Appendix

Appendix A1: Overview of questions for the Delphi questionnaire

Questions	Sub-questions	References
Q0) What is your background?	In what sector do you work or have expertise in? What is your highest level of formal education? How many years of relevant working experience do you have in your field of expertise? What is your geographical perspective when answering questions about EV batteries? More specifically, which countries would relate to your geographical perspective?	
Q1) What do you consider a reasonable share of used EV Lithium-ion batteries that will be repurposed from your geographical perspective?	a) share of EV LiBs repurposed regardless of application.	(Kastanaki & Giannis, 2023)
	b) share of EV LiBs repurposed for the household context, specifically.	Proposed by the research team.
Q2: How likely would you expect the following secondary applications to succeed?	a) ESS based on repurposed EV LiBs solely for load-leveling and peak-shaving in a household context.	(Heymans et al., 2014)
	b) ESS based on repurposed EV LiBs for load-levelling and peak-shaving in combination with solar panels in a household context	(Assunção et al., 2016; Thakur et al., 2022)
	c) Application of repurposed EV LiBs in portable power packs in a household context	(Manthey, 2023)
	d) EV batteries will reach their end-of-life in the same application by EVs changing the hands of users with lower range and speed requirements	(Börner et al., 2022)
	e) Based on your current insights: Which other likely secondary applications besides the household context based on repurposed EV LiBs would you like to list?	
	Optional remarks to Q2:	
Q3: Based on your current insights: How likely would you expect the following value chain structure to succeed?	a) OEMs are responsible for the collection, treatment, and repurposing of the first end-of-life batteries.	(Ahmed et al., 2025; *Nissan Gives EV Batteries a Second Life*, 2021)
	b) OEMs are responsible for the collection and treatment of the first end-of-life batteries.	(Albertsen et al., 2021; Haram et al., 2021; Reinhardt et al., 2020; Rönkkö et al., 2024)
	c) Repurposers are responsible for the collection, treatment, and repurposing of the first end of life batteries.	(Evyon, 2022)
	d) Insurance companies are responsible for the collection and transportation of the first end-of-life	(Ahmed et al., 2025; Wrålsen et al., 2021)

	batteries.	
	e) Car dismantlers are responsible for the collection and transportation of the first end-of-life batteries.	(Karagoz et al., 2020; TCEQ EV reuse and recycling advisory group, 2022)
	f) Based on your current insights: Which other likely value chain structures based on repurposed EV LiBs would you like to list?	
	Optional remarks to Q3:	
Q4: Based on your current insights: How likely would you expect the following business model to successfully emerge for the original equipment manufacturers (OEMs)?	a) OEM owns the battery throughout its life cycle and aims to capture value at every lifecycle stage.	(Albertsen et al., 2021; Jiao & Evans, 2018; Reinhardt et al., 2020; Rufino Júnior et al., 2023; Wrålsen et al., 2021)
	b) OEM takes back the first end of life batteries and then sells them untreated to the repurposer	Proposed by the research team and (ECO STOR, 2021)
	c) OEM provides treated batteries to the repurposer who makes different second-life battery products.	(Ahmed et al., 2025; Evyon, 2022), Interviews conducted
	d) Based on your current insights: Which other likely sustainable business models based on EV LiBs for the OEMs would you like to list?	
	Optional remarks to Q4:	
Q5: When will repurposing EV LiBs for household applications become:	- Technically feasible?	(Assunção et al., 2016; Heymans et al., 2014)
	- Economically feasible for user and industry?	(Montes et al., 2022)
	- Contributing to sustainability?	(Philippot et al., 2022)
	Optional remarks to Q5:	
Q6: How would you rate the importance of the driver for repurposing LiBs for the household context?	a) National and international regulations and policies to promote repurposing of LiBs.	(Wrålsen et al., 2021), Interviews Conducted
	b) Increasing market interest for household energy storage solutions.	(Figgener et al., 2021; Pantelatos et al., 2023)
	c) Potential profits for repurposers.	(Jiao & Evans, 2018)
	d) Scarcity of raw materials for new LiB production on a global level.	(Aguilar Lopez et al., 2023)
	e) Increasing environmental awareness in society.	(Wrålsen et al., 2021)
	f) Vast amounts of first-end-of-life LiBs piling up in need of treatment.	(Harper et al., 2019; Xu et al., 2023)
	g) Increasing development of automation technology for the dismantling of EV LiB packs.	(Meng et al., 2022)
	h) Market protectionism in the EU.	Proposed by the research team.
	i) Goal of higher self-sufficiency in households to relieve the grid.	(Gstöhl & Pfenninger, 2020)
	j) Increasing energy cost.	(Guan et al., 2023; Thakur et al., 2022)
	k) Based on your current insights: Which other important drivers for repurposing batteries for the household market would you like to list?	
	Optional remarks to Q6:	

Q7: How important would you rate this challenge when introducing repurposed EV LiBs in the household market?	a) Low awareness amongst consumers about more sustainable options.	(Painuly & Wohlgemuth, 2022)
	b) Price reduction of new LIBs.	(Sun et al., 2018; Ziegler et al., 2021)
	c) Low performance of obsolete battery technology used for repurposing compared to new LiBs.	(Jiao & Evans, 2018)
	d) Higher value of repurposed EV LiBs in other markets than the household market.	(Michelini et al., 2023)
	e) High transportation cost of end-of-life LiBs.	(Wrålsen et al., 2021), Interviews conducted
	f) Low availability of first end-of-life LiBs for repurposers.	Interviews conducted
	g) Liability of OEMs in terms of safety hazards of repurposed LiBs.	(Börner et al., 2022; Kielland & Skibstad, 2022)
	h) Lack of regulations to promote safe and sustainable repurposing of LiBs.	(Wrålsen et al., 2021)
	i) Many "different" designs of EV battery packs by different OEMs.	Interviews conducted
	j) Lack of design for repurposing of EV LiBs.	(Börner et al., 2022), Interviews conducted
	k): Based on your current insights: Which other challenges do you consider to be likely for repurposing batteries for the household market?	
	Optional remarks to Q7:	
Q8: How important would you rate the importance of the factor affecting customer willingness to implement repurposed LiBs in the household context?	a) Customer willingness to buy a reduced product.	(Börner et al., 2022; Bräuer, 2016)
	b) Perceived safety of repurposed EV LiBs.	(Börner et al., 2022)
	c) Increase self-sufficiency in household as a measure to ensure reliable power in the future.	(BVES, 2024)
	d) Individual/customer wanting to create an image of taking responsibility towards climate change.	(Ryghaug et al., 2018)
	e) Installing repurposed LiBs in households being a tangible way for users to act upon climate change.	(BVES, 2024)
	f) Potential savings on household electricity bills.	(Thakur et al., 2022)
	g) Which other important factors affecting consumer willingness to adopt repurposed LiBs in the household market would you like to list?	
	Optional remarks to Q8:	

Appendix A2: Results of Q6) Drivers for repurposing LiBs for the hosuehold Context.

a) National and international regulations and policies to promote repurposing of LiBs

	2025	2030	2045
Not answered	0 %	0 %	0 %
1 - Not important	17 %	8 %	8 %
2	8 %	0 %	0 %
3	0 %	8 %	0 %
4	0 %	0 %	8 %
5	0 %	0 %	0 %
6	17 %	17 %	17 %
7 - Very Important	58 %	67 %	67 %
Mean	***5,4***	***6,0***	***6,1***

b) Increasing market interest for household energy storage solutions

	2025	2030	2045
Not answered	8 %	8 %	17 %
1 - Not important	17 %	0 %	0 %
2	17 %	8 %	8 %
3	8 %	0 %	0 %
4	8 %	33 %	8 %
5	8 %	0 %	8 %
6	8 %	17 %	33 %
7 - Very Important	25 %	33 %	25 %
Mean	***4,1***	***5,3***	***5,6***

c) Potential profits for repurposers

	2025	2030	2045
Not answered	0 %	0 %	8 %
1 - Not important	8 %	0 %	0 %
2	33 %	8 %	0 %
3	0 %	17 %	8 %
4	0 %	8 %	0 %
5	25 %	8 %	17 %
6	8 %	25 %	25 %
7 - Very Important	25 %	33 %	33 %
Mean	***4,3***	***5,3***	***6,0***

d) Scarcity of raw materials for new LiB production on a global level

	2025	2030	2045
Not answered	0 %	0 %	0 %
1 - Not important	33 %	17 %	17 %
2	25 %	0 %	8 %
3	17 %	25 %	17 %
4	8 %	33 %	0 %
5	8 %	17 %	17 %
6	0 %	0 %	17 %
7 - Very Important	8 %	8 %	25 %
Mean	***2,7***	***3,7***	***4,4***

e) Increasing environmental awareness in society

	2025	2030	2045
Not answered	0 %	0 %	0 %
1 - Not important	8 %	0 %	0 %
2	17 %	8 %	8 %
3	8 %	17 %	25 %
4	42 %	17 %	0 %
5	17 %	42 %	33 %
6	8 %	17 %	25 %
7 - Very Important	0 %	0 %	8 %
Mean	***3,7***	***4,4***	***4,7***

f) Vast amounts of first-end-of-life LiBs piling up in need of treatment

	2025	2030	2045
Not answered	0 %	0 %	0 %
1 - Not important	25 %	0 %	0 %
2	42 %	17 %	8 %
3	8 %	25 %	8 %
4	8 %	25 %	25 %
5	17 %	33 %	25 %
6	0 %	0 %	17 %
7 - Very Important	0 %	0 %	17 %
Mean	***2,5***	***3,8***	***4,8***

g) Increasing development of automation technology for the dismantling of EV LiB packs

	2025	2030	2045
Not answered	0 %	0 %	0 %
1 - Not important	33 %	0 %	0 %
2	25 %	17 %	8 %
3	8 %	17 %	8 %
4	25 %	33 %	17 %
5	0 %	17 %	25 %
6	8 %	17 %	33 %
7 - Very Important	0 %	0 %	8 %
Mean	***2,6***	***4,0***	***4,9***

h) Market protectionism in the EU

	2025	2030	2045
Not answered	0 %	0 %	0 %
1 - Not important	8 %	0 %	0 %
2	33 %	17 %	17 %
3	0 %	8 %	8 %
4	42 %	42 %	42 %
5	8 %	25 %	17 %
6	0 %	0 %	8 %
7 - Very Important	8 %	8 %	8 %
Mean	***3,4***	***4,1***	***4,2***

i) Goal of higher self-sufficiency in households to relieve the grid

	2025	2030	2045
Not answered	0 %	0 %	0 %
1 - Not important	17 %	0 %	0 %
2	33 %	25 %	33 %
3	25 %	25 %	8 %
4	17 %	25 %	17 %
5	0 %	8 %	25 %
6	8 %	17 %	0 %
7 - Very Important	0 %	0 %	17 %
Mean	***2,8***	***3,7***	***4,0***

j) Increasing energy cost

	2025	2030	2045
Not answered	0 %	0 %	0 %
1 - Not important	17 %	8 %	8 %
2	25 %	8 %	17 %
3	17 %	25 %	0 %
4	17 %	25 %	17 %
5	25 %	25 %	25 %
6	0 %	8 %	33 %
7 - Very Important	0 %	0 %	0 %
Mean	***3,1***	***3,8***	***4,3***

Appendix A3: Ranking of drivers by mean across short, medium and long term.

	a) National and international regulations and policies to promote repurposing of LiBs.	c) Potential Profits for repurposers	b) Increasing market interest for household energy storage solutions.	e) Increasing environmental awareness in society.	h) Market protectionism in the EU.	j) Increasing energy cost.	j) Goal of higher self-sufficiency in household to relieve grid.	d) Scarcity of raw materials for new LiB production on a global level-	g) Increasing development of automation technology for the dismantling of EV LiB packs.	f)Vast amounts of FEoL LiBs piling up in need of treatment.
2025	1	2	3	4	5	6	7	8	9	10
2030	1	2	2	3	4	6	7	7	5	6
2045	1	2	3	6	9	8	10	7	4	5

Appendix A4: Results of Q7) Challenges to introducing repurposed EV LiBs in the household market?

a) Low awareness amongst consumers about more sustainable options

	2025	2030	2045
Not answered	0	0	0
1 - Not important	17 %	8 %	8 %
2	0 %	8 %	8 %
3	8 %	8 %	25 %
4	33 %	33 %	33 %
5	0 %	25 %	17 %
6	33 %	17 %	8 %
7 - Very Important	8 %	0 %	0 %
Mean	*4,3*	*4,1*	*3,7*

b) Price reduction of new LIBs

	2025	2030	2045
Not answered	0,0	0,0	0,0
1 - Not important	8 %	0 %	0 %
2	0 %	0 %	0 %
3	0 %	0 %	0 %
4	8 %	17 %	17 %
5	25 %	8 %	25 %
6	25 %	42 %	25 %
7 - Very Important	33 %	33 %	33 %
Mean	*5,5*	*5,9*	*5,8*

c) Low performance of obsolete battery technology used for repurposing compared to new LiBs

	2025	2030	2045
Not answered	0	0	8,3
1 - Not important	8 %	0 %	0 %
2	0 %	0 %	8 %
3	17 %	25 %	8 %
4	17 %	8 %	17 %
5	0 %	8 %	0 %
6	42 %	17 %	17 %
7 - Very Important	17 %	42 %	33 %
Mean	*4,9*	*5,4*	*5,5*

d) Higher value of repurposed EV LiBs in other markets than the household market

	2025	2030	2045
Not answered	0	0	0
1 - Not important	8 %	0 %	0 %
2	0 %	0 %	0 %
3	17 %	8 %	8 %
4	8 %	8 %	0 %
5	25 %	25 %	25 %
6	17 %	17 %	33 %
7 - Very Important	25 %	42 %	33 %
Mean	*4,9*	*5,8*	*5,8*

e) High transportation cost of end-of-life LiBs

	2025	2030	2045
Not answered	0	0	0
1 - Not important	8 %	0 %	0 %
2	0 %	0 %	0 %
3	8 %	17 %	33 %
4	17 %	17 %	8 %
5	50 %	50 %	42 %
6	17 %	8 %	8 %
7 - Very Important	0 %	8 %	8 %
Mean	*4,5*	*4,8*	*4,5*

f) Low availability of first end-of-life LiBs for repurposers

	2025	2030	2045
Not answered	0	0	0
1 - Not important	8 %	8 %	17 %
2	0 %	0 %	17 %
3	0 %	17 %	25 %
4	0 %	8 %	17 %
5	25 %	50 %	17 %
6	42 %	17 %	8 %
7 - Very Important	25 %	0 %	0 %
Mean	*5,6*	*4,4*	*3,3*

g) Liability of OEMs in terms of safety hazards of repurposed LiBs

	2025	2030	2045
Not answered	0	0	0
1 - Not important	8 %	0 %	0 %
2	0 %	8 %	8 %
3	0 %	0 %	0 %
4	8 %	0 %	8 %
5	0 %	8 %	25 %
6	42 %	58 %	33 %
7 - Very Important	42 %	25 %	25 %
Mean	*5,8*	*5,8*	*5,5*

h) Lack of regulations to promote safe and sustainable repurposing of LiBs

	2025	2030	2045
Not answered	0	0	0
1 - Not important	8 %	0 %	0 %
2	0 %	17 %	25 %
3	8 %	0 %	0 %
4	0 %	0 %	8 %
5	8 %	17 %	17 %
6	25 %	25 %	17 %
7 - Very Important	50 %	42 %	33 %
Mean	*5,8*	*5,6*	*5,0*

i) Many "different" designs of EV battery packs by different OEMs

	2025	2030	2045
Not answered	0	0	0
1 - Not important	0 %	0 %	0 %
2	0 %	0 %	8 %
3	8 %	8 %	17 %
4	8 %	8 %	17 %
5	0 %	17 %	17 %
6	33 %	33 %	25 %
7 - Very Important	50 %	33 %	17 %
Mean	*6,1*	*5,8*	*4,8*

j) Lack of design for repurposing of EV LiBs

	2025	2030	2045
Not answered	0	0	0
1 - Not important	0 %	0 %	0 %
2	0 %	0 %	0 %
3	8 %	8 %	25 %
4	8 %	8 %	17 %
5	8 %	33 %	42 %
6	25 %	17 %	0 %
7 - Very Important	50 %	33 %	17 %
Mean	*6,0*	*5,6*	*4,7*

Appendix A5: Ranking of challenges by mean across short, medium and long term.

	i) Many "different designs of EV battery packs by different OEMs.	j) Lack of design for repurposing of EV LiBs.	g) Liability of OEMs in terms of safety hazards of repurposed LiBs.	h) Lack of regulations to promote safe and sustainable repurposing of LiBs.	f) Low availability of first end-of-life LiBs for repurposers.	b) Price reduction of new LiBs.	c) Low performance of obsolete battery technology being repurposed.	d) Higher value of repurposed EV LiBs in other markets than the household market.	e) High transportation cost of FEoL LiBs.	a) Low awareness amongst consumer about more sustainable option.
2025	1	2	3	3	4	5	6	6	7	8
2030	2	3	2	3	6	1	4	2	5	7
2045	4	5	2	3	8	1	2	1	6	7

Appendix A6: Results of Q8) Factors affecting willingness to implement repurposed LiBs in the household context.

a) Customer willingness to buy a reduced product

	2025	2030	2045
Not answered	8 %	8 %	8 %
1 - Not important	0 %	0 %	0 %
2	0 %	0 %	0 %
3	8 %	0 %	0 %
4	0 %	8 %	8 %
5	8 %	8 %	25 %
6	58 %	58 %	42 %
7 - Very Important	17 %	17 %	17 %
Mean	*5,8*	*5,9*	*5,7*

b) Perceived safety of repurposed EV LiBs

	2025	2030	2045
Not answered	8 %	8 %	8 %
1 - Not important	0 %	0 %	0 %
2	8 %	8 %	8 %
3	0 %	0 %	17 %
4	0 %	8 %	0 %
5	8 %	8 %	0 %
6	17 %	17 %	33 %
7 - Very Important	58 %	50 %	33 %
Mean	*6,2*	*5,9*	*5,5*

c) Increase self-sufficiency in household as a measure to ensure reliable power in the future

	2025	2030	2045
Not answered	8 %	8 %	8 %
1 - Not important	17 %	17 %	8 %
2	0 %	0 %	8 %
3	25 %	25 %	25 %
4	17 %	0 %	8 %
5	17 %	17 %	8 %
6	17 %	25 %	8 %
7 - Very Important	0 %	8 %	25 %
Mean	*3,7*	*4,2*	*4,4*

e) Installing repurposed LiBs in households being a tangible way for users to act upon climate change

	2025	2030	2045
Not answered	8 %	8 %	8 %
1 - Not important	17 %	8 %	0 %
2	8 %	17 %	25 %
3	17 %	8 %	0 %
4	25 %	17 %	17 %
5	17 %	25 %	25 %
6	0 %	17 %	25 %
7 - Very Important	8 %	0 %	0 %
Mean	*3,5*	*3,9*	*4,3*

f) Potential savings on household electricity bills

	2025	2030	2045
Not answered	8 %	8 %	8 %
1 - Not important	8 %	8 %	0 %
2	8 %	0 %	8 %
3	17 %	8 %	0 %
4	0 %	17 %	17 %
5	17 %	8 %	17 %
6	8 %	8 %	0 %
7 - Very Important	33 %	42 %	50 %
Mean	*4,8*	*5,3*	*5,6*

d) Individual/customer wanting to create an image of taking responsibility towards climate change

	2025	2030	2045
Not answered	8 %	8 %	8 %
1 - Not important	17 %	8 %	0 %
2	8 %	17 %	17 %
3	25 %	8 %	8 %
4	17 %	25 %	17 %
5	8 %	8 %	17 %
6	8 %	25 %	33 %
7 - Very Important	8 %	0 %	0 %
Mean	*3,5*	*3,9*	*4,5*

Appendix A7: Ranking of factors affecting customer willingness by mean across short, medium and long term.

	b) Perceived safety of repurposed LiBs.	a) Customer Willingness to buy a reduced product.	f) Potential savings on household electricity bills.	c) Increase self-sufficiency in households as a measure to ensure reliable power in the future.	d) Individual/customer wanting to create an imageof taking responsibility towards climate change.	e) Installing repurposed LiBs in household being a tangible way for users to act upon climate change.
2025	1	2	3	4	5	5
2030	1	1	2	3	4	4
2045	3	1	2	5	4	6

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