



Forecasting the Smart Battery Explosion

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Dramatic Growth

- Smart battery packs for portable electronics are an exploding market
- 24.8% of battery pack market in 1997
- 61.2% of battery pack market in 2002
 - 23.1% annual growth of the overall pack market
- Changes anticipated in mix of chemistries and applications



Key Forecasting Factors

- Complex economics, numerous factors
- Analysis performed in 4th quarter 1997 for "Worldwide Battery Pack Markets"
- Chemistry
 - NiCd, NiMH, Li
- Application
 - cellular, laptop, camcorder, other
- Some results are counter intuitive



Defining Smart Packs

- Include electronics for various functions
 - charging, protection, monitoring, history
- Communicates with host system
 - SBS most common industry standard
- Smart packs gaining market share
 - 24.8% smart unit share in 1997
 - 61.2% smart unit share in 2002
 - Overall battery packs growing 23.1% annually



Chemistry Matters

- All Li packs are smart
- No NiCd packs are smart
- NiMH is split between smart and dumb
 - varies by application
 - varies by time period



Application Influences

- All Laptops are smart
- Other applications are split between smart and dumb
 - Cellular
 - Camcorders
 - Others



Chemistry Penetration Rates

- Measure the percentage of a given application using a given chemistry
- Vary by application
- Vary by time period
- Vary by units versus dollar sales



Penetration Rate Examples

- Laptops 1997, 100% smart
- Camcorder 1997, 17% smart
- NiMH 1997, 66% smart
- Overall market 25% smart in 1997
- Overall market 61% smart in 2002



note: these are units percentages

Constant Factors

- Average power requirements
 - Laptops, 40-Wh
 - Cellular, 7.5-Wh
 - Camcorders, 15-Wh
 - Others, 10-Wh
- Price declines across regions
- Wh pricing assumed constant



Limits to Smart Battery Use

- Cost sensitive applications
- Certain high-rate applications
- Laptops already dominated by smart packs



Cost Structure of Packs

- Battery cost variables
 - chemistry
 - pack size
- Electronics cost variables
 - chemistry
 - application



Pack Pricing Analysis

- Based on three factors
 - Wh cost of cells
 - Wh size of packs
 - Electronics content
- Example - NiMH cell pack (97) \$15.60
 - NiMH cost \$1.20/Wh
 - Cellular pack 7.5 Wh
 - Battery cost - \$9.00
 - Electronics cost - \$6.60



Constant Pricing

- Cell pricing assumed constant across regions and applications
- Rates of price decline dependent only upon chemistry; independent of region
 - Li, 16.5% average decline/yr
 - NiMH, 9.3% average decline/yr
 - NiCD, 2.6% average decline/yr
- Electronics decline 12.9% annually



Applications

- Growth varies by region and chemistry
- Li in cellular
 - growing 101.3% annually in Far East
 - growing 61.2% annually in Europe
 - growing 71.1% annually in North America
- Camcorder, worldwide
 - shrinking 2.5% annually in Li
 - shrinking 11.6% annually in NiCd
 - shrinking 8.5% annually in NiMH



Results of this Analysis

- “Popular” assumptions
- NiCd projections
- NiMH projections
- Li projections



“Popular “ Assumptions

- NiCd is obsolete and will decline in all application areas
- NiMH is currently strong, but will be displaced by Li
- Li will be the dominant chemistry for portable electronics



NiCd Projections

- 17.5% of battery pack market (\$), 1997
- 7.0% of battery pack market (\$), 2002
- Will shrink, but not disappear
 - 5.4% annual growth in “other” dollar sales
 - 9.8% annual growth in “other” unit sales
 - shrinking in cellular and camcorders
 - 6.9% annual decline in overall dollar sales
 - 4.4% annual decline in overall unit sales



NiMH Projections

- 20.8% of battery pack market (\$), 1997
- 24.4% of battery pack market (\$), 2002
- Will grow, not shrink in market share
 - 23.9% annual growth in cellular \$ sales
 - 7.8% annual decline in laptop \$ sales
 - 8.5% annual decline in camcorder \$ sales
 - 16.9% annual growth in "other" \$ sales



Li Projections

- 61.7% of battery pack market (\$), 1997
- 68.6% of battery pack market (\$), 2002
- Already dominant, and gaining share
 - 64.1% annual growth in cellular \$ sales
 - constant laptop \$ sales
 - 2.5% annual decline in camcorder \$ sales
 - 27.5% annual growth in “other” \$ sales



Safety Issues are Critical

- Preceding analysis assumed Li is safe
- Perception is Reality
- Poor safety record could DOOM Lithium
 - Consumer confidence shaken
 - OEM risk factor too great
 - Insurance issues could eliminate Li-ion
- NiMH can offer similar performance
 - Little to no risks
 - Lower costs

