Tab. S1 Contents of oxides and fluorine elements in de-lithium material powder.

Molecular formula	P_2O_5	Fe_2O_3	F	Other
Content(wt%)	52.63	44.62	2.18	0.57

Tab. S2 The cost and profit to dispose of 1 kg spent LiFePO4 cathode power.

	Chemical	Price	Dosage	Total
Consumption	SLFP	2.48 $/kg	1.00 kg	2.48 $
	$C_6H_8O_7·H_2O$	0.74 $/kg	2.33 kg	1.72 $
	MgO	0.41 $/kg	0.17 kg	0.07 $
	$C_6H_{12}O_6·H_2O$	0.42 $/kg	0.24 kg	0.10 $
	Na_2CO_3	0.63 $/kg	0.35 kg	0.22 $
	Electricity	0.09 $/kw·h	17.21 kw·h	1.55 $
Total	6.14 $			
	Chemical	Price	Dosage	Total
Product	$LiFePO_4$	9.39 $/ kg	0.86 kg	8.08 $
	Al	2.22 $/ kg	0.09 kg	0.20 $
Total	8.28 $			
Profit	2.14 $			

As shown in Tab. S2, the total cost and profit of the lab-scale recycling process were calculated in detail based on 1.0 kg of spent $LiFePO_4$ cathode sheets. It is estimated that treating 1.0 kg of spent $LiFePO_4$ cathode sheets can yield 0.86 kg of regenerated $LiFePO_4$ and 0.09 kg of aluminum foil. Consequently, the profit from recycling 1.0 kg of spent $LiFePO_4$ cathode sheets is $2.14.