

Contents

Page

1.	EXECUTIVE SUMMARY AND CONCLUSIONS	1
1.1.	Forecast for numbers of LEVs sold globally to 2025	2
1.2.	Pricing	2
1.3.	Market value forecast	3
1.4.	Reasons for growth	6
1.4.1.	Competition and profitability	6
1.4.2.	Opportunities	6
1.4.3.	Typical requirement	7
2.	INTRODUCTION TO LIGHT ELECTRIC VEHICLES	9
2.1.	Definition of a light electric vehicle	9
2.2.	E-motorcycles	10
2.2.1.	E-bikes and e-motorcycles compared	10
2.2.2.	Record-breaking e-motorcycles	12
2.2.3.	Motorcycle sales in Colombia	14
2.3.	Choices of LEV	15
2.3.1.	Rocket drag bike USA	24
2.3.2.	Moveo foldable scooter Hungary	25
2.4.	The Industry of LEVs	26
2.4.1.	Taiwan and China	26
2.4.2.	Outside Taiwan and China	27
2.4.3.	Too much cost cutting	27
2.5.	Tricycles to reduce accidents and help policing	28
2.5.1.	Twikke Europe	30
3.	REQUIREMENTS FOR LEVS	33
3.1.	How good does it have to be?	33
3.2.	What retail price?	34
4.	TYPES OF LEV AND REGULATIONS	37
4.1.	What is an electric bicycle?	37
4.1.1.	Pedelec	37
4.1.2.	Power on Demand bikes and other categories	38
4.1.3.	Electric vehicles for disabled and others	38
4.1.4.	Power restriction	38
4.1.5.	Notable regulations	38
4.2.	Universal Technical Terms for Ebikes	39

5.	MOBILITY FOR THE DISABLED – THE SECTOR WITH THE MOST COMPELLING AND ENDURING NEED	41
5.1.	The demographic time-bomb	41
5.1.1.	Ageing population and the dependent elderly	42
5.1.2.	Laws make mobility easier	43
5.2.	Types of mobility vehicle	43
5.2.1.	Growth by new market segments	44
5.2.2.	Interchina Industry Group China	46
5.2.3.	Solar powered power chair in 2013	47
5.3.	Market drivers	48
5.3.1.	Geographical distribution	48
5.3.2.	Needs creating new segments	49
5.3.3.	What is driving regional differences?	51
5.3.4.	Zhejiang R&P Industry China	51
5.3.5.	Pride Mobility, USA	52
5.4.	Listing of manufacturers	53
5.5.	Market forecasts 2012-2022	55
5.5.1.	Growth by creating new markets	55
6.	LEV TECHNOLOGIES	57
6.1.	Battery Technology – as currently used in LEVs, on a pack level	57
6.1.1.	SVRLA strengths and weaknesses	57
6.1.2.	Battery packagers	59
6.1.3.	Battery Packs from China	60
6.1.4.	Power management and user interface	61
6.1.5.	Electric motor controller	62
6.1.6.	Motor Controls:	63
6.1.7.	Accessory features:	63
6.1.8.	Chinese Coin Charger	65
6.1.9.	Energy harvesting	66
6.1.10.	User Interface	66
6.1.11.	Real Time Data Logging and Reporting	68
6.1.12.	Infrastructure challenges and Government incentives	68
6.2.	Examples of battery suppliers to this sector	69
6.2.1.	Advanced Battery Technologies (ABAT) China	69
6.2.2.	Leyden Energy USA	70
6.2.3.	PowerGenix USA	72
6.2.4.	ReVolt Technologies Ltd Switzerland	72
6.2.5.	Toshiba Japan	73
7.	LEV STANDARDS AND COMPONENT INDUSTRIAL TRENDS	75
7.1.	Standards Efforts	75
7.2.	Component industry trends	75

7.3.	LEV electric motor industry	77
7.4.	Controller industry	78
7.5.	Wiring harness and connectors	78
8.	LEV MARKETS, MARKET DRIVERS AND FORECASTS	79
8.1.	Markets by territory	79
8.1.1.	China	81
8.1.2.	Japan	82
8.1.3.	India	82
8.1.4.	Europe	82
8.1.5.	USA	83
8.1.6.	Worldwide	83
8.2.	Markets by providers	83
8.3.	Bicycle Brands with ebikes or expected to have ebikes soon:	84
8.3.1.	USA	84
8.3.2.	European Bike Brands	84
8.3.3.	Netherlands brands:	85
8.4.	Channels of distribution	85
8.5.	Market forecasts and drivers	86
8.6.	Drivers of market	87
8.6.1.	Fuel price	87
8.6.2.	Fuel availability	87
8.6.3.	Efficiency	87
8.6.4.	Cost of government subsidy	88
8.6.5.	Traffic congestion	88
8.6.6.	Parking congestion	88
8.6.7.	Urbanization	88
8.6.8.	Air pollution	88
8.6.9.	Government regulation	88
8.6.10.	Personal responsibility	88
8.6.11.	Total cost of ownership	89
8.6.12.	Aging populations	89
8.6.13.	Living in apartments	89
8.6.14.	Negative factors	89
8.6.15.	Bans in Malaysia and elsewhere?	91
9.	ELECTRIC SCOOTERS	93
9.1.	Market dynamics	93
9.2.	Dominated by East Asia for the next decade	95
9.2.1.	Brazil	95
9.2.2.	China	96
9.2.3.	Europe	96
9.2.4.	France	96

9.2.5.	Germany	97
9.2.6.	India	98
9.2.7.	Japan	101
9.2.8.	Taiwan	105
9.2.9.	Korea	106
9.3.	Retro scooters	107
9.4.	Push scooters	109
9.5.	Folding scooters and energy harvesting	110
10.	CAR-LIKE VEHICLES NOT HOMOLOGATED AS CARS: MICROEV, QUADRICYCLE, E-TRIKE, NEV, GOLF CAR	113
10.1.	Many names, common factors	113
10.2.	Car-like vehicles that evade restrictions, taxes and other costs	115
10.3.	Philippines: big new commitments to e-trikes	117
10.4.	Listing of manufacturers beyond golf cars	118
10.5.	Toyota i-ROAD e-trike is a scooter/ MicroEV crossover	121
10.6.	MicroEV racing cars	122
10.7.	Golf cars	124
10.7.1.	What is included	124
10.7.2.	Market drivers	124
10.7.3.	Listing of manufacturers	128
10.7.4.	Market forecasts 2012-2023	129
	APPENDIX 1: LISTINGS OF LEV BRANDS, OEMS, COMPONENT MAKERS	133
	APPENDIX 2: ADDITIONAL REGULATORY SUPPORT	153
	APPENDIX 3: IDTECHEX EV PUBLICATIONS AND CONSULTANCY	239

Tables

	Page	
Table 1.1	LEV number, unit value in dollars ex-factory and total global market value 2012-2023	3
Table 2.1	Prices and performance of electric two wheelers – e-motorcycles and LEVs compared	10
Table 5.1	Statistics relevant to the challenge to society caused by ageing population	42
Table 5.2	Evolution of three families of powered vehicles for the disabled	45
Table 5.3	Evolution of power chairs 1980 to 2010	46
Table 5.4	Evolution of scooters for the disabled 1980 to 2010	47
Table 5.5	The continental percentage split of markets for vehicles for the disabled by value in 2010	49
Table 5.6	The percentage split of market for vehicles for the disabled by country within Europe	49
Table 5.7	The numbers in thousands of scooters plus power chairs that were and will be sold in Europe 2005 to 2015	49
Table 5.8	Features of mobility vehicles that may hold up the price by offering more in future	50
Table 5.9	The percentage distribution of manufacture between Taiwan and Mainland China by value of vehicles for the disabled 2005, 2010 and 2015	53
Table 5.10	Market for EVs for the disabled by geographical region, ex works pricing and percentage split in 2005, 2010 and 2020	53
Table 5.11	82 examples of manufacturers of EVs for the disabled by country	53
Table 5.12	Global sales of EVs used as mobility aids for the disabled by number, ex-factory unit price in thousands of dollars and total value in billions of dollars, 2012-2023, rounded	56
Table 8.1	World e-bike sales (Units) estimated for 2007-2010	81
Table 8.2	Chinese cities banning or restricting electric bikes.	91
Table 9.1	e-scooter number and ex-factory price by region for 2013 compared to the total market for LEVs.	94
Table 10.1	Listing of manufacturers beyond golf cars	118
Table 10.2	MicroEV quadricycle forecasts 2012-2023	121
Table 10.3	19 examples of golf EV manufacturers	128
Table 10.4	Global sales of electric golf cars and motorised caddies in number thousands, ex-factory unit price in thousands of dollars and total value in billions of dollars 2012-2023, rounded	129
Table 10.5	Geographical split of golf EV sales by value 2010, 2015 and 2020	129

Figures

Page

Fig. 1.1	LEV number in thousands 2012-2023	4
Fig. 1.2	LEV unit value in dollars ex-factory 2012-2023	5
Fig. 1.3	LEV total global market value in dollar billions 2012-2023	5
Fig. 2.1	The 2013 Motoczysz	13
Fig. 2.2	Voltitude folding pedelec	15
Fig. 2.3	Chinese domestic ebike left and Currie IZ ViaRapido ebike right	16
Fig. 2.4	Electric motor scooters in China	16
Fig. 2.5	Electric moped by Ultra Motor	17
Fig. 2.6	Electric motorcycle by Vectrix	17
Fig. 2.7	Electric mini scooters by Currie Technologies	17
Fig. 2.8	Segway personal transporter	18
Fig. 2.9	Toyota Winglet personal transporter	18
Fig. 2.10	3 wheel LEV with windshield and cover	19
Fig. 2.11	The folding Yike Bike from New Zealand	20
Fig. 2.12	Ebike by Ultra Motor A2B	20
Fig. 2.13	LEV Shop Window with ebike.	21
Fig. 2.14	EU small folding ebike	21
Fig. 2.15	Chinese ebike loaded down	21
Fig. 2.16	Chinese ebike rider	22
Fig. 2.17	Chinese ebike with two riders	22
Fig. 2.18	Ebikes used at Chinese factories	23
Fig. 2.19	China LEVs at stop light	23
Fig. 2.20	Ebike Food Delivery for Papa John's in China	23
Fig. 2.21	Ebike food delivery by A2B Ultra Motor	24
Fig. 2.22	LEV four wheeler for seniors – a crossover from LEVs to mobility for the disabled	24
Fig. 2.23	Shawn Lawless Rocket drag bike	25
Fig. 2.24	Moveo foldable scooter Hungary	25
Fig. 2.25	IBD Bloomfield Bikes Ebike Display in CT USA	28
Fig. 2.26	Electric tricycle	29
Fig. 2.27	Examples of three wheel leisure and delivery vehicles promoted at EVS26 in California May 2012	30
Fig. 2.28	TriBred electric Trikke patrol vehicle and general purpose version	31
Fig. 3.1	Chinese Repair in the Street	34
Fig. 3.2	Chinese Ebike Tire Repair	34
Fig. 3.3	Escooter or Ebike?	35
Fig. 3.4	Traditional Chinese Ebike	35
Fig. 3.5	Optibike USA "The Ferrari of Electric Bikes"	35
Fig. 3.6	Small French Folding Ebike	36
Fig. 3.7	DK City db0 Ebike	36
Fig. 5.1	Percentage of dependent elderly 1970 to 2040	42

Fig. 5.2	New Pihsiang Shoprider pure electric mobility vehicle for the disabled	45
Fig. 5.3	The Electric Car (INEC-KAR0) for the disabled from Interchina Industry Group	46
Fig. 5.4	Solar powered power chair vehicle for the mobility impaired	48
Fig. 5.5	Zhejiang R&P Industry ES 413	51
Fig. 5.6	Pride Jazzy – making new things possible	52
Fig. 6.1	Battery pack interiors	59
Fig. 6.2	Controller by Suzhou Bafang	62
Fig. 6.3	Lead Acid Battery Charger by High Power	64
Fig. 6.4	Solar parking lot for charging by Sanyo	66
Fig. 6.5	User Interface by Gepida	67
Fig. 6.6	User Interface by BionX	67
Fig. 6.7	UI 1 Photo with phone Interface	68
Fig. 6.8	Toshiba e-bike battery	74
Fig. 7.1	SVRLA battery sizes by Long	76
Fig. 7.2	Transparent battery box	76
Fig. 7.3	Innovative Chinese motor	77
Fig. 7.4	High speed brushless motor by Bafang	77
Fig. 7.5	Typical connector	78
Fig. 8.1	Example of China exports to the EU	80
Fig. 8.2	Hero Electric of India Flash Ebike 1	81
Fig. 8.3	Electric vehicle energy consumption per passenger kilometer with full occupation.	87
Fig. 9.1	Peugeot e-Vivacity	97
Fig. 9.2	E-scooter promotion in India	99
Fig. 9.3	Terra motors electric scooter with smartphone	101
Fig. 9.4	Suzuki experimental scooter	104
Fig. 9.5	Sanyo system	105
Fig. 9.6	Kymco two wheel pure electric scooter	106
Fig. 9.7	Leo scooter initially with lithium polymer battery	107
Fig. 9.8	Retro scooters	108
Fig. 9.9	The Koooper scooters	109
Fig. 9.10	KPV scooter	110
Fig. 10.1	Car-like vehicles not homologated as cars, in the context of two wheelers and Europe. Love them or hate them?	114
Fig. 10.2	The Daimler Smart, left, is a mainstream car subject to tax, insurance, crash tests etc. whereas the G-Whiz from India, right, is registered as a quadricycle and was the best-selling pure electric car in the UK for ten years with sales of only hundreds yearly	115
Fig. 10.3	Renault Twizy quadricycle which is selling over ten thousand within two years from launch. The standard model has no windows	116
Fig. 10.4	Chinese micro-EV cars in China. Most of them have three wheels	116
Fig. 10.5	E-trikes	118
Fig. 10.6	Toyota i-ROAD e-trike	122
Fig. 10.7	E-Rex microEV racing car	123
Fig. 10.8	Tonaro golf and general purpose vehicle from China	126

Fig. 10.9	Suzhou Eagle two and four seat golf cars from China	126
Fig. 10.10	Yongkang Fourstar golf vehicles from China	127
Fig. 10.11	Shandong Wuzheng golf cars from China	127
Fig. 10.12	Jinhua Ryder golf car from China	128