From Beakers to Batteries
The Curving Path to Commercialization and Volume Production

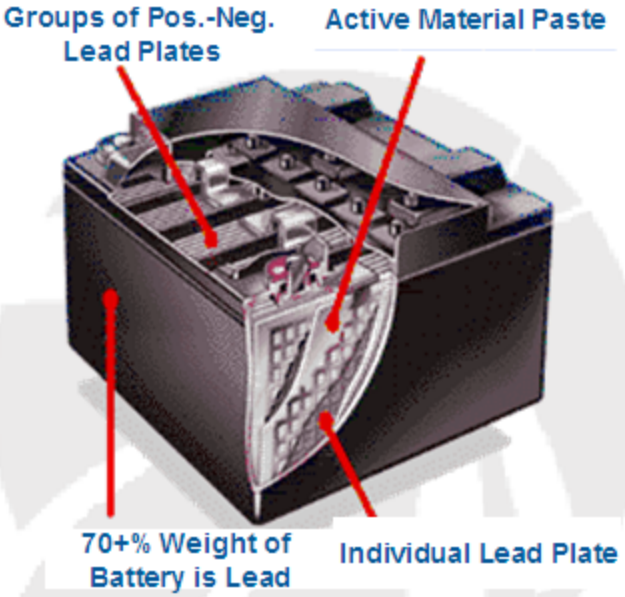
Mil Ovan
Sr. VP & Co-founder
KGSM '82

November 11, 2009

Innovations Take Wing™

Using Lead Acid Batteries is a Necessary Evil

- Never Runs Long Enough, Loses Capacity from Sulfation
- Not Enough Cycles in Heavy Deep-Discharge Use
- Lead Metal Electrode Corrodes in High Heat = Short Life
- Can't Get Power Out at Cold Temperatures
- The Chemistry Inside Degrades
- Long Recharge Times

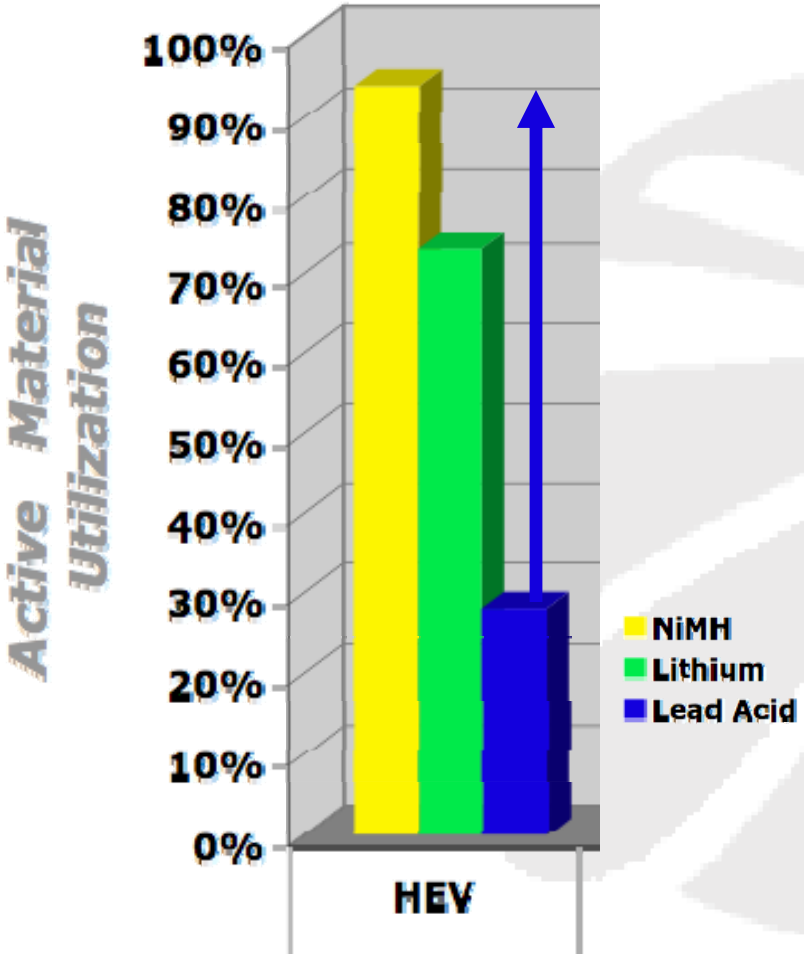


In the Beginning…

- Technology Incubated at Caterpillar Inc in 2000
  - Discovered in CAT's $600 million technology research operations
  - Driven by product performance problems - Not solved by leading battery manufacturers
    - Heavy Vibration
    - Hot/Cold Temps
    - Frequent/Infrequent Use

Kurt Kelley
Inventor

Performance Upside of Lead Acid Chemistry

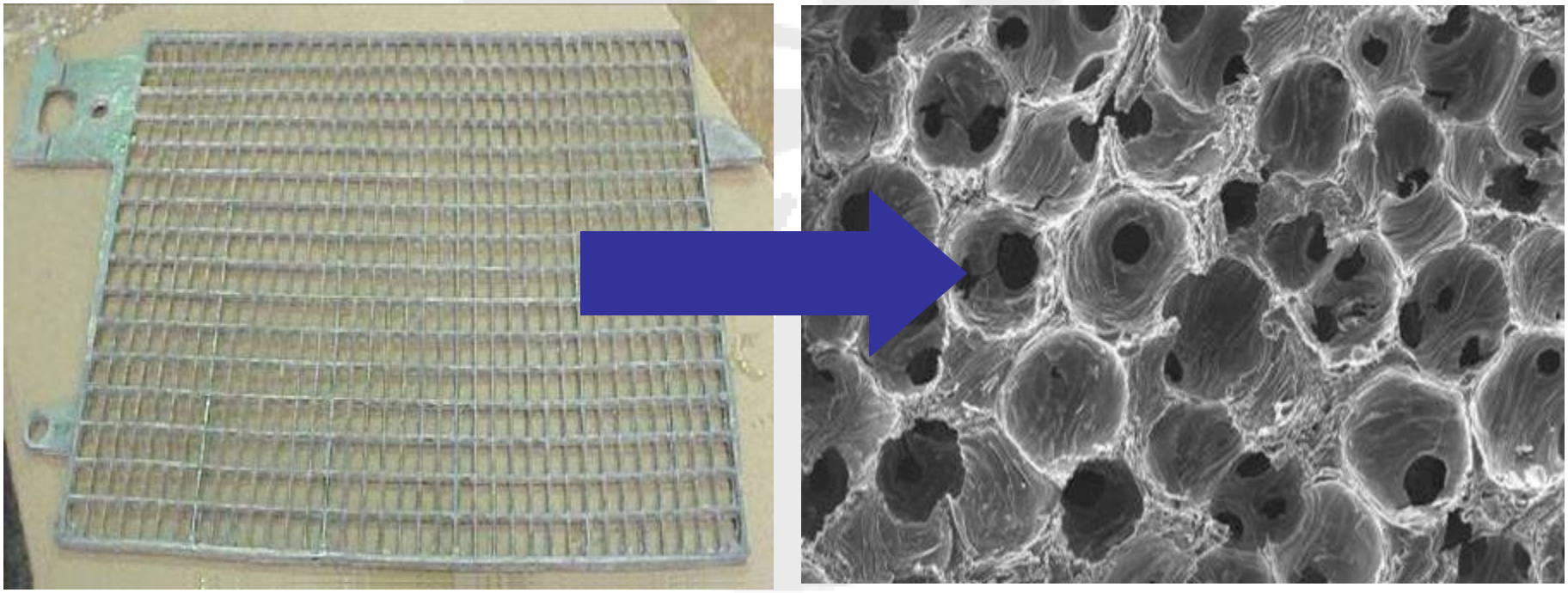


- Lead Acid chemistry is currently engineered to deliver only 20%-40% of its theoretical potential.
- Firefly Energy's long term technology roadmap moves the chemistry to 90%+ of its potential.

The Key Technology:
Three Dimensional Carbon-Graphite Foam Plates

Batteries use the same corroding & sulfating lead metal grid since invented in 1859!

Firefly batteries uses a 21st century light weight, non- corroding & non-sulfating “Microcell” foam grid



The Value of Networking

October 2002

- Ed Williams and Mil Ovan put together by mutual VC
  - Serial entrepreneurs who wound up their companies in the 2002 “Tech Wreck”
  - Decide to work together to find a deal
- Ed asked by another VC to judge business plans in Peoria
  - CAT on the agenda
- Ed and Mil discuss
  - Let’s figure out this out
    - Is it real?
    - Can we win?
    - Is it worth it?

peoria next

where scientists, investors, and entrepreneurs really mean business.

Work with CAT on Tech Transfer

- Scope of Activities
  - In-Depth Interviews with Flagship Companies in Various Applications
  - Market Research into Segment Sizes
  - Analyze Competitors
  - Search for prior patents by others
  - Obtain third party opinion of Firefly technology for VC use
  - Negotiate “realistic” valuation
  - Develop strategies and secure Seed investment

Firefly "Takes Wing" at May 1st 2003 @ Peoria Next Discovery Forum!

- Seed funding from CAT and State of Illinois

Caterpillar's CEO Glen Barton and CTO Sherril West "transfer power" to Firefly Energy CEO Ed Williams and SVP Mil Ovan

Consumers and Companies Have Been Stuck Between Two Extremes

- Like Lead Acid Prices & Safety
- But Hate Its Poor Life and Heavy Weight

- Like Small footprint/light weight of Li and NiMH
- But Hate Its multiple x cost, temperature and safety challenges

Enter Firefly Energy Microcell Foam Battery Technology

Firefly Energy Company Introduction

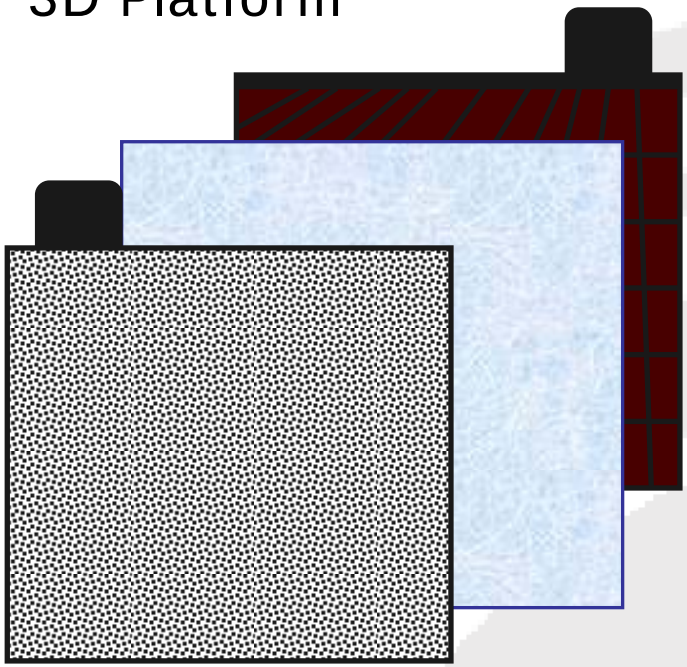
- Battery & Energy Storage Technology Company
  - *Initial Technology from Caterpillar*
- Portfolio of Patented Lead-Acid Battery technologies
  - *Eight generations of lead-acid technology*
  - *Delivers Performance of Lithium / NiMH, Safely @ ¼ the Cost*
  - *Addresses a well-established multi-billion worldwide marketplace*
- $31.5M in capital raised since 2003 / Investors:

Financial	Strategic
Infield Capital (MTD) KB Partners Khosla Ventures Quercus Trust	Caterpillar BAE Systems Husqvarna

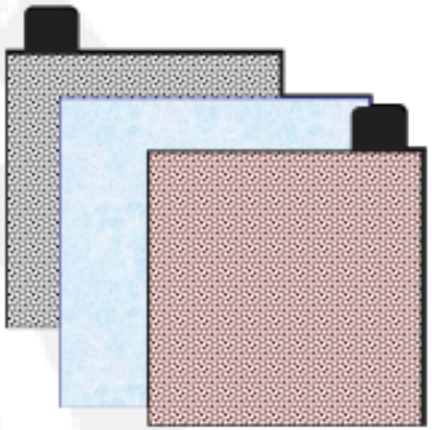
- Series D – Raising $20M Equity

Firefly Microcell Technology - Platforms

- 3D Platform



- $3D^2$ Platform



- o Traditional grid-based positive plate
- o Microcell foam-based negative plate
- o Hybrid separator

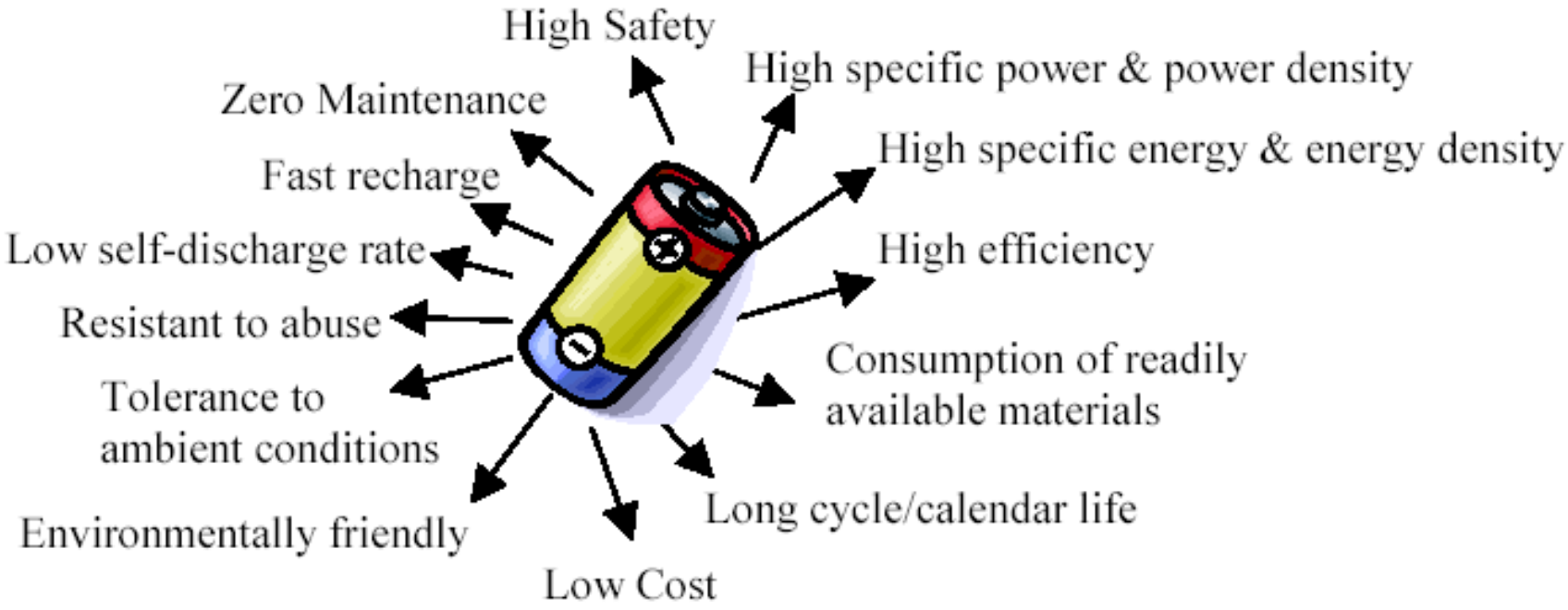
- o Microcell foam-based positive plate
- o Microcell foam-based negative plate
- o New technology separator system

The Markets

$20B+ Billion Worldwide Opportunity in Lead Acid Alone!

Ideal Battery Characteristics

Which Combination for which Segment(s)?

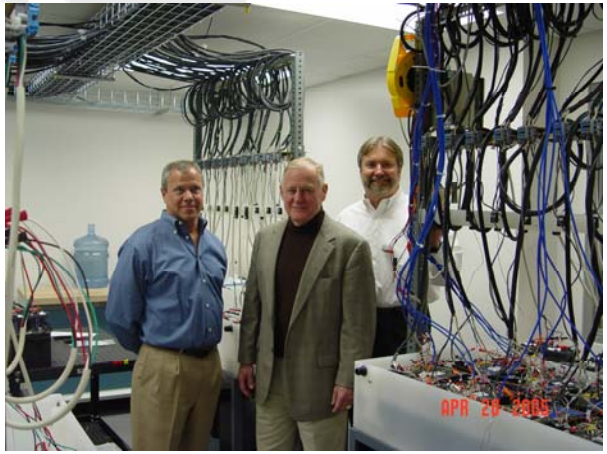


Pursue Dual-Use Commercial/Military Apps

- Work to Secure Defense Appropriations
- Get to Right levels of Military

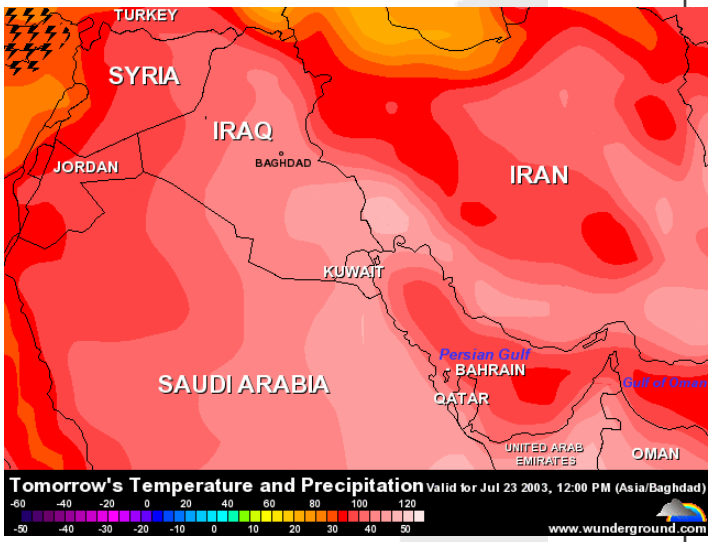
Obtaining support from Sen. Durbin

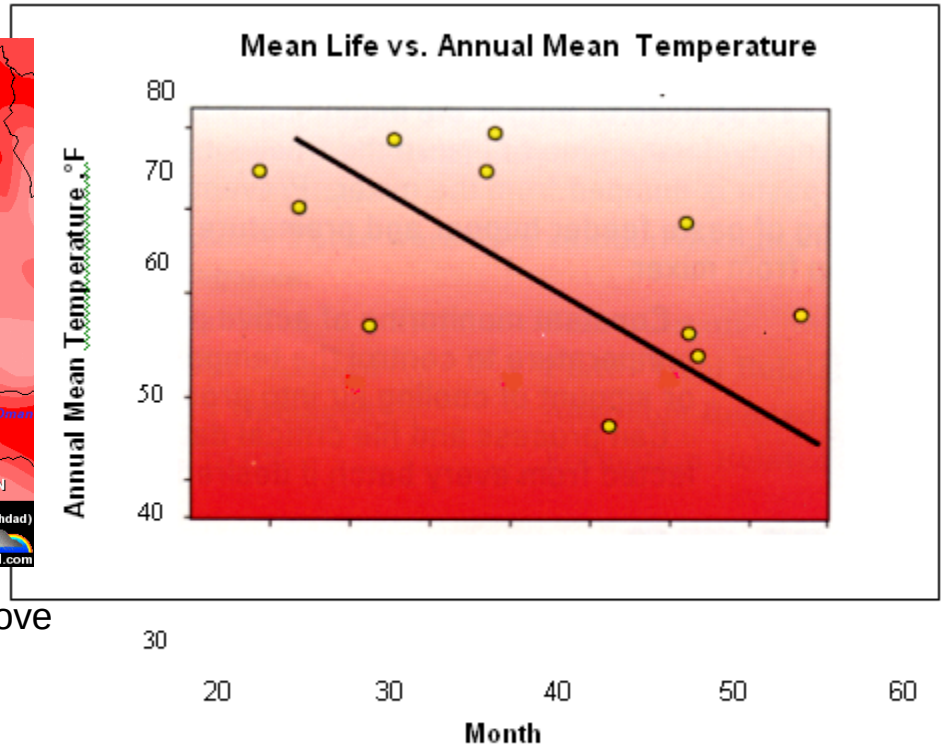
Getting GEN Wayne Downing on our Advisory Board



Firefly and the Army

"Batteries surviving in the heat of Iraq was one of the biggest problems my Army faced."
--G4 Deputy Chief of Staff Lieutenant General Chuck Mahan (September 2003)



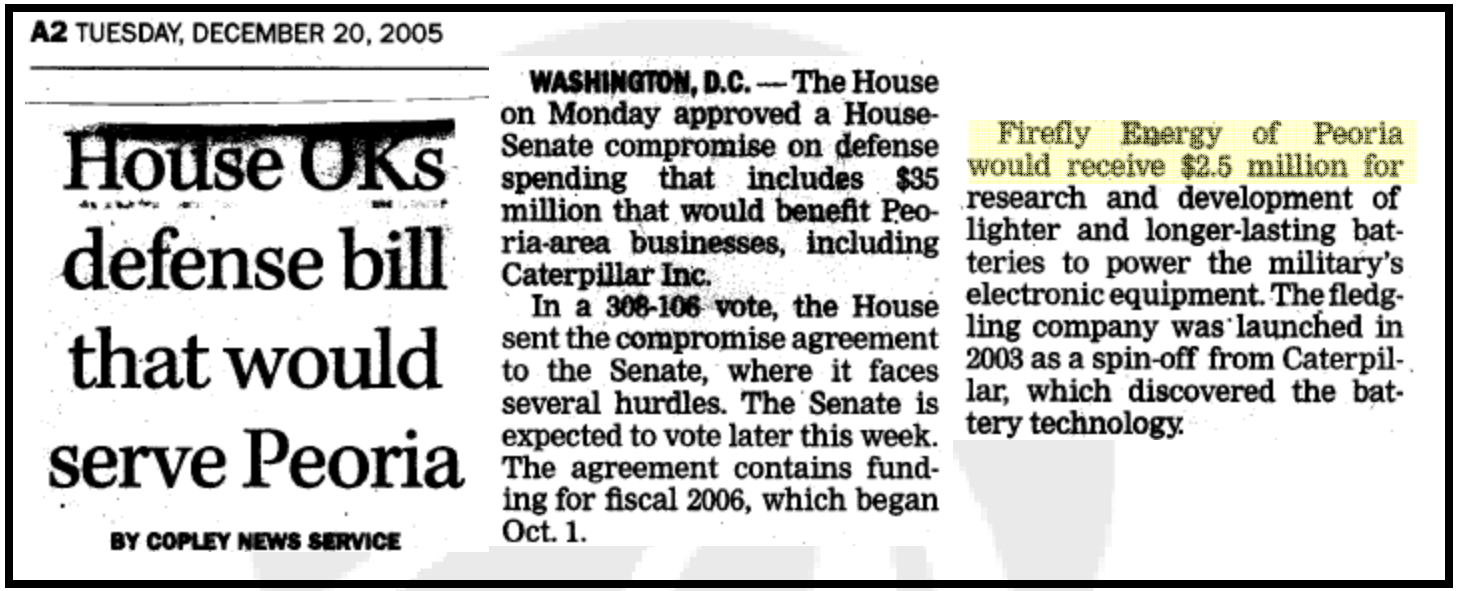


For every 15 degree increase in temperature above 70f, battery life decreases by 50%
--Both Firefly technologies address this problem!

***Fig. 1*: Battery Life Expectancy - Temperature Dependence**

(Ref. : BCI Technical Sub-committee Report on Battery Failure Modes in US Market during the period 1995 to 2000)

Military Appropriations Success!



A2 TUESDAY, DECEMBER 20, 2005

House OKs defense bill that would serve Peoria

BY COPLEY NEWS SERVICE

WASHINGTON, D.C. — The House on Monday approved a House-Senate compromise on defense spending that includes $35 million that would benefit Peoria-area businesses, including Caterpillar Inc.

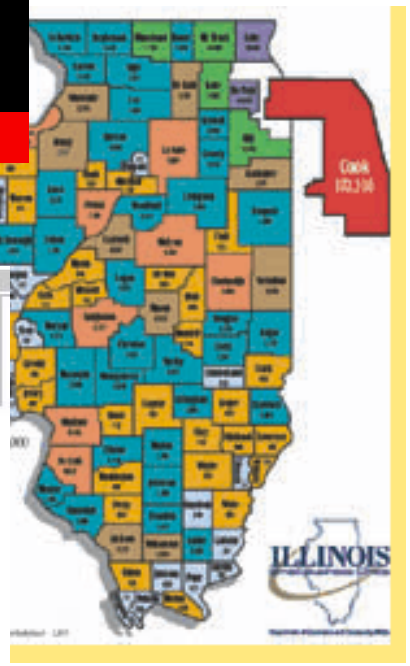
In a 308-106 vote, the House sent the compromise agreement to the Senate, where it faces several hurdles. The Senate is expected to vote later this week. The agreement contains funding for fiscal 2006, which began Oct. 1.

Firefly Energy of Peoria would receive $2.5 million for research and development of lighter and longer-lasting batteries to power the military's electronic equipment. The fledgling company was launched in 2003 as a spin-off from Caterpillar, which discovered the battery technology.

- Firefly went on to secure over $14M in non-dilutive development funding since inception

Series A $4 million funding round

United Defense



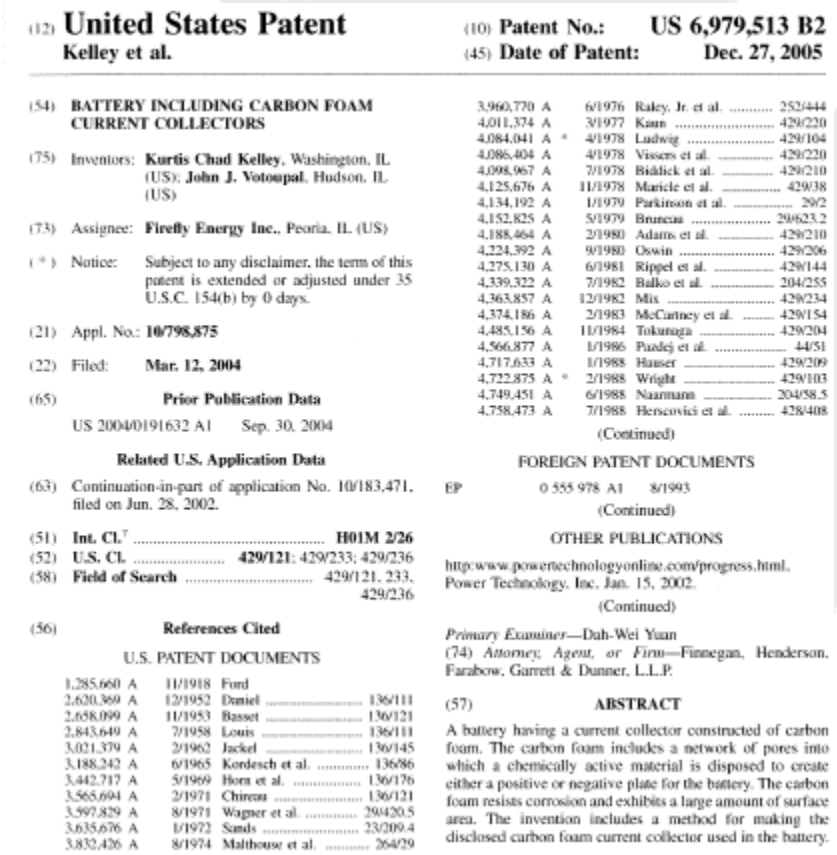
Series B $10M
Husqvarna as Strategic

Husqvarna Status

- Summary
  - Combined investment/NRE program
    - Immediate $1.1 Million Series “A1” investment @ $1.45/share
    - $1.3 Million in NRE over 2nd-4th project phases
  - Electrolux “Scope Creep” on escalating battery requirements
    - After several successful iterations, Firefly and Electrolux stood down

Intellectual Property

- Firefly's First Patent Issued 12/27/05!



(12) **United States Patent**
Kelley et al.

(10) **Patent No.: US 6,979,513 B2**
(45) **Date of Patent: Dec. 27, 2005**

(54) **BATTERY INCLUDING CARBON FOAM CURRENT COLLECTORS**

(75) Inventors: **Kurtis Chad Kelley**, Washington, IL (US); **John J. Votoupal**, Hudson, IL (US)

(73) Assignee: **Firefly Energy Inc.**, Peoria, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/798,875**

(22) Filed: **Mar. 12, 2004**

(65) **Prior Publication Data**

US 2004/0191632 A1 Sep. 30, 2004

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/183,471, filed on Jun. 28, 2002.

(51) **Int. Cl.**[7] **H01M 2/26**
(52) **U.S. Cl.** **429/121**; 429/233; 429/236
(58) **Field of Search** 429/121, 233, 429/236

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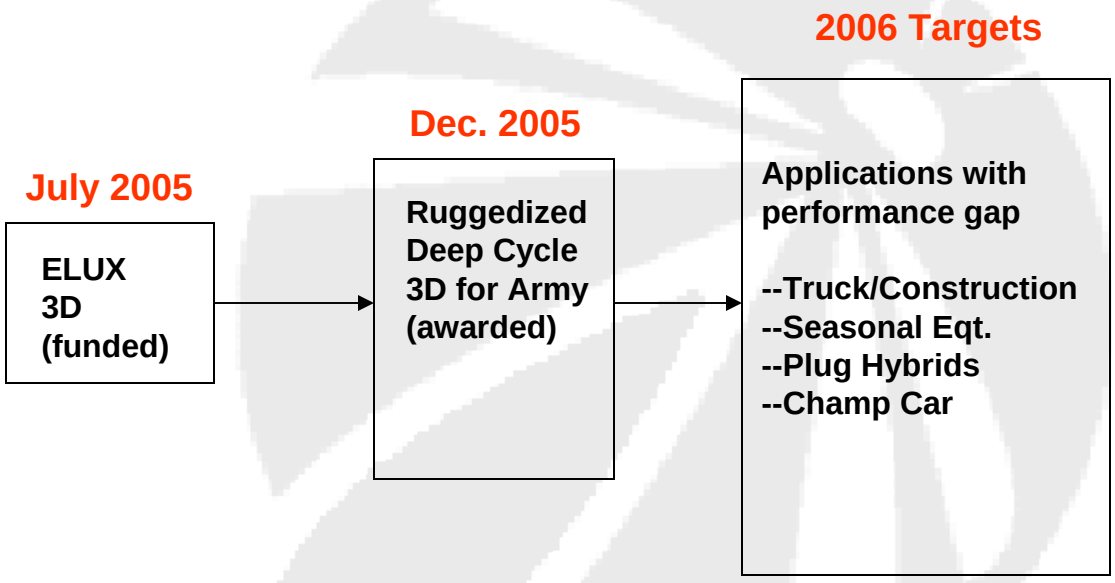
Primary Examiner—Dah-Wei Yuan
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, L.L.P.

(57) **ABSTRACT**

A battery having a current collector constructed of carbon foam. The carbon foam includes a network of pores into which a chemically active material is disposed to create either a positive or negative plate for the battery. The carbon foam resists corrosion and exhibits a large amount of surface area. The invention includes a method for making the disclosed carbon foam current collector used in the battery.

Leveraging Product Development Toward Broader Applications



Market Segment Targeting

- Focal Question: Which application (and associated flagship customer) is most appealing to pursue and leverages development for Husqvarna and U.S. Army?

Market Segmentation: Introduction

- First market selection is fundamental to our success
  - Provides focus for product development/optimization
  - Success shows customers/investors our legitimacy
  - Enables a beach head for further markets (“Crossing the Chasm”)
- Essential Ingredients
  - In depth knowledge of segment characteristics/opportunities
  - Certainty as to our product’s ultimate performance and scheduled availabilit

Market Entry Decision Criteria

1) Technology & Performance Leadership

- Application leverages high number of our technology performance attributes
- Extends our technology in a consistent strategic direction
- Enables our technology to serve adjacent market segments easily
- Ease of design & manufacture – FFE Industry Knowledge
- Quantum Leap in Competitive Value Proposition (Price/Performance)

2) Availability of Market (Ease of Entry)

- Strategic Pain creating an environment for immediate change
- Early adopter profile, experience & culture
- Available Manufacturing & Channel Partners
- Proprietary Solution Knowledge (Integrated product & battery design efforts)
- Competitive Solutions – Existing or Planned

3) Financial: Profitability & Cost of Entry

- Design & Manufacturing Considerations
- Time to Revenue
  - Testing Schedule
  - Sales Process & Acceptance Schedule
  - Manufacturing Partnership & Implementation
- Volume Commitments & Channel (Support) Partnership Structures
- Average Gross Margins & Price Elasticity
- Engineering Funding

4) Market Segment Considerations

- Size
- Growth
- Financial Stability
- Fragmentation vs. Monopoly
- Channel Infrastructure
  - Manufacturing
  - Distribution
  - Support
- Expected Rate of Technology Change
- Marquee Profile of the Segment

2007 R&D 100 Award Winner
For 3D Carbon-Graphite Foam-Based Battery

*"**Congratulations!** The Carbon-Graphite Foam-Based Battery that you submitted in the 2007 R&D 100 Awards program has been selected by the independent judging panel and editors of R&D Magazine as one of the 100 most technologically significant products introduced into the marketplace over the past year. Let me personally congratulate you and your project team on the design, development, test, and production of this remarkable product. This year's program was especially competitive and you should be proud of your accomplishment…The full list of winners will be published in the September 2007 issue of R&D Magazine."*

Sincerely, Tim Studt, Editor in Chief of R&D Magazine

Product /Market Analysis

- Group 31 Product Design: May 2007
  - C/10 for Trucking HVAC
  - Run Time
  - Cold Weather Performance
  - Sulfation Recovery – Cyclability
  - Low CCA's – Not Critical
- Market Drivers – "Must Have" Product
  - Fuel Prices
  - Anti-Idling Laws
  - Massive Growth in Transportation Business

Idling numbers are staggering

- The average Class 8 diesel engine burns approximately one gallon of diesel fuel for every hour that it idles.
  Source: California Air Resources Board

- Class 8 trucks that use main engine idling do so for an average 8 hours per night, 300 nights a year.

  Source: Clean Air Fleets

- A study by Argonne National Labs found that sleeper cabs idle 1830 hours annually.

Tipping Points: 1/1/08

Anti-idling legislation enacted in California on January 1 year combined with a precipitous rise in fuel prices have prompted a strong movement toward anti-idling solutions

Strategies:

Firefly G31 Name Focused on truckers

What ***IS*** a sleeper cab to a trucker tired after a 14 hour day at a truck stop in Yuma Arizona on a summer night?

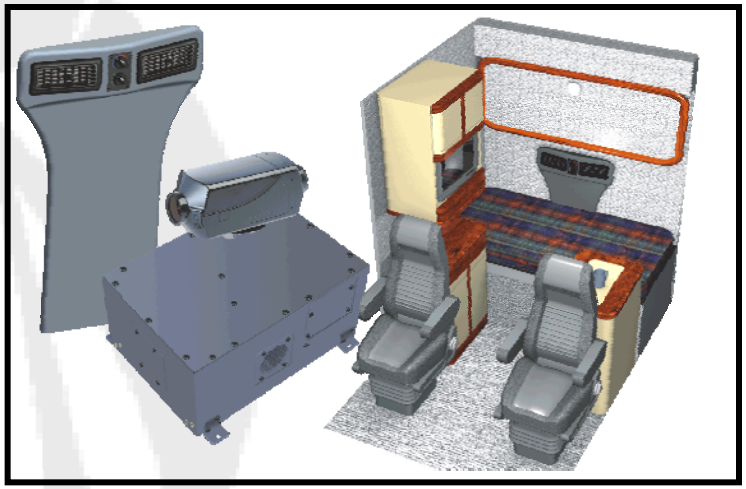
- His “Sanctuary”?
- His “Refuge”?
- His “***Oasis***”!

First Product: Oasis Group 31 Battery

- Specifications:
  - Group 31/29 Dimensions
  - Weight: 32 kg
  - C/20: 112 Ah
  - C/10: 105 Ah
  - RC: 230 min
  - CCA: 625 A
- Cycle Life:
  - 600 cycles @ 80% DoD
  - 600+ J-2185 Cycles (cycling on-going)
  - 126 hrs J-930 Vibration

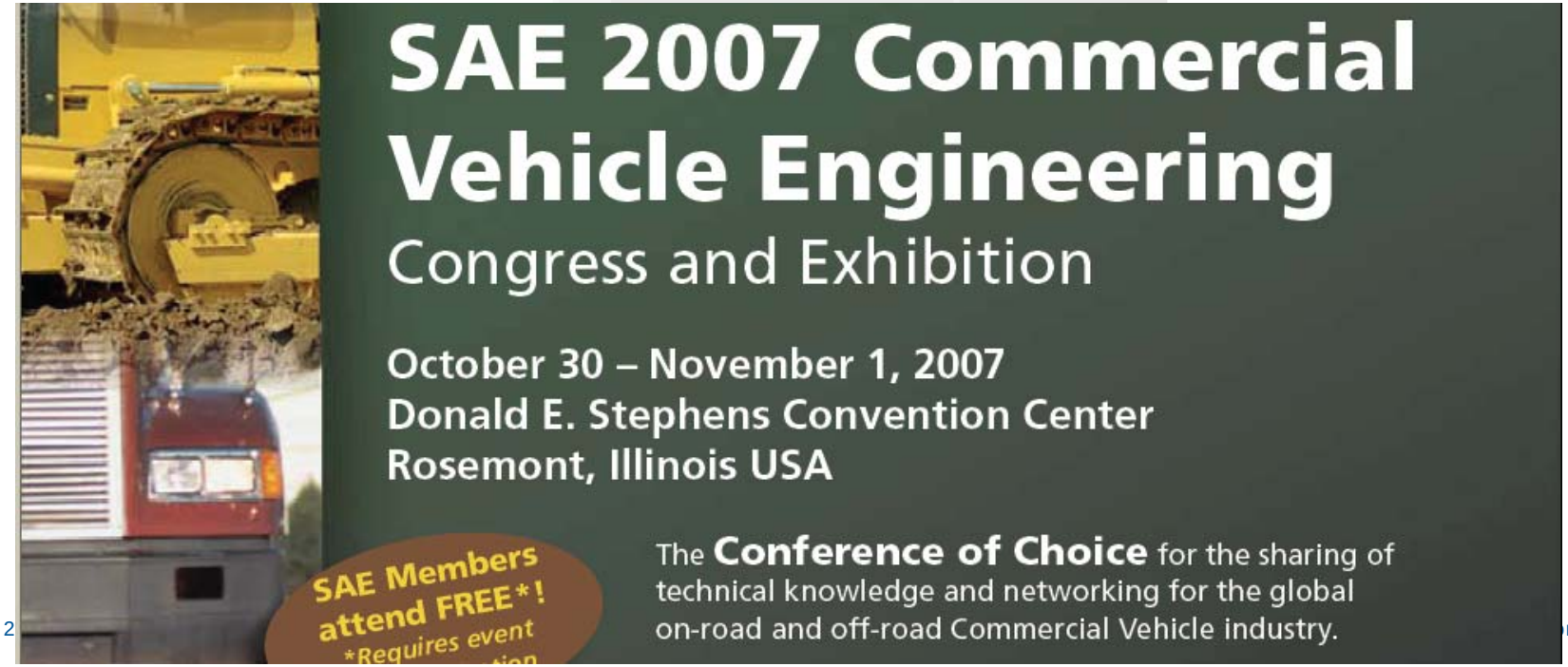
Alliance with Key Battery HVAC Truck Supplier

- Bergstrom
  - Strategic Marketing Agreement
    - Joint testing
    - Marketing collaboration
    - New Higher Power NITE System Offering with Firefly
    - Access to their installed base



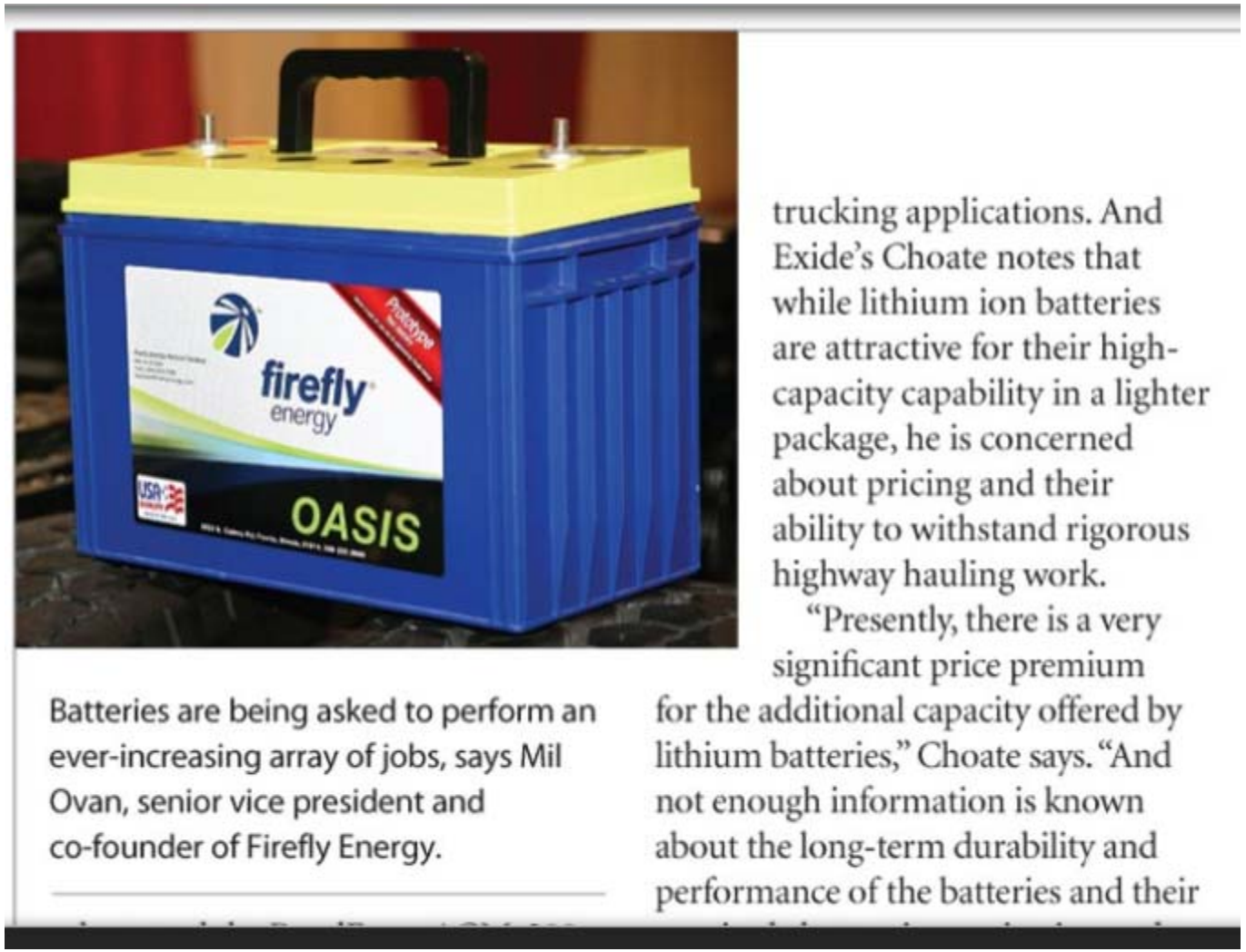
Strategies
Product Launch

- Announce at SAE Commercial Vehicle Engineering Conference October 30-November 1 2007 in Rosemont IL
  - Introduce name, price, availability, performance attributes
  - Firefly booth on main isle/corner




Oasis™ Group 31 battery outperforms regular lead-acid batteries:
• Capable of 850+ cycles — up to 600 more
• Recharges up to 3 times faster
• Supplies a 45% increase in energy density
• Delivers 65% of rated power capacity at -20° C
• Highly resistant to corrosion, sulfation and vibration
firefly® energy
CARBON GRAPHITE FOAM
POWERING THE FUTURE OF BATTERY TECHNOLOGY
Winner of the 2007 R&D 100 Award
Winner of the Wall Street Journal 2007 Technology Innovation Awards
OASIS
Note: Design of Name, product label, and packaging color not finalized yet

January 09 Issue of Common Carrier Journal Magazine

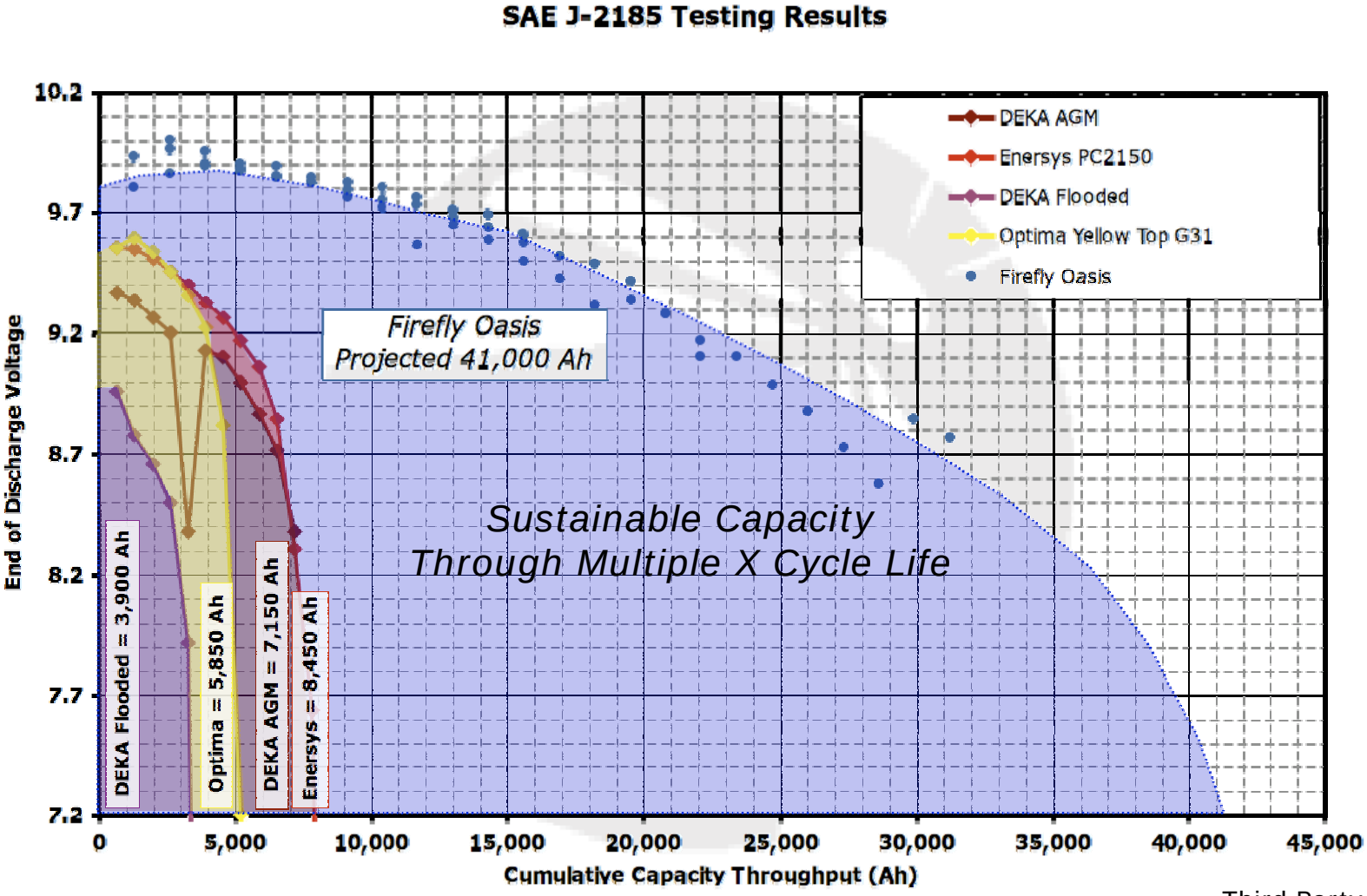


Batteries are being asked to perform an ever-increasing array of jobs, says Mil Ovan, senior vice president and co-founder of Firefly Energy.

trucking applications. And Exide's Choate notes that while lithium ion batteries are attractive for their high-capacity capability in a lighter package, he is concerned about pricing and their ability to withstand rigorous highway hauling work.

"Presently, there is a very significant price premium for the additional capacity offered by lithium batteries," Choate says. "And not enough information is known about the long-term durability and performance of the batteries and their

SAE J-2185 Testing - Third Party

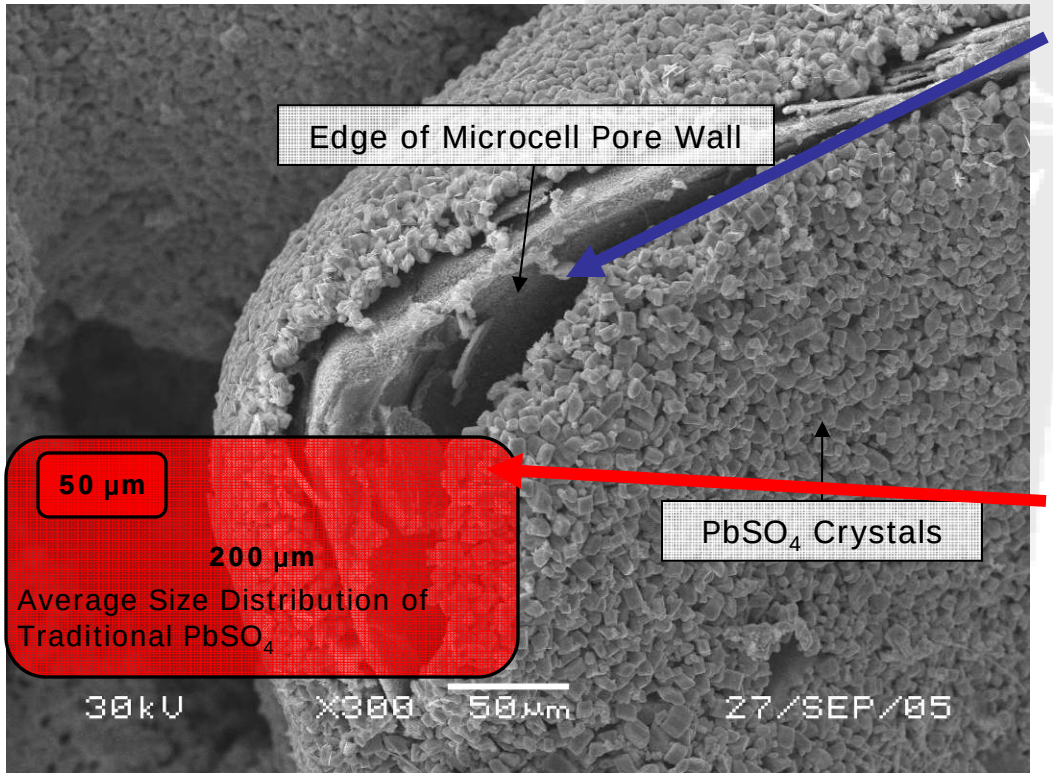


Third Party Testing

Why This Performance is Achievable

Resilience Against Life & Runtime-Robbing Sulfation

- Negative active material sulfation is a prime failure mode in traditional lead acid batteries in High Rate Partial State-of-Charge Cycling



- Firefly Sulfation ($PbSO_4$) crystals on negative plates do not grow larger than 8-10 µm
  - o Much easier to reconvert these crystals to active material
- Traditional Battery Sulfation ($PbSO_4$)
  - o 2-10 µm during routine cycling
  - o 50-200 µm during HRPSoC and extended stands

Oasis Benefits to Customers

- Lowest Self Discharge + Highest Reserve Capacity *= More Available Power*
- Highest Reserve Capacity + Fastest Capacity Recovery *= Less Time & Money Running the Engine or Using the Grid for Recharging*
- Highest Consistent Return to Full Reserve Capacity after Repeated Cycling *= Undiminished Runtime over Life*
- Highest Resistance to Vibration + Lowest Sulfation "Memory" + Cooler Running Battery *= Longest Cycle & Calendar Life & Lowest Cost of Ownership*

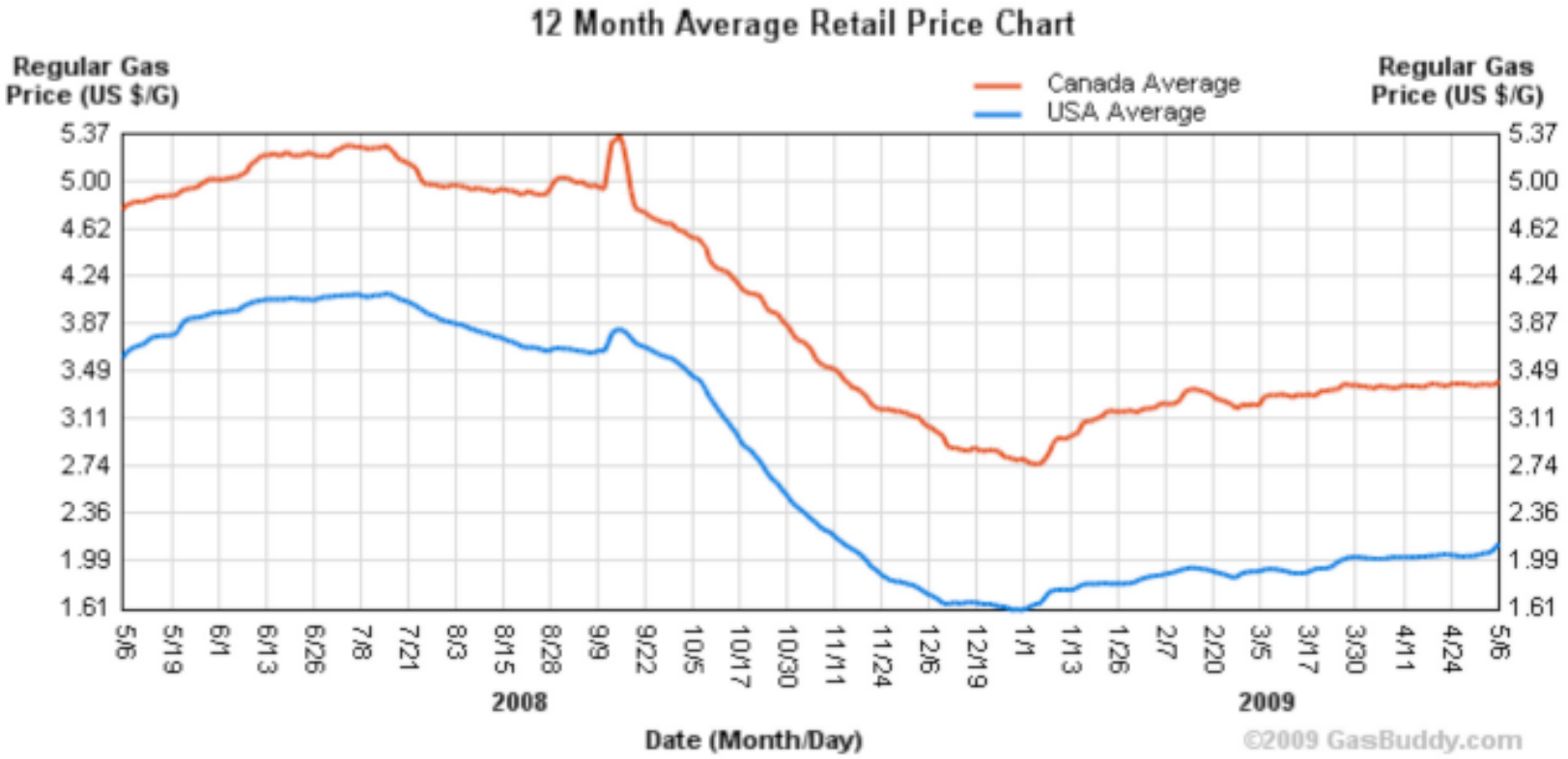
Focus on Commercial Customers Where:

Battery performance is central to the success of the end product or service

The Batteries are repeatedly deep discharged

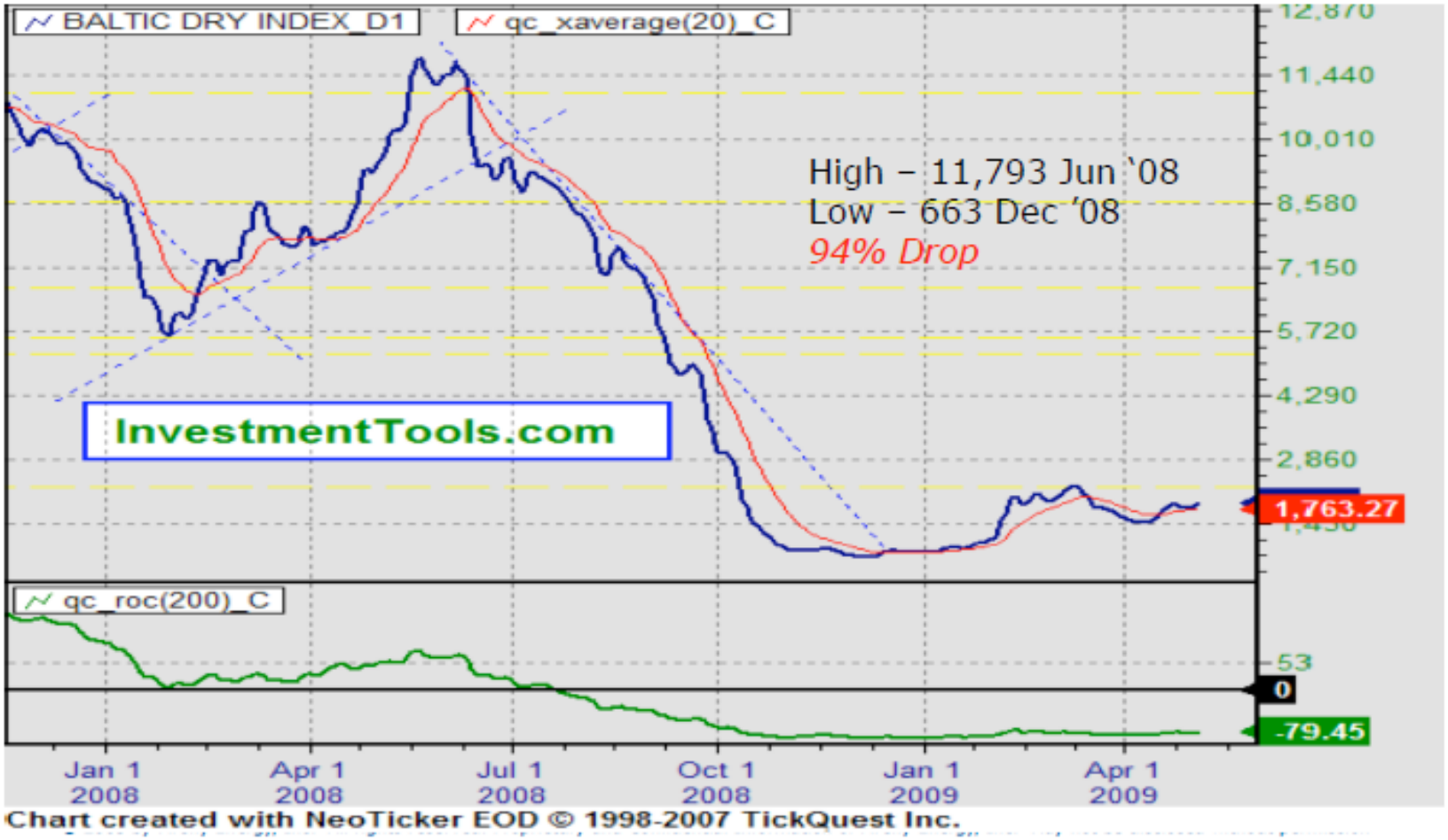
Total Cost of Ownership Advantage can be proven

Fuel Prices



Average Annual Fuel Savings from Extended Run Cut in Half

Baltic Index – Velocity of Goods Transported



Marketing Challenges with continued slips

- Loss of credibility in truck market
- Lack of marketable test data – Internal and External
  - Delays customer evaluation & commitment to scheduled production of 2009
  - Delays of expanding G31 to new markets
- Continued economic downturn may be detriment for G31 2009 sales revenue
  - Increasing gas prices good for battery payback calculation
  - Decreasing goods to ship lowers truck firm revenues

World Economic Crisis! Now What?

- One month into our $20M Series D fundraising
- Slow down our spending
  - Delay high speed automated mfg equipment
  - Delay salesforce build-out
  - Utilize “Wisdom of Solomon” in dealing out sample prototypes
  - Pursue Stimulus funding

Flagship Deployments in Challenging Applications

Pursue Stimulus Funding

- Cemented our position with leaders in the incoming Administration and House/Senate

Senate Majority Whip & Chief Obama campaign advisor Dick Durbin

Peoria Congressman/Incoming DoT Secretary Ray LaHood

DOE Program Proposal/Results

- Firefly submitted a $225M proposal to the Department of Energy for grants/loans under the $2B Electric Drive Vehicle Battery and Component Manufacturing Initiative

- 95% of money went to lithium companies
- 95% went to Michigan and Indiana companies

Lessons from an Entrepreneur

- Tolerating/thriving on ambiguity
- Figure out quickly where your product/company fits
- Avoiding the “Lilly Pad” syndrome
- Don’t out drive your headlights
- Definite Yes or No vs “Dangling Maybe”
- Don’t bank on something until it’s “In ink”
- Resiliency and speed after rejection/failure
- Time literally is money
- “Spinning Multiple Plates” + Triage

Lessons from an Entrepreneur

- Take more money than you need for rainy days (year!!)
- Long term outlook plus every day progress
- Principals as sales people
- Hiring “A” Players
- Create pull for your solution/be larger than life
- Build a great product & company first (vs. IPO)
- Pay it forward/nurture relationships
- Exercise now un-common business courtesy
- Follow your passion/Love what you do
- Soar with eagles rather than flock with turkeys

Thank You!

2006 FROST & SULLIVAN
Energy Storage
Entrepreneurial Company of the Year Award

2006 FROST & SULLIVAN
Advanced Lead Acid Battery
Technology Innovation of the Year Award

THE WALL STREET JOURNAL - THE WALL STREET JOURNAL EUROPE
THE WALL STREET JOURNAL ASIA
TECHNOLOGY INNOVATION AWARDS

The 44th Annual Awards
R&D 100