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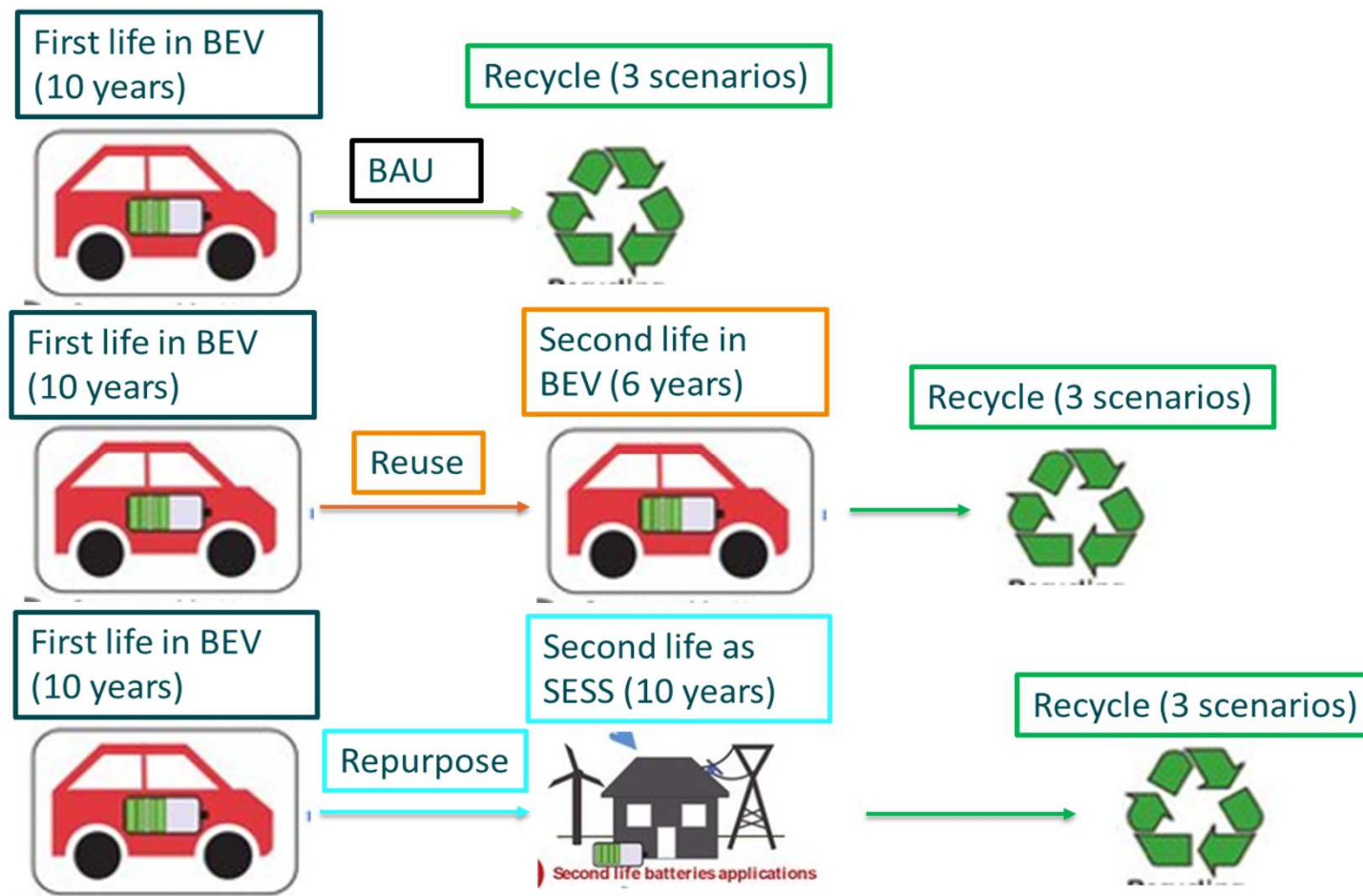
Faculty of  
Engineering

# End of life options for Electric Vehicle batteries

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# 1. Possible life cycle management choices

- Considering the current technology and market situation, the life cycle management of EV batteries shows three possible paths of second life and three possible recycling choices (*orientative life-spans shown*)



## 2. European legislation

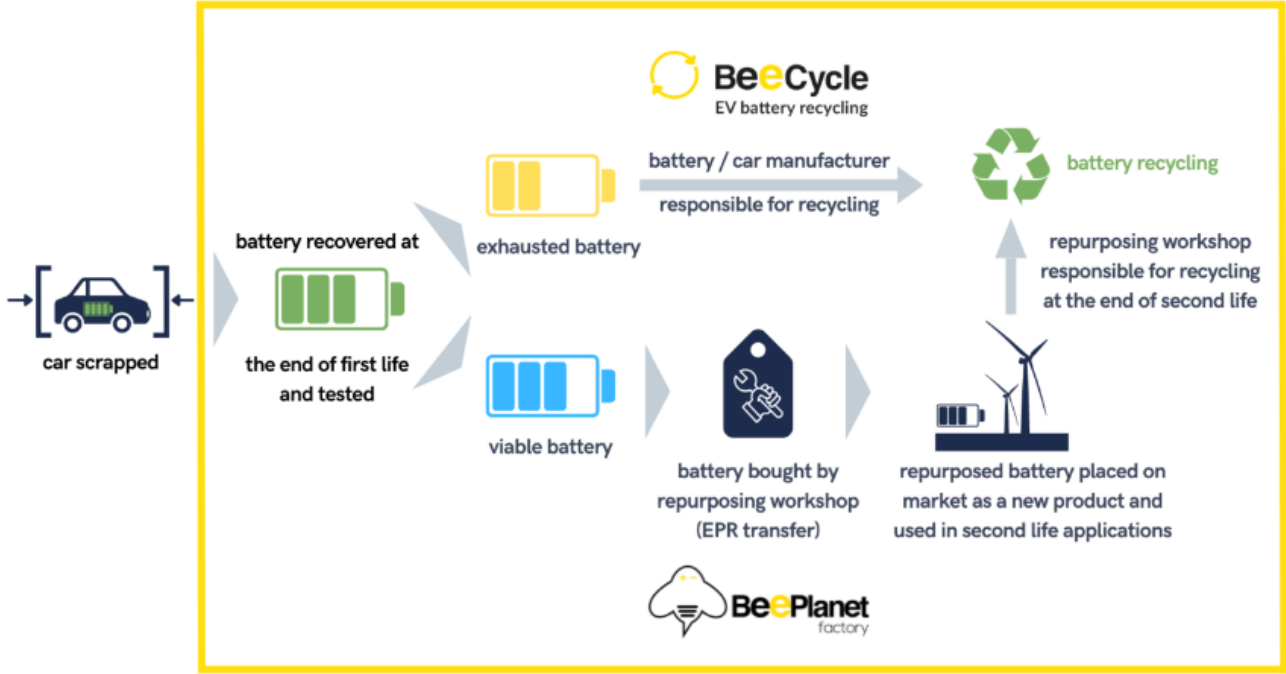
### EU has passed the REGULATION (EU) 2023/1542 of 12 July 2023 concerning batteries and waste batteries

- Minimum recycled content in 2035: 20 % cobalt, 10 % lithium and 12 % nickel
- Recycling efficiency by 2030: 95 % for cobalt, copper and nickel, 70 % for lithium;
- Possibility for re-use and re-purpose must be made available by the producer (through Extended producer responsibility laws)
- The battery passport will be a tool and a proof that these rules are met



# 3. Second life routes

- OEMs are working on re-using and repurposing projects (e.g. Renault, Mercedes-Benz)
- Third-party companies acquire the batteries from the OEMs, assume the EPR and repurpose the batteries (e.g. BeePlanet)



*Second life batteries as stationary storage for Solar panels (Renault Group)*

*Second life batteries as stationary storage for Solar panels (BeePlanet)*

### 3. Second life routes - Beeplanet



<https://www.youtube.com/watch?v=-dBdDstsVwY>

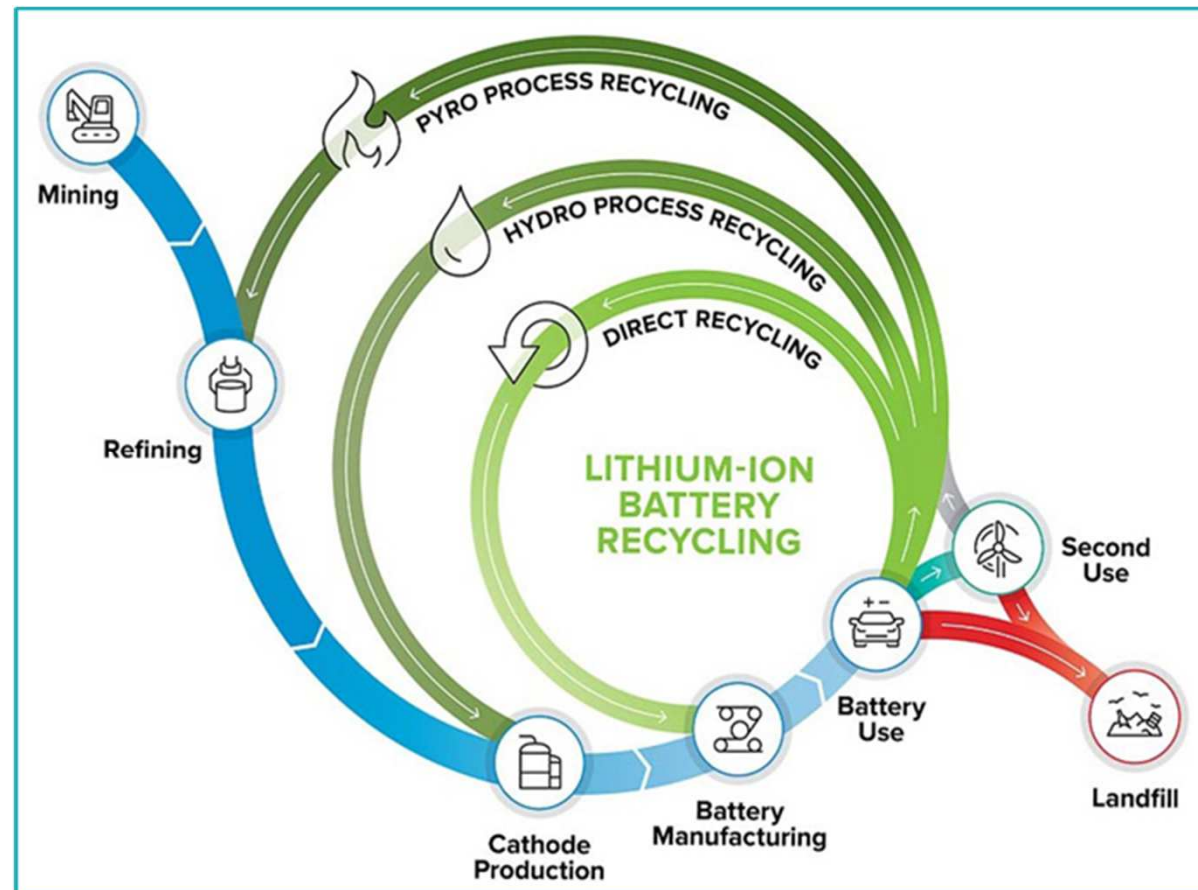


<https://www.youtube.com/watch?v=brtkuDK9et4>

# 4. Recycling routes

## Three main recycling routes are currently analysed for EV batteries

- Pyrometallurgy: Burning the battery to recover the critical metals. Some material losses (lithium).
- Hydrometallurgy: Using chemical leaching to extract materials. Good recovery, however used chemicals must be burnt.
- Direct cathode recycling / mechanical recycling: Promising choice, not industrially applied yet



Source, CICEnergygune



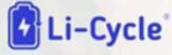









# 4. Recycling projects

Most of the big players are pushing for hydro or direct recycling:

- Pyrometallurgy currently can not meet the EU legislation recycling minimums
- Direct/mechanical recycling does not use any chemicals but shows scaling-up problems at the moment
- Hydrometallurgy can be fine-tuned for each battery chemistry

TECHNOLOGICAL BET OF SOME OF THE LEADING BATTERY RECYCLING COMPANIES

CIC energigUNE  
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

COMPANY	RECYCLING PROCESS COMBINATION			
	Mechanical	Hydro	Pyro	Thermal
 Li-Cycle®	●	●		
PrimoBius		●		
 eraMET			●	
 umicore		●	●	
 CATL	●	●		●
 ACCUREC®	●	●	●	●
 SungEel HiTech	●	●		●
 ATTERO	●	●		
 华友钴业 HUAYOU COBALT	●	●		
 KYOEI SEIKO technologies solving the needs of people			●	
 Cirba Solutions	●	●		

Source: Own elaboration from public information

# 4. Reciclaje de baterías de plomo ácido



<https://www.youtube.com/watch?v=tpIXljsiz4&t=21s>



## 4. Reciclaje de baterías de plomo ácido



[https://www.youtube.com/watch?v=YvxH\\_bVBRMY](https://www.youtube.com/watch?v=YvxH_bVBRMY)

## 4. Reciclaje de baterías de plomo ácido



<https://www.youtube.com/watch?v=tfZ7n0ogtH0>