Battery Recycling Basics

WeRecycle Batteries.com

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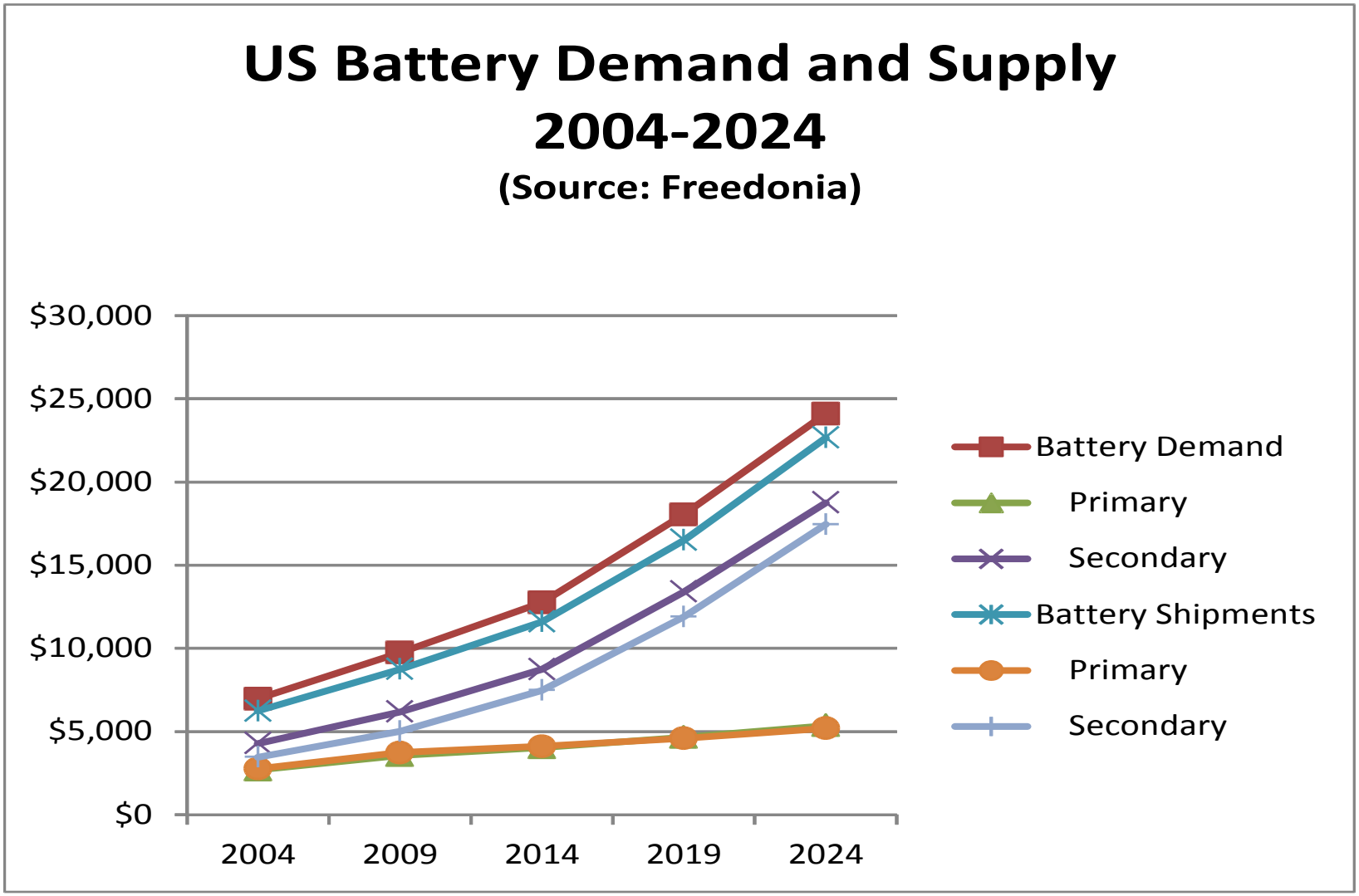
Battery Recycling

- Reduce, Recycle, Reuse
- US Market Demand & Supply
- Battery Types
- Non-Rechargeable (Primary)
- Rechargeable (Secondary) Batteries
- Regulatory Frame Work
- Who Pays who for Battery Recycling
- Future Outlook: Battery Waste Avalanche?

Battery Market Growth Makes Battery Waste



Market Segments by Type

- Portable Battery Market
  - Laptops, cameras, cell phones, computers, remotes
- Industrial/High Energy Storage
  - Some are dangerous shock/fire hazards if not handled correctly
  - Forklifts, Standby power for data center, and Telecom
- Electric Vehicle

Regulatory

- Hazmat Transport classifications
- US Domestic DOT exemptions
- UN Basel/OECD export requirements
- US “Universal Waste”
- Speculative accumulation
- Superfund Liability

Volume Battery Waste

- 2.5M tons of Lead-Acid (2012)
- 10M lbs of Rechargeable – Call2Recycle (2012)

Battery Types – Who's on 1st?

- Non-Rechargeable (A.K.A Primary batteries– used once (1st time only)
  - Alkaline
  - Lithium

Lithium non-rechargeable batteries

A barrel of Alkaline Batteries

Battery Types – Who's on 2nd

- Rechargeable batteries are known Secondary batteries.
  - Lead-Acid
  - Lithium-Ion
  - Nickel-Cadmium (Ni-CD)
    - Dry Cells
    - Wet Cells
  - Nickel-Metal Hydride

Lead-Acids

- 98% Recycle Rate – recycling pays handler
- Forklift, industrial, car, and truck, solar, wind
- Emergency backup power for computers
- WET Spillable vs “Non-Spillable”
- Unique US Hazmat regulations.

Forklift
Lead-Acid

Gel Cell Lead-Acid

Lithium-Ion

- The 5 Major recipes
- 20% cobalt?
- Lithium sources
  - African miner – salt or flour?
  - Commercial sources
  - Chilean desert
  - 10 lbs Lithium per Tesla

Nickel based

- Ni-MH – Rare Earth recovery
- Ni-CD
  - Wet
  - Dry
- Greater than 9 Insulating is fine

Alkaline

- Some recovery for new
- Car “powered” by Alkaline battery
- New problem
  - Lead-Alkaline (9V picture from volt meter).
  - Neither PB or Alkaline processors can handle them.
- 1 Billion batteries per year
- 10 AA batteries = 1 lb of waste

Where's the Money

- Income earners
  - Lead-Acid
  - Ni-MH
  - Li-Ion – Reuse (Portable) limited
  - Li-Ion – Cobalt Recovery (much less)

Vermont – Producer Responsibility

- Call2Recycle
- State level – tackling the problem – no Federal
- “Free-Riders”

Must pay

- Alkaline
- Lithium Non-Rechargeable
  - This is NOT li-Ion
  - Picture of a Tadiran
- Ni-CD
    - Dry cells
    - Wet Cells

Future Outlook: Avalanche of Batteries?

- Battery processing plants take years to build, because the regulatory approvals and capital investments.
- Rechargeable renewable energy storage market
  - 100MW of small Lithium Ion batteries cells could require over 6 miles of 53' trailers stacked end to end.
  - Forecasts are in 10s then 100s of GW/year of energy battery storage (70%+ Li-Ion) .