



Recent Development of LEV in Taiwan

Bing Ming Lin

Material and Chemical Research Laboratories

Industrial Technology Research Institute

bmlin@itri.org.tw



Some Figures of Taiwan Light Vehicles

- **Motorcycle & Scooter**
 - Over ten million registered on road
 - 1.44 million sets produced in 2005, over USD2.5 billion in value, 45% exported, world No.3 production country
 - Adopt phase 4 emission regulation, 2-stroke engine is hardly able to survive
 - Domestic market descending
- **Bicycle**
 - 5.52 million sets produced in 2005, over USD1.7 billion in value, 90% exported, world No.2 production country
 - Increasingly welcome in domestic market
- **Electric Mobility**
 - 0.25 million produced in 2005, USD 0.17 billion in value, 95% exported, world No.1 production country



Potentiality of Taiwan in Light Vehicle Business

- Strong RD and manufacturing infrastructure
- Own brand name with worldwide awareness
- Increasing competition from China, search for high value added products and peripheral benefits
 - New material, new function, new application
- New position of two wheelers in energy conservation and emission reduction
- Thinking worldwide



Taiwan has been devoting in LEV Business (1)

- Debut of 1st ES by Kang Yang in 1993
- EPA started subsidizing ES purchase from 1995, ended by 2002, over 27000 ES made by 7 companies got subsidy from government
- Charge station construction could be subsidized if qualified by review committee
- There are still around 8000 ES in operation, EPA sponsors a project to take care of those vehicles
- E-bike gets subsidy of NT3000 since 2001, near 20000 EB made by 14 companies got such incentive
- A new category “Small Light Motorcycle” is promoted to be legal on road which is considered as a new market for small ES, there are over 30 vehicle makers in the business



Taiwan has been devoting in LEV Business (2)

- An aggressive ES Promotion Program was passed by Executive Yuan in 1997 to project 3 million ES on road, EPA set 2% mandate of ES sales from year of 2000
- A 150 ES fleet demonstration was held during 1997~1999, 33 academic units participated in promoting ES
- A strategic alliance company was organized by traditional scooter makers to manufacture ES
- IDB sponsored a project to investigate feasibility of battery SWAP system
- EPA sponsored a project to investigate feasibility of quick charge system



Review of Previous ES Promotion Difficulty

Vehicle technology	Sale
<ul style="list-style-type: none">• Difficult to compete with Ice scooter in performance• Reliability and cost issue of battery• Heavy in weight• Some poor product image, reliability• Incidents	<ul style="list-style-type: none">• Traditional scooter retailers don't support• Lack sale channels for new makers• Exaggerative in performance data• Too small market, hard to invest on product improvement or new design
Infrastructure	Promotion
<ul style="list-style-type: none">• Limited charge infrastructure, hard to find plug place for most apartment residents• Lack of maintenance infrastructure and capability, very slow replacement and repair	<ul style="list-style-type: none">• Too aggressive planning in the beginning• Strong opposition from traditional scooter makers on 2% sales mandate



Is Timing Coming?

Was--

- Timing not ready yet? or
- Subsidy stopped?

HOWEVER--

- Manufacturing infrastructure exists
- Technology is improving
- Some new approaches are found
- Environmental concerns are getting strong
- More practical in promotion activity



Ongoing Programs and Activities

- Electric Vehicle Industry Promotion Project
 - Exhibition & Conference(2 domestic, 2 international)
 - Small LEV fleet demonstration and market survey
 - Electronic information platform and publication
 - Concept design competition
 - Common communication interface design
 - New battery application
- Small Light Motorcycle legalization
- New Generation for LEV
 - Renting business in sight-seeing area
 - New approaches



2005 LEV Conference and Exhibition and Summit Forum

Time : 2005/3/4~3/7

Place : Taipei International Convention Center

成果：配合2005年台北自行車國際展，舉辦「國際輕型電動車輛研討會」及「雙峰論壇」，並規畫電動車展覽專區，共有18家廠商31個攤位展示國內電動車最新產品，研討會也邀請來自美日歐及大陸等輕型電動車相關專家來台演講，共有250位國內外人士參與。





2005 EV Carnival

Time : 2005/10/15

Place : Kaohsiung Museum of Fine Art Front Square



Front gate



Opening



Presentation



Illustration



Booth area



Special vehicle



2005 Taiwan Electric Vehicle Symposium

Time : 2005/9/8~9/9

Place : MiaoLi West Lake Resortopia

成果：邀請產官學研等業者及代表共105人參加。與會貴賓有工業局陳副組長、清大金重勳教授、北科大黃炳照教授、吳景興理事長等。

研討會內容包含：

- A. 瞭解輕型電動車輛之發展現況。
- B. 瞭解環保法規對輕型電動車輛產業的影響。
- C. 瞭解電動車輛之能量供應系統與動力系統的匹配技術。
- D. 促進電動車輛整車及零組件業者相互交流。





Small LEV Fleet Demonstration in Kinmon Island

Vehicle Model: 4 models of registered small light electric scooter

Vehicle quantity: 5 sets each model

Duration: 2005/7/8~12/7 for five months

Driver: Local government officials or employees (100 man-months)

Object: To investigate customer acceptance and vehicle reliability



eHelio



JHF



Raido



YuanHwai₁₂



Fleet Vehicle Qualification & Appraisal

Company		A	B	C	D
Model		A	B	C	D
Basic requirement	DOTC Registered	yes	yes	yes	yes
	<60kg	yes(60kg)	yes(58kg)	yes(60kg)	yes(60kg)
	<30km/hr	yes(28.4km/hr)	yes(26.2km/hr)	yes(24.5km/hr)	yes(25.3km/hr)
	With common Charge plug	yes	yes	yes	yes
	Top speed (score)	28.4km/hr(25)	26.2km/hr (15)	24.5km/hr(15)	25.3km/hr (15)
Performance appraisal	1~30m acceleration	5.52sec(16)	6.47sec(6)	5.69sec(14)	6.21sec (8)
	10deg climbability (score)	20km/hr(25)	14.5km/hr(12.5)	15.1km/hr(15)	11.3km/hr (5)
	Range per charge (score)	58.56km(30)	47.2km (21)	22.01km(3)	19.02km (0)
	total	96	54.5	47	28
	Final approval	pass	pass	pass	pass



Fleet Demonstration opening Ceremony

Time : 2005/7/8

Place : Kinmon Athletic field

參加廠商：瑞德、圓匯、易立歐及景興發等4家廠商20輛車
由工業局副組長陳奇福、金門副縣長楊忠全共同主持。





Driver Satisfaction

(accumulated milage:7437km)

item	comment
Speed	Between average and not satisfactory
Start up	Between satisfactory and average
Climbability	Between average and not satisfactory
Range	Between satisfactory and average
Weight	Between satisfactory and average
Overall satisfaction	Between satisfactory and average
Price awareness	NTD9167~18344, 13126 in average
Willing to buy	29 yes, 67 no, 4 no answer
General comments	<ul style="list-style-type: none">•Too slow•No fuel gage or gage not dependable•Quiet and light•Mostly become worse after one month test drive



Website and Publication


<http://evs.org.tw>

經濟部 

第二期 2005年7月出版

輕型電動車專刊

- 專訪環保署空氣品質保護及噪音管制處吳盛忠副處長
- 專訪中華民國電動休閒代步車發展協會
- 專訪台灣電動機車產業發展協會許佑正理事長
- 專訪台灣易立歐科技股份有限公司林協笙總經理與劉佩原經理
- 台灣電動機車發展歷程與現況分析
- 淺談輕型電動車輛的電控系統
- 輕型電動車輛用模組化電池管理系統



創刊 2005年4月出版

輕型電動車專刊

- 全球電動
- 專訪必翔明總經理
- 專訪中華范如玉理
- 專訪中華范如玉理
- 電動代步
- 自行車及壇&2005輕



LEV Concept Design Competition

Time : 2005/7~2005/12

Organizer :

**China Industrial Designers
Association (CIDA)**

Achievement :

- 13 concept design works were chosen from 91 competitors.
- Works were exhibited in 2005 EV Carnival.
- They will be sponsored for model fabrication for final competition in 2006.





Common Communication Interface Design



- Prototype development
- BMS pass information by SMBus to CPU and transfer to RS485 interface to communicate with charger, or transfer to RS232 interface to monitor



Will cooperate with ExtraEnergy、Digalog、BMZ及Wolfenbuettel C&S Group, currently decide to adopt LIN Bus



New Battery Application

- Low Cost High Power Lithium Polymer Cell and Module Technology Development Project
 - Low cost electrode material, 6Ah, 24V battery module development
- Fuel Cell hybrid Electric Scooter Technology Development Project
 - PEMFC hybrid with a 7Ah, 36V lithium-ion battery module
 - Swappable metal hydride canister





Lithium Polymer Battery Module Application

Company	Kenfa	Justwin	Ever	Lerado
Model picture				
Speed	24km/hr	30km/hr	25km/hr	8km/hr
Range	30km	20km	32km	9km
Climbability	12deg	12deg	12deg	12deg
Power	292W	400W	250W	270W
Battery	Lithium polymer	Lithium polymer	Lithium polymer	Lithium polymer
Capacity	26.6V10AH	26.6V10AH	26.6V10AH	26.6V10AH
Charge time	2.5hr	2.5hr	2.5hr	2.5hr
Weight	19kg(with battery)	25kg(with battery)	22kg(with battery)	32kg(with battery)
Tyre	12.5"	20"	22"	8"
Max carrying	100kg	100kg	100kg	115kg

Information from: Welldone Technology



Small Light Motorcycle legalization

Item	Regulation (Draft only)
Dimension	Length<2.5m, width<1m, height<2m
Stand stability and reliability	-Stability test of side stand and middle stand -10000 times durability kickoff test for each stand -15000 times durability kickoff test for vehicle equipped only one stand
Weight	<60kg
Nominal voltage	<48V
Motor power output	<1kW
Speed	<30kph
tyre	4.10/3.50*5''
Frame fatigue strength	Under specified load, 6.6~10Hz, 2G after 70000 cycles vibration, no rupture
License plate	Require
Others	Front and rear light, horn, turning and braking signs, license plate light, rear refractive sign.....

Under rehearsal and review by Department of Transportation and Communication²¹

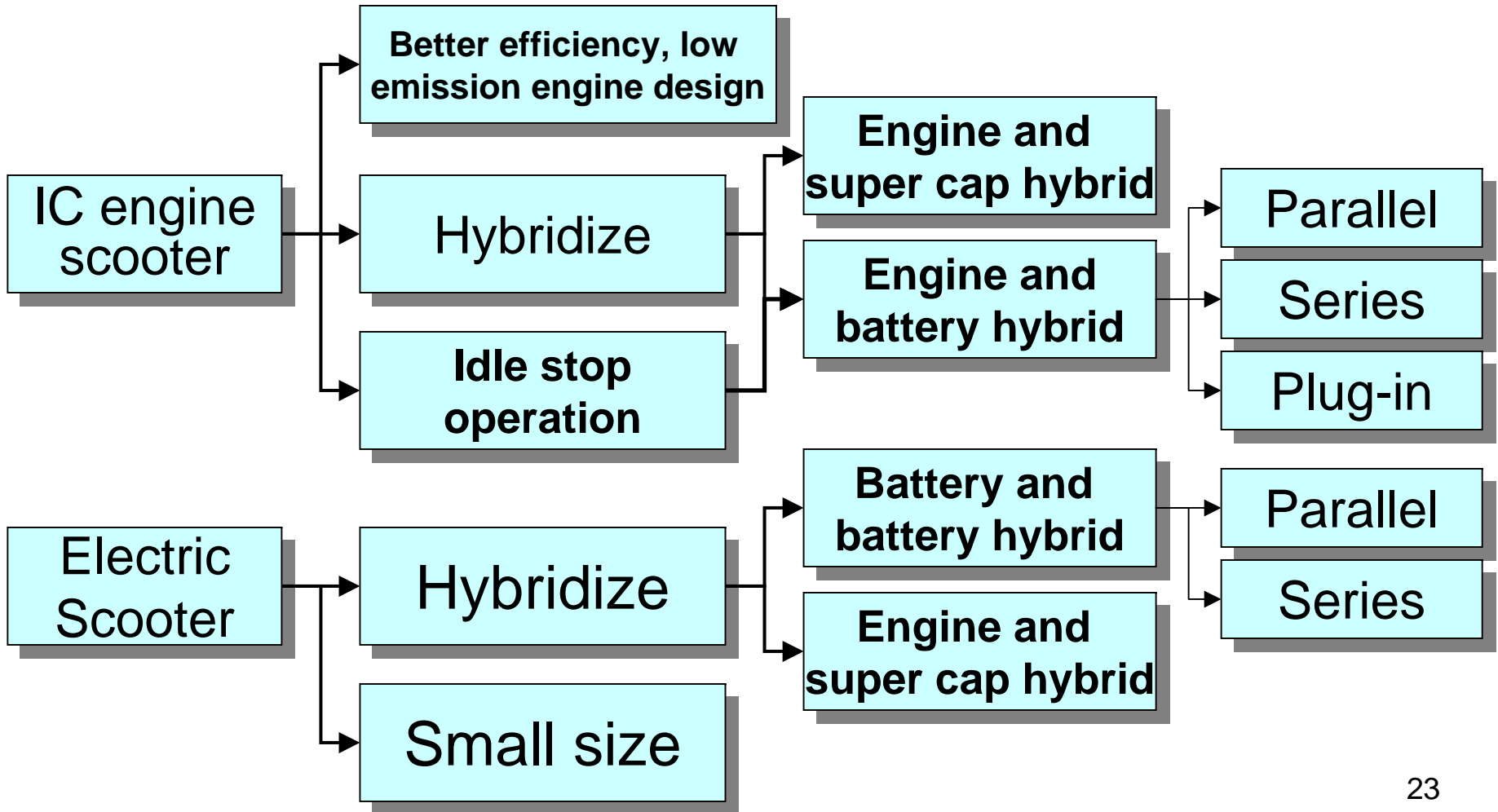


Will Small Light ES become popular?

- Heavier than bicycle, smaller than bicycle
- With speed limit, even lower than some bicycle speed, easy to start up, comparably safe on road driving
- With standard front and rear light, brake light and direction sign, comparably safe than bicycle
- Easy to maintain stability when stop without getting off the vehicle
- Require safety helmet while riding bicycle is not mandatory to wear helmet in Taiwan
- Public transportation become more and more accessible, traditional motorcycle population is decreasing, personal mobility tends to be lighter and more convenient for short range commuting
- Some medium to old aged person need vehicle light and easy to handle
- If bicycle can run on road, why not small light ES



New Generation for LEV Environment Friendly Scooter Design





Prosperous ES Rent Business Around Taiwan





Prosperous ES Rent Business Around Taiwan



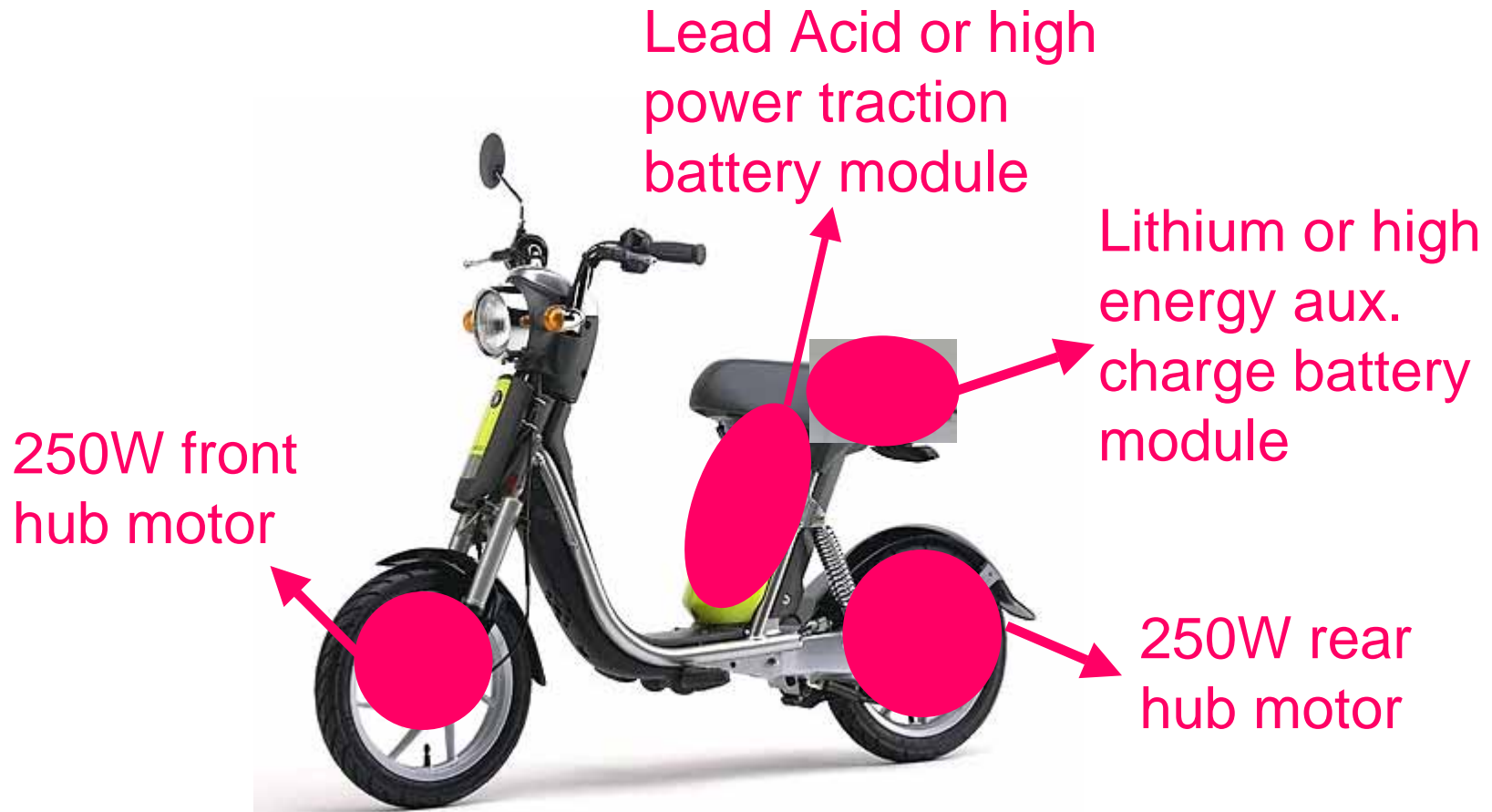


Quick charge Stations Are Under Construction

輸入電壓	Input voltage	220Vac single phase 60Hz
輸出電壓	Output voltage	24V、48V~60Vdc
最大輸出電流	Maximum output current	60A
輸出功率	Maximum power delivery	3600W
控制方式	CONTROL	MICROPROCESSOR
效率	Efficiency	>80% (Full load)
功率因數	Power factor	>0.8 (Full load)
環境溫度	Operation temperature	0° ~ 50° C
環境濕度	Operation humidity	20~80 % R.H.
尺寸大小	Dimensions	500nm Length 240nm Width 540nm Height
重量	Weight	< 60Kg



Hybrid Battery Dual Motor System





Concept

- Use low cost, mass production, high energy, reliable Li-ion cell (such as 18650) as charge energy to charge traction battery, high energy gets longer driving range.
- The high energy module is portable or swappable to be charged at any place, on board or off board.
- constant current output make it reliable for longer cycle life.
- Dual fuel gage, driver can be aware of charge requirement when charge battery runs out of energy

**A new hybrid dual
battery system!!!**



Performance Estimation

Portable battery (13.2Ah/26V)

charge time

2~3Hrs

life mileage

15,000Km

Weight

3kg

Traction battery(14Ah/36V)

life

2 Years

Weight

13.5kg

Speed

45Km/h

Range (@30Km/h)

30Km+30Km

**Ideal medium to
short range commuter!**



**WE ARE EXPECTING A
NEW AGE OF LEV!!!**

THANKS FOR YOUR ATTENTATION