

Table of Contents

AbstractIII

Table of Contents VII

List of Abbreviations..... IX

List of SymbolsXI

List of Figures XII

List of Tables..... XV

1. Introduction 1

1.1 Problem Statement..... 1

1.2 Target..... 2

1.3 Method..... 2

2. State of the Art and Hypothesis 4

2.1 Drivetrain Technologies 4

2.2 Battery Integration..... 5

2.3 Lithium-Ion Battery Technologies 6

2.3.1 Basics 7

2.3.2 Current and future Battery Technologies..... 12

2.3.3 Lithium-Ion Battery Cost Structure 13

2.4 Lifecycle Analysis 16

2.4.1 Life Cycle Assessment Basics 16

2.4.2 Analysis of existing Life Cycle Assessments 17

2.4.3 Relevance of Battery Recycling within the LCA..... 18

2.5 Recycling Technologies 19

2.5.1 Battery Recycling Overview..... 19

2.5.2 Circular Economy 21

2.5.3 Recycling Methods 24

2.5.4 2nd Life Methods 30

2.5.5 Ethic and socio-political Impact of Recycling..... 31

2.6 Product Development Process 31

2.7 Hypothesis 32

3.	Development of Measures to Increase the Share of Secondary Raw Materials ...	33
3.1	Initial Situation	33
3.1.1	Material Flow Analysis of Battery Recycling.....	33
3.1.2	KPI Analysis on battery recycling MFA	44
3.1.3	Ideal Sustainable Powertrain Mixture.....	45
3.2	Technical Aspects	53
3.2.1	Battery.....	53
3.2.2	Recycling Processes.....	63
3.3	Product Development Process	70
3.3.1	Method	71
3.3.2	Activity Details within the Process	76
3.3.3	Design of Measures to realize Circular Economy	79
3.4	Financial Analysis of Circular Economy.....	82
3.4.1	CAM Value development	83
3.4.2	Financial overview of Circular Economy	84
4.	Review and Discussion	112
4.1	Response to Research Target.....	112
4.2	Reflection on the Approach.....	116
5.	Conclusion and Outlook	118
5.1	Conclusion	118
5.2	Contributions	119
5.3	Outlook	120
Appendix		i
A)	Interview Minutes	ii
B)	Publications of the Author.....	xi
C)	Supervised Theses	xii
D)	Attended Conferences.....	xiii
E)	References	xiv