Electric Power Train For Eco Mobility: The Case of Electric Two Wheels

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2W Vehicles for Transportation

- Walking → Bicycle → Motorcycle → Automobile
- Two wheels as a major transportation worldwide, Asia in particular.
- Four wheels as the main transport only for the USA, Japan, a nd parts of Europe.
- IC based four wheels are not the solution for the transportation.

Limitations of IC Power train

- The number of people worldwide using IC power train will ne arly triple in the next 10 years.

- But the supply of oil is finite. Experts say that 40-50% of all the oil in the world has already been burned. The remaining oil is much oil expensive to extract from the ground

Limitations of IC 2W Vehicles

- Many millions of gasoline motor scooters are used all over the world.
- These are very dirty, and not acceptable for densely populated cities.
- Governments all over the world are trying to discourage gas oline motorcycles for this reason. But to do so, an alternative is needed.

Importance of E2W vehicles

Best Footprint and Operating Environment for Electric Power train

-Energy Efficiency

Less rolling resistance and aerodynamic drag

-Affordability

smaller battery required and lower part count

-Time To Money / Market

Approval process is faster and less costly with lighter regulatory environments

-Immediate Channel Access

Easiest to establish distribution/service network

-Best Candidate For ICE Parity

Heavier vehicles are impacted more by reduced energy density

-Operating Environment Suits Lithium Batteries

Lithium batteries operate optimally in the temperature range that is comfortable for riding E2W

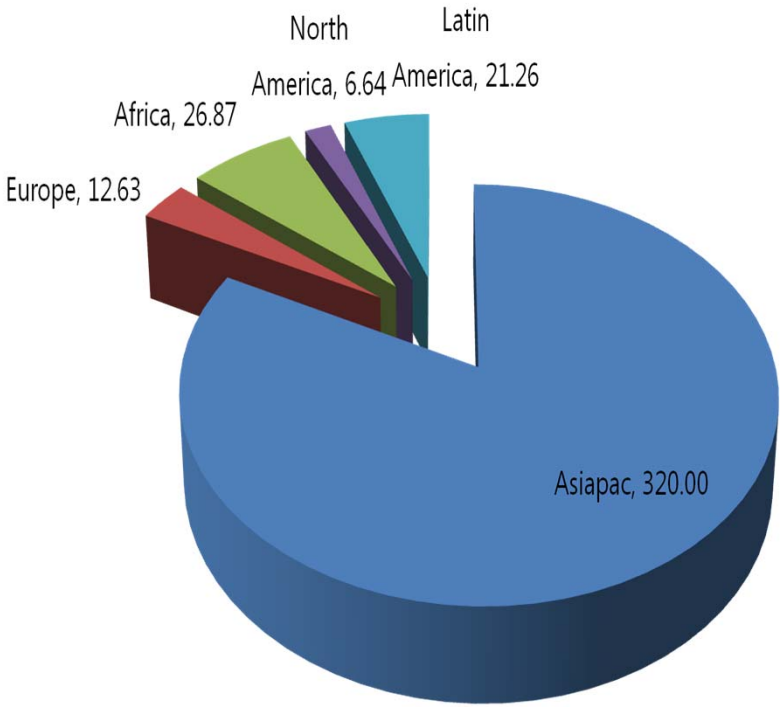
Opportunity

Range, Performance, Cost : Ready For Prime Time

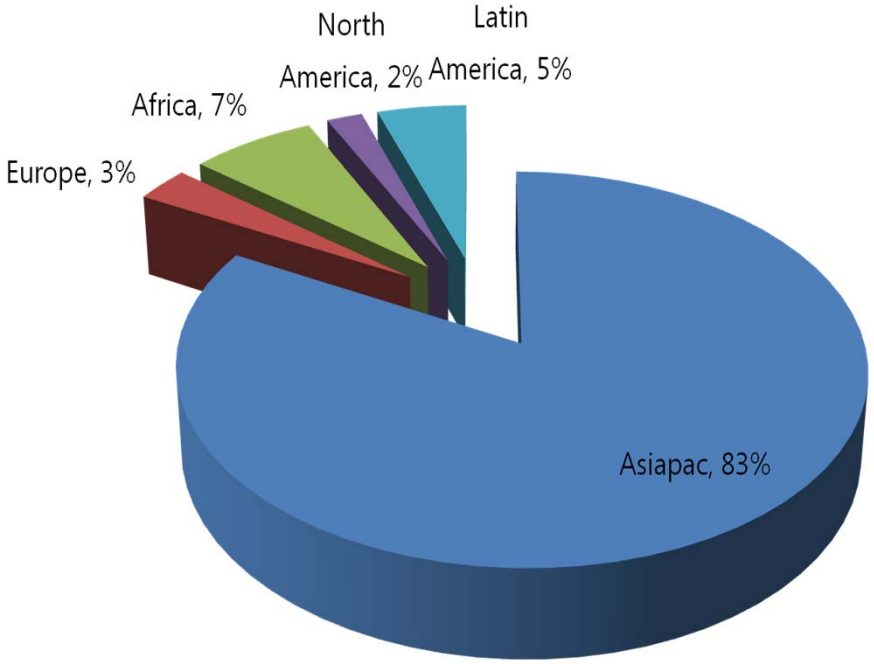
- 200K meters between charges now a reality with 1 hour recharge cycle
- E2W inexpensive and already marketed in Asia
- E2W as the major transportation for Asia
- Sustainable power train solution for Environment protection
- Recreational / Commuter Markets Ripe For Crossover
  - High-Performance Recreational
  - Dual Sport and Off-Road Recreational
  - Urban Commuters
  - E2W vehicles substantially reduce noise generation
    - Requirement To Maintaining off-Road Recreational Areas
    - Urban Noise Reduction Regulation now A Global Trend

Global Volume and Distribution Ripe for Crossover

Sales 2003-2018
(millions of units)



Distribution



AsiaPac Alone : e2W Accounts for $16.7B in 2016

"The size of the global motorcycle market is projected to climb to 700 million in 2013"

Annual Sales

Asia-Pacific, Western Europe and North America (2009)

Asia-Pacific(61m+)

-China	38,200,000
- Vietnam	2,740,000
- Malaysia	540,000
- Singapore	250,000
- Indonesia	6,460,000
- Thailand (Bangkok only)	2,546,821
- India	7,380,000
- Philippines	2,945,626

EU(W)-NA(3m+)

Western Europe	2,490,000
North America	
street bikes	
Dual sport	357,690
Off Road	105,103
Scooters	31,450
Total	**520,500**

California represents 10% of total US registered motorcycles

E2W Global Forecast

37.7 million units in 2016, 20.3 billion in revenue

Asia-Pacific

- $ 16.7B in 2016
- 98% share, lower % revenue
- 78.6 million units(2009-16)

Western Europe

- $2.4 B in 2016
- 3.4%share, 12% revenues
- 1.941 million units(2009-16)

North America

- $1.2 B in 2016
- 1.9 % share, 5.6% revenues
- 800,000 units(2009-16)

eMotorcycles/eScooters

Asia-Pacific	35m
Western Europe	1.9m
North America	.8m

Comparatives

Electric and Gas-Powered Two-Wheel Vehicles

	Lightning-Dual-Sport/Commuter eMotorcycle	Yamaha FZ6R Motorcycle	Lighting Commuter eScooter	Vespa GTV300 Scooter
Fuel	Electricity	Gasoline	Electricity	Gasoline
Top Speed	100mph	120+mph	65mph	76mph
Range	70/100 miles	195miles	60miles	160miles
Battery	Li-Ion		Li-Ion	
Engine Size	45kw	600cc	18kw	16kw278cc
Fuel Economy	300mpg(equivalent)	43mpg	350mpg(equivalent)	67-70mpg
Typical Yearly Cost	$90.	$755.81	$45.	$242.53
MSRP	7k-11k	$7,190.00	5k-6k	$6,899.00
Assumptions	Driving 10k miles/yr, Electricity costs are $0.09/kwh	Driving 10k miles/gas costs are $3.25/gallon	Driving 5k miles/yr, electricity costs are $0.09kwh	Driving 5k miles/gas costs are $3.25/gallon