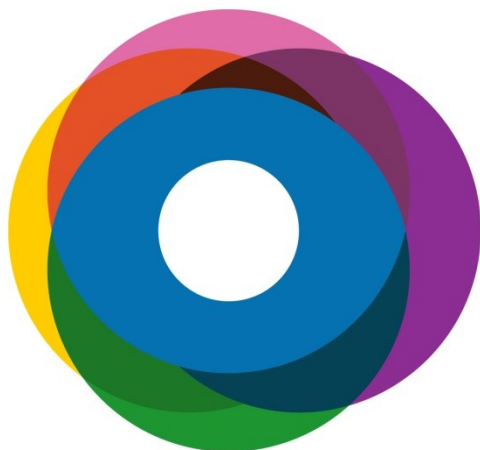


# The Thin Film and Printed Battery Industry

An Analysis of Leading Players, Technologies,  
and Market Opportunity

December 2008



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# 1. Methodology and Scope

This report has been prepared to address the following scope:

- a forecast of TFB volumes by market segment / application until 2013;
- a forecast of the average selling price (“ASP”) for TFBs during the next five years and their evolution by sub-segment;
- a forecast of the current and future cost of a TFB as a percentage of the total manufacturing cost per unit in each application (smart card, RFID tag etc.);
- an analysis of the principal issues and concerns regarding the wider applicability of the technology;
- an overview of existing market players in the sector and likely market entrants; and
- a summary of competing technologies within the industry and their current price points;

In undertaking this research VB/Research has relied on a wide range of sources (both publicly available and privately held within VB/Research’s archives). For example, VB/Research owns substantial proprietary data on many of the companies, products and technologies analysed in this report. This data includes funding history and capital requirements, management biographies, key management interviews and revenue projections. Sources used to compile this report include: Nanotechnology, IdTechEx and a number of archived research reports held at VB/Research.

After analysing these sources in detail, VB/Research has leveraged its network, which includes many of the leading players in the TFB industry. Through executives interviews conducted by VB/Research’s team of analysts we have attempted to provide answers to the harder questions posed within the scope including:

- What are the major obstacles to wider adoption of the technology?
- How do price points vary between the different TFB technologies? Is it possible to reduce per unit costs and at what volumes? How important is the per-unit cost in each sector / application?
- Which sectors are likely to gain the greatest traction in the short and long term?
- What are the differences between the three principal TFB technologies and where are they most likely to be applied?

**Disclaimer:**

While this report attempts to answer in as full a manner as possible the questions included in the scope, it does not pretend to be exhaustive. VB/Research has verified information, data and opinions on a best effort basis. All information used in this report is believed to be reliable but has not systematically been verified by VB/Research. VB/Research makes no guarantee of its accuracy and completeness and is not responsible for errors of transmission of factual or analytical data, nor is it liable for damages arising out of any person's reliance upon this information. Any opinions in this document constitute the present judgement of VB/Research which is subject to change without notice. This document is neither an offer to sell, purchase or subscribe for any investment nor a solicitation of such offer. This document is not intended for distribution.

## 2. Executive Summary

The Thin Film and Printed Battery (“TFB”) industry is currently in the early production and development phase. Today the industry is being advanced by private companies that vary in maturity (research and development, pre-production and small scale manufacturing). VB/Research believes that this industry can develop into a large, potentially multi-billion dollar market, but its growth rate will depend on how quickly large volume manufacturing can be achieved to drive down the currently prohibitive per unit costs.

Three very distinct types of TFB technologies exist – their properties are explained in more detail in Appendix 1. They vary from the cheaper lower performance Zinc printed TFBs, to the single use higher performance Lithium-ion (Li-ion) batteries, and lastly to the most expensive solid state rechargeable LiPON batteries. Currently Zinc batteries can be fully printed and used in roll-to-roll manufacturing processes, while the other batteries use complex vapour deposition and sputtering manufacturing. Each battery technology has very different uses and applications. A new entrant or investor needs to consider carefully which end user markets are strategically important before choosing their preferred TFB technology.

Today the addressable market for TFBs is estimated at \$30 million. This is forecasted to increase to over \$2.5 billion by 2013. However, in its current form, the TFB industry is not positioned to capitalize on this market opportunity. Most players are under-capitalised and do not have the manufacturing capacity to produce the necessary volumes. VB/Research believes there is scope for new entrants in this market. In 2008 existing TFB manufacturers will penetrate \$20 million of the market in (total industry revenue). This is forecast to increase to \$940 million in 2013.

Growth within the TFB market will be driven by three main sectors; Battery Assisted Passive (“BAP”) RFID, Smart Cards and Sensors. RFID is the most dominant addressable market growing from \$17.5 million in 2008 to \$2 billion in 2013; this is specifically relevant to the lower performance Zinc batteries. This is followed by more complex applications in Smart Cards (\$240 million target market in 2013) and Sensors (\$120 million target market in 2013). These two sectors are likely to provide the largest opportunity for the higher performance Li-ion and LiPON batteries.

In this report, growth in the TFB market has been forecast based on existing markets (e.g. RFID), the future growth of these markets and the ability for TFBs to be deployed within them. However, there is also the potential for TFBs to revolutionise the electronic industry by accelerating the growth of fully printable electronics and make a similar impact as the cellular phone had on the telecommunications sector.

Overall VB/Research believes that the Thin Film and Printed battery industry represents an exciting growth opportunity. However, large risks and challenges remain. Ultimately the level of growth of the

TFB industry will depend on three factors: firstly, the technology needs to be proven for its proposed applications; secondly, volume manufacturing efficiencies need to be achieved to drive down the current prohibitive unit cost to access the larger opportunities; and thirdly, growth in the applications.

## About VB/Research

VB/Research is a leading global research firm providing proprietary intelligence and data on companies and investors combined with legal, financial and sector analysis in the Clean Tech & Renewable Energy industry.

VB/Research offers clients a range of decision making tools including pipeline™, online advanced platform offers direct access articles, company profiles and deal databases (VC, PE, M&A, public markets, funds) tracked since 2002. In addition the company undertakes bespoke consultancy projects, arranges seminars and provides a unique service that offers direct access to VBR's research team

Founded in early 2006, today VB/Research is a market leader in its field in two of the world's most economically dynamic sectors in North America and Europe Clean Technologies & Renewable Energies and Security (IT & Homeland) and Defense.

Members of our research service range from governments and multinational companies to investment banks, venture capitalists, private equity funds, hedge funds and law firms in over 55 countries.



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