	3,206	474,1	Abuse Test 1	CEA/INES
4	1600133002011	15969	3,3	3,227	473,3	Abuse Test 2,3	CEA/Ripault
5	1600133002019	15982	3,3	3,198	473,1	Abuse Test 2,3	CEA/Ripault
6	1600133002018	15954	3,3	3,059	472	Abuse Test 2,3	CEA/Ripault
7	1600133002016	15882	3,3	3,403	474,5	Abuse Test 2,3	CEA/Ripault
8	1600133002026	15808	3,3	3,036	467,6	Abuse Test 2,3	CEA/Ripault
9	1600133002050	15914	3,3	3,242	473,1	Abuse Test 2,3	CEA/Ripault
10	1600133002052	16008	3,3	3,095	472,8	Autopsie	CEA/Grenoble
11	1600133002004	16313	3,3	2,742	475,8	Initial performance	CIDETEC
12	1600133002005	16225	3,3	2,911	474,5	Initial Performance	CIDETEC
13	1600133002022	16285	3,3	2,698	474,9	Life cycling	CEA/Grenoble
14	1600133002031	16268	3,3	2,853	475,2	Life cycling	CEA/Grenoble
15	1600133002033	16183	3,3	3,022	474,6	Life cycling	CEA/Grenoble
16	1600133002034	16338	3,3	3,058	474,9	Life cycling	CEA/Grenoble
17	1600133002036	16123	3,3	3,089	474,6	Life cycling	CEA/Grenoble
18	1600133002044	16013	3,3	3,323	475,1	Life cycling	CEA/Grenoble
19	1600133002006	16145	3,3	3,125	474,8	Life cycling 5°C	CIDETEC
20	1600133002007	16117	3,3	2,992	472,8	Life cycling 5°C	CIDETEC
21	1600133002008	16174	3,3	3,102	474,5	Life cycling 5°C	CIDETEC
22	1600133002013	16006	3,3	2,838	468,8	Life cycling 5°C	CIDETEC
23	1600133002014	16171	3,3	3,058	475,3	Life cycling 5°C	CIDETEC
24	1600133002015	16252	3,3	2,83	475,6	Life cycling 5°C	CIDETEC
25	1600133002010	16115	3,3	3,118	474,7	Storage	TUM
26	1600133002017	15960	3,3	3,301	474,1	Storage	TUM
27	1600133002021	16050	3,3	3,021	473,1	Storage	TUM
28	1600133002023	16105	3,3	3	473,8	Storage	TUM
29	1600133002027	16291	3,3	2,794	475	Storage	TUM
30	1600133002028	16175	3,3	2,963	474,7	Storage	TUM

Reference, capacity, resistance and weight of each cell are reported in the following table for prismatic wound hard packaging cells manufactured by CEA. The test and location is also given.

Cell specifications	
Cathode material	LFP
Anode material	Gr
Lower Voltage limit (V)	2,5
Upper Voltage limit (V)	3,6
Maximum Charge current (A)	50
Maximum Discharge current (A)*	100
Temperature opration range	[-10°C,+55°C]**

*30s pulse
** Charge [+5°C,+55°C]
*** 30%SOC
**** Ri measurement : discharge 10s at C/5 then discharge 10s at C and Ri measurement

N°	Cell reference	Cell capacity [mAh] @ 1C	Voltage before delivery [V]***	AC resistance [mOhm]****	Weight [g]	Test	Delivery
1	1600833001043	15912	3,31	3,41	535,7	Abuse Test 1	CEA/INES
2	1600833001037	15733	3,31	3,80	543,7	Abuse Test 1	CEA/INES
3	1600833001038	15522	3,31	3,88	539,9	Abuse Test 1	CEA/INES
4	1600833001001	15752	3,30	3,29	543,5	Abuse Test 2,3	CEA/Ripault
5	1600833001003	15548	3,30	3,33	540,8	Abuse Test 2,3	CEA/Ripault
6	1600833001020	15883	3,30	3,67	543	Abuse Test 2,3	CEA/Ripault
7	1600833001007	15722	3,29	3,43	544,2	Abuse Test 2,3	CEA/Ripault
8	1600833001035	15861	3,29	3,78	542	Abuse Test 2,3	CEA/Ripault
9	1600833001031	15799	3,29	3,68	541,3	Abuse Test 2,3	CEA/Ripault
10	1600833001039	15661	3,31	3,53	536	Autopsie	CEA/Grenoble
11	1600833001011	16003	3,29	3,52	542	Initial performance	VITO
12	1600833001013	16072	3,29	3,32	542,1	Initial Performance	VITO
13	1600833001005	15995	3,29	3,22	543,3	Life cycling	CEA/Grenoble
14	1600833001010	15925	3,29	3,15	534,5	Life cycling	CEA/Grenoble
15	1600833001023	15955	3,29	3,63	541,4	Life cycling	CEA/Grenoble
16	1600833001026	16042	3,29	3,58	541,8	Life cycling	CEA/Grenoble
17	1600833001034	15976	3,29	3,66	541,9	Life cycling	CEA/Grenoble
18	1600833001036	15927	3,29	3,68	542,9	Life cycling	CEA/Grenoble
19	1600833001025	15892	3,29	3,71	541,3	Life cycling 5°C	CIDETEC
20	1600833001027	15963	3,29	3,72	543,4	Life cycling 5°C	CIDETEC
21	1600833001029	16095	3,29	3,63	544,3	Life cycling 5°C	CIDETEC
22	1600833001030	15946	3,29	3,61	542,1	Life cycling 5°C	CIDETEC
23	1600833001032	15902	3,29	3,65	540,8	Life cycling 5°C	CIDETEC
24	1600833001033	15919	3,29	3,66	542,6	Life cycling 5°C	CIDETEC
25	1600833001014	16113	3,29	3,41	542	Storage	VITO
26	1600833001015	15946	3,29	3,55	542,3	Storage	VITO
27	1600833001016	15877	3,29	3,63	541,8	Storage	VITO
28	1600833001017	15933	3,29	3,55	541,8	Storage	VITO
29	1600833001019	15901	3,29	3,59	541,7	Storage	VITO
30	1600833001024	15943	3,29	3,69	541,4	Storage	VITO

3.4. Gen0 cells : Weight contribution of each components

As requested for the cost analysis and life cycle analysis in the WP8, weight contribution of components and materials are reported for every designs, for each components in Table 2. In the Table 3, materials percentage are reported for every designs.

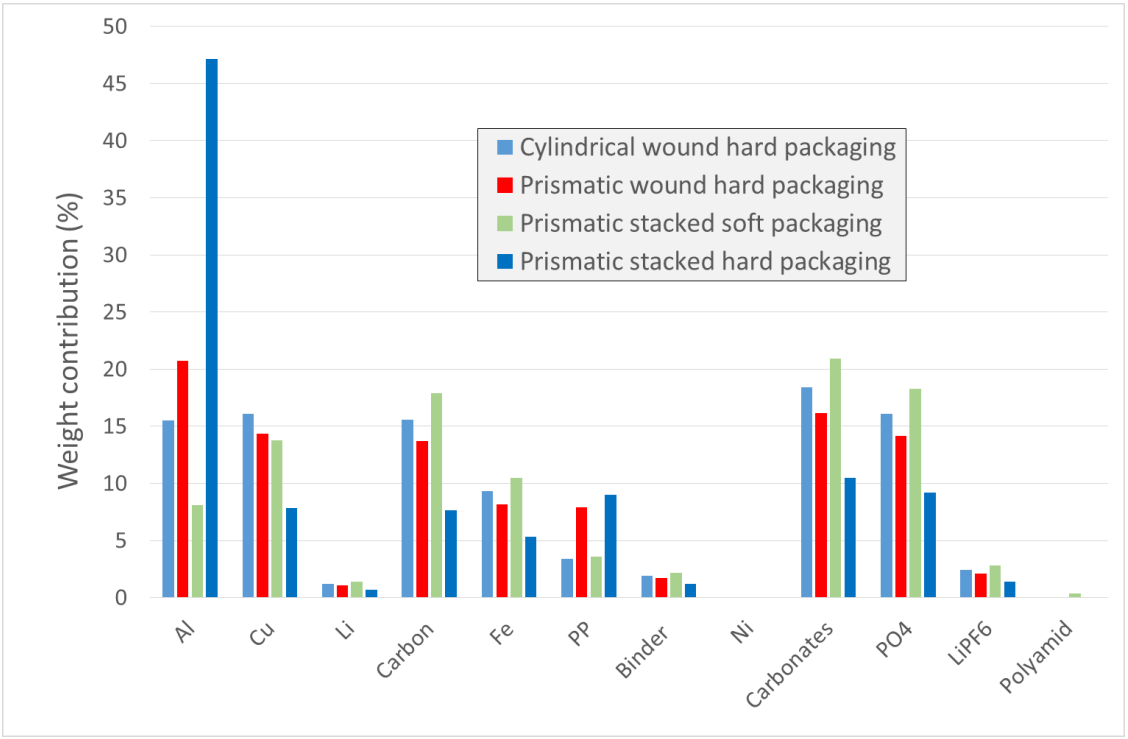
Weight (g)	Cylindrical wound hard packaging	Prismatic wound hard packaging	Prismatic Stacked Soft packaging	Prismatic Stacked hard packaging	
Electrode collector	26,78	26,78	24,49	8,24	Al
	55,53	55,53	48,59	16,81	Cu
Electrode coating					
	73,99	73,99	71,10	21,48	Carbon
	5,93	5,93	5,63	2,01	Li
	43,94	43,94	41,69	14,93	Fe
	76,43	76,43	72,51	25,96	PO4
	9,15	9,15	6,12	2,18	Binder
Separator	11,30	11,30	10,45	2,09	Polypropylene
Electrolyte					
	11,74	11,74	11,10	3,89	LiPF6
	87,40	87,80	82,90	29,08	Carbonate
Mechanical parts (packaging , collectors, core …)					
	46,54	85,19	7,70	122,71	Al
	5,06	31,41	3,80	22,92	Polypropylene
	20,88	22,04	6,01	5,04	Cu
	0,18	0,26	0,20	0,00	Ni
			1,50		Polyamid
			0,37		Other
Total	475	542	394	278	
SPICY GEN0 cells weight average (g)	474	542	394	277	

Table 2 – Weight contribution of each component for the 4 designs

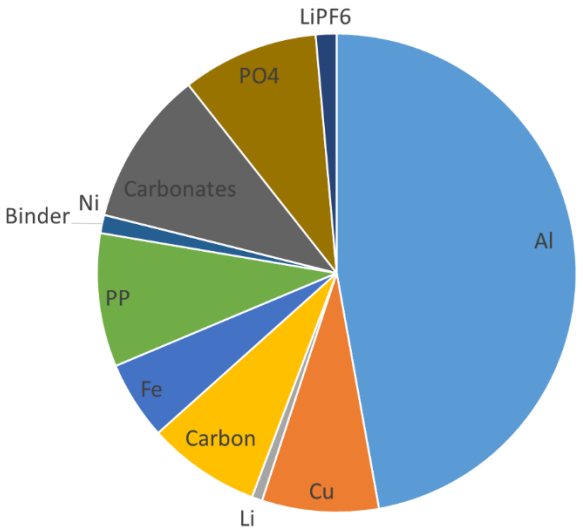
Main difference between every designs is the weight of casing first, with a strong advantage for the soft packaging. Then at a second level, the weight of the core and the internal design explain the differences.

Weight(g)	Cylindrical wound hard packaging	%	Prismatic wound hard packaging	%	Prismatic Stacked Soft packaging	%	Prismatic Stacked hard packaging	%
Al	73,32	15,5	111,97	20,71	32,19	8,11	130,95	47,22
Cu	76,4	16,1	77,57	14,34	54,60	13,76	21,85	7,88
Li	5,93	1,2	5,93	1,10	5,63	1,42	2,01	0,72
Carbon	73,99	15,6	73,99	13,68	71,10	17,92	21,48	7,75
Fe	43,94	9,3	43,94	8,13	41,69	10,51	14,93	5,38
PP	16,36	3,4	42,71	7,90	14,25	3,59	25,01	9,02
Binder	9,15	1,9	9,15	1,69	6,12	2,19	2,18	0,79
Ni	0,18	0,04	0,26	0,05	0,20	0,05	-	-
Carbonates	87,4	18,4	87,4	16,16	82,90	20,90	29,08	10,49
PO4	76,43	16,1	76,43	14,13	72,51	18,28	25,96	9,36
LiPF6	11,4	2,4	11,4	2,11	11.1	2,80	3,89	1,40
Polyamid					1,50	0,38		
Adhesive					0,37	0,09		
Total weight(g)	475		541		397		277	

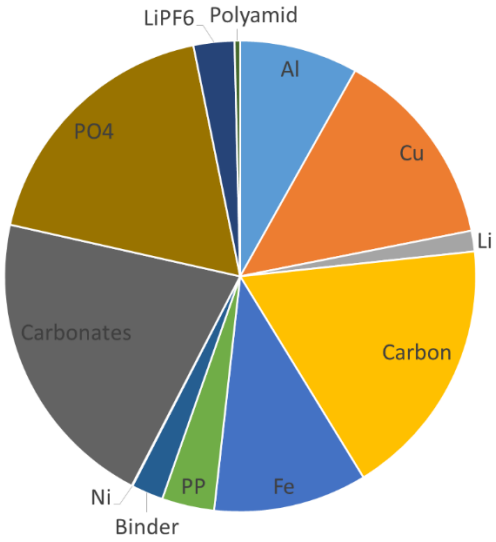
Table 3 – Weight contribution of each material for the 4 designs



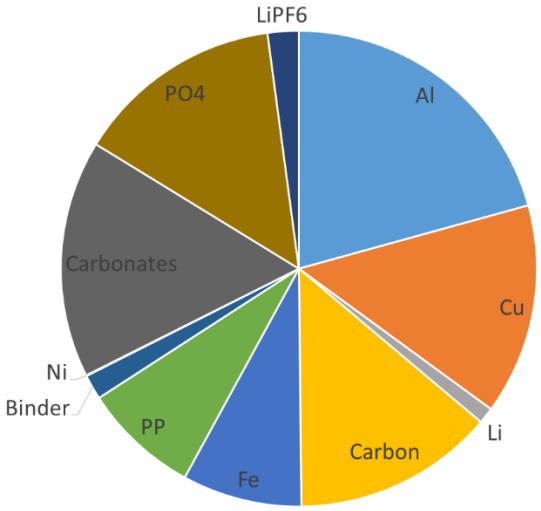
Prismatic stacked hard packaging



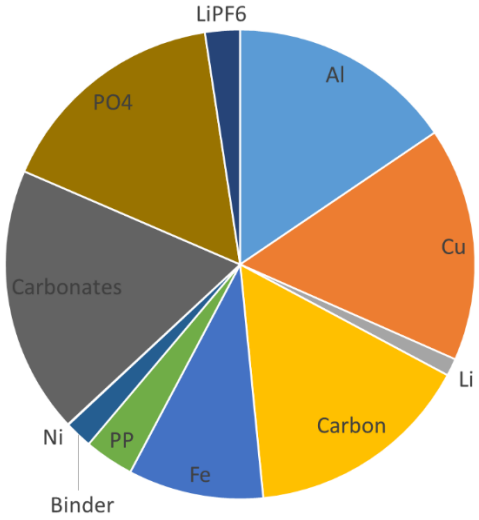
Prismatic stacked soft packaging



Prismatic wound hard packaging



Cylindrical wound hard packaging



4. Conclusion

All the cells were delivered from January to June 2016 for the 4 different designs. Even if the electrodes were reference electrode for the project, more than 6 months were necessary to assemble 2 designs:

- For the prismatic stacked soft packaging, the delay (2 months) was due to the fact that the equipment planned to make them was actually not purchased because it was not compliant with the needs. The stacks were assembled manually, required a lot of manpower and only 24 cells could be delivered. Even if this design shows the better specific energy (130Wh/kg), it is impossible to plan to make others cells for next generations with this process at CEA.
- For the prismatic stacked hard packaging, the delay (1 month) was due to the fact that TUM has to adapt its cell conception to this chemistry especially.

With all the Gen0 cells manufactured, the general distribution of capacity of the cells is globally good and should enable to have relevant evaluation of these 4 designs in WP6. The specific density energy obtained (110Wh/kg for the cylindrical hard packaging by Prollion) are compliant with what expected in D1.2, considering that the design is for a PHEV application.

Data have been provided also for the LCA in WP8, with the weight contribution of components and materials for every designs.

5. Annex

SPICY
Conditioning and Characterization cycles :

Conditioning

TUM cells: Precharge at C/10, 25°C until voltage reaches 3.0V

Other cells: Precharge at 1C for 5s

Impregnation: 10h / 45°C

Charge at 45°C and at constant current C/10 until 3.6V then charge at constant voltage until current drops to C/100

Rest 30min

Discharge at 45°C and at constant current C/10 until 2.5V

Rest ~30 min - 1h (= time to go from 45°C to 25°C)

Characterization

Charge at 1C and at 25°C until 3.6V, then charge at constant voltage until current drops to C/100.

Rest 15 min

Discharge at 1C and at 25°C to 50% DOD

Rest XXX

Internal resistance measurement (discharge 10s at C/5 then discharge 10s at C)

Discharge at 1C and at 25°C to 2.5V

Rest 15min

Charge at 1C and at 25°C to 30% SOC