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A vision for the Asian battery industry

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Abstract

A very positive future is forecast for the battery manufacturing industry in Asia, and for the further development of sustainable and profitable long-term markets. In detail, it is argued that the lead/acid battery has a longer and more promising future than its detractors would like others to believe; that the supply of lead will remain fairly stable in both quantity and price; and that the regulatory and environmental pressures in other parts of the world can be turned to favour Asian manufacture, and to increase the global market share of the region.

Proposition I

The first stage in crystallizing a vision for the Asian battery industry is based on a seemingly contentious and sweeping proposition: *the lead/acid battery is the only practical, economic and safe means of storing electrical energy for the foreseeable future.*

The lead/acid battery has been used as a practical power source for over a hundred years, since before the invention of the automobile. The range of uses that the lead/acid battery now encompasses has made it a vital part of some of the world's most important infrastructures, especially telecommunications. Any alternative technology that seeks to replace the lead/acid battery must deliver substantial improvements before it can expect to make lead/acid battery technology obsolete: it must deliver either higher performance (greater storage capacity), lower volume and weight, reduced cost, or environmental and safety advantages. In fact, any real alternative will need to deliver more than one of these, and it will have to take into account, over its research and development cycle, the fact that lead/acid battery technology is consistently and constantly improving.

Figure 1 illustrates how lead/acid batteries have improved in performance since 1950: battery life has increased, power-to-mass performance has risen, and lead costs have fallen. These incremental performance improvements will continue into the foreseeable future, and will continue to present a formidable challenge to any competing technology.

There is a range of proposed alternatives to the lead/acid battery. Nickel/cadmium is a proven contender, but it is too expensive to be widely adopted. Other technologies now in their formative stages — lithium secondary cells, nickel/zinc, nickel/hydrogen, zinc/halogen and sodium/sulfur — are unlikely to be suitable across the range of applications that lead/acid covers, or to deliver any increment in safety or cost. In fact, all are likely to be both more expensive and more hazardous. Nevertheless, this

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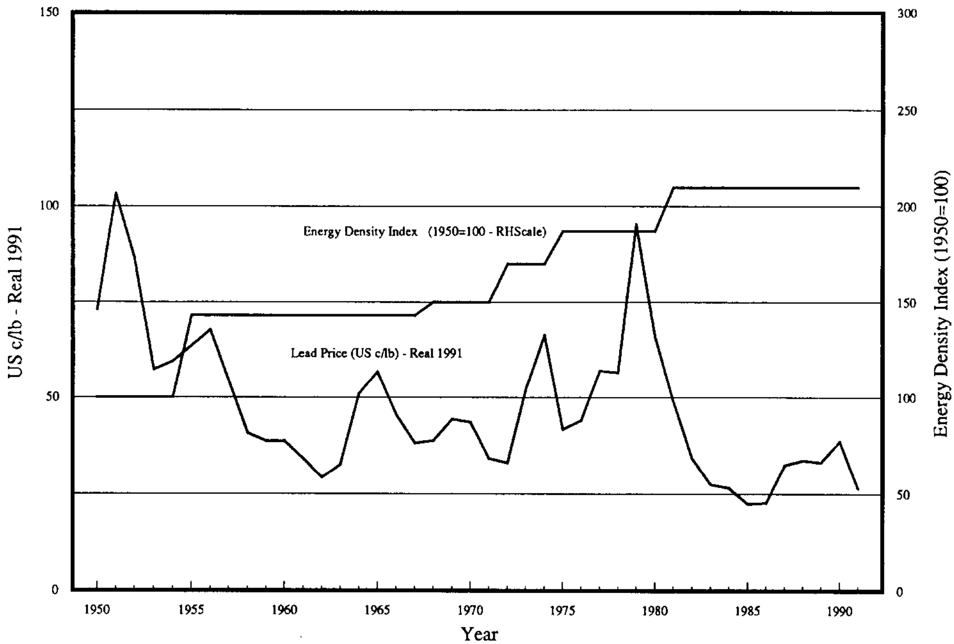

Fig. 1. Battery performance improvements and lead cost reductions.

will not stop attempts to find an alternative to lead/acid. The US Department of Energy (DOE), in conjunction with the 'Big Three' American automobile manufacturers — General Motors, Ford and Chrysler — is reported to have committed US$ 100 million per year for the next seven years to the effort to find an electrical storage technology appropriate to the 21st century. It is absurd that the lead/acid battery is not being considered as an option in this mammoth research project. The assumptions — that lead/acid is out-moded, and that throwing money at unproven, or even undiscovered technology will produce the answer — are false assumptions, and the metal suppliers are approaching the DOE to include lead/acid battery technology in their research project. Perhaps the DOE research effort will succeed. Even then, it is very improbable that an alternative will be produced that outperforms lead/acid across the board. Furthermore, it would take only a fraction of the resources involved to achieve substantial performance gains in lead/acid technology instead. Nevertheless, the lead/acid battery industry can take heart from the belief expressed in such a large investment — that it will cost an enormous amount of money and energy to improve on the present capability of the lead/acid system. The danger, on the other hand, is that such a commitment will lead to the adoption of whatever alternative the research identifies, whether or not it improves on what is currently available. In seven years time, both the DOE and the car makers will have 700 million good reasons to pursue the alternative they identify, irrespective of its comparative performance.

It is the author's prediction that the DOE research project must result in a range of application-specific performance gains, leading to new technology niches and to a number of improvements in existing battery technology — without producing a universal replacement for lead/acid. The outcome will not become clear for at least five years, and this time can be used to introduce refinements in lead/acid technology and performance that will make the task of replacing this system still more challenging – and less necessary.

The greatest vulnerability of lead/acid batteries lies in very large stationary applications, the greatest strength in traditional markets. The question mark lies over the development of new-generation electric motor vehicles, now that the world's leading car makers have committed themselves to zero-pollution transportation. In this latter market, there are both threats and opportunities for lead/acid. Clearly, the longer it takes to prove alternatives, and the more quickly world opinion moves towards the zero-pollution benchmark, the greater the demand for lead/acid battery designs.

History has shown that technology moves in jumps rather than in a smooth and predictable curve. A breakthrough into viable alternatives may come over the decade, but, until it does, there are strong grounds for the proposition that the lead/acid battery is the only practical, affordable and safe means of electrical storage for the foreseeable future.

Proposition II

It is time now to add a second proposition: *the future is encouraging for increased-volume use of lead/acid batteries in more diverse high-technology applications.*

The most promising path for the industry lies in valve-regulated 'sealed' lead/acid (VRB) technology. The target is a maintenance-free, sealed battery with deep-cycling characteristics, produced by high-technology manufacturing plants. Automotive batteries are now labelled as maintenance-free, and although this is not quite accurate, the maintenance required by present-day batteries is only a fraction of what was needed 20 years ago.

The technical limitation has always been imposed by the trade off between discharge and recharge depth and the need for regular topping-up. The level of antimony is simultaneously responsible for the volume of gas produced by the battery, and its discharge and recharge capability. Thus, at present, deep-cycling characteristics have to be sacrificed if a sealed, no-antimony, low-maintenance product is desired. The International Lead and Zinc Research Organization (ILZRO) has committed $1 million to a three-year research project to overcome this limitation. Much of the work will be carried out in Melbourne, in association with Australia's largest scientific research body, the CSIRO. There are high hopes of a promising result, at about a thousandth of the cost of the US DOE programme.

A recyclable VRB already exhibits many of the characteristics of an ideal battery. It is safe to handle, environmentally sound, portable, long-lasting, convenient and cost-effective. Although VRBs require high-quality control in manufacturing, they are essential for many high-technology applications. The batteries are also supplied in a vast range of size and power, from the small units for video cassettes, medical equipment, clocks and desk-top computers, through those for home-sized equipment, to large designs for industrial applications such as host computers and telecommunications networks.

Every segment of the industrial battery market has shown consistent growth over the period 1983–1990 (Fig. 2), and success in the above ILZRO project will open further opportunities for market growth. Deep-cycling capability will mean that VRBs will be used in more peak-shaving/load-levelling applications, such as the Chino project in California, and will make the dream of electric-vehicle propulsion real. In Sept. 1990, the California Air Resources Board adopted new vehicle-emission standards,

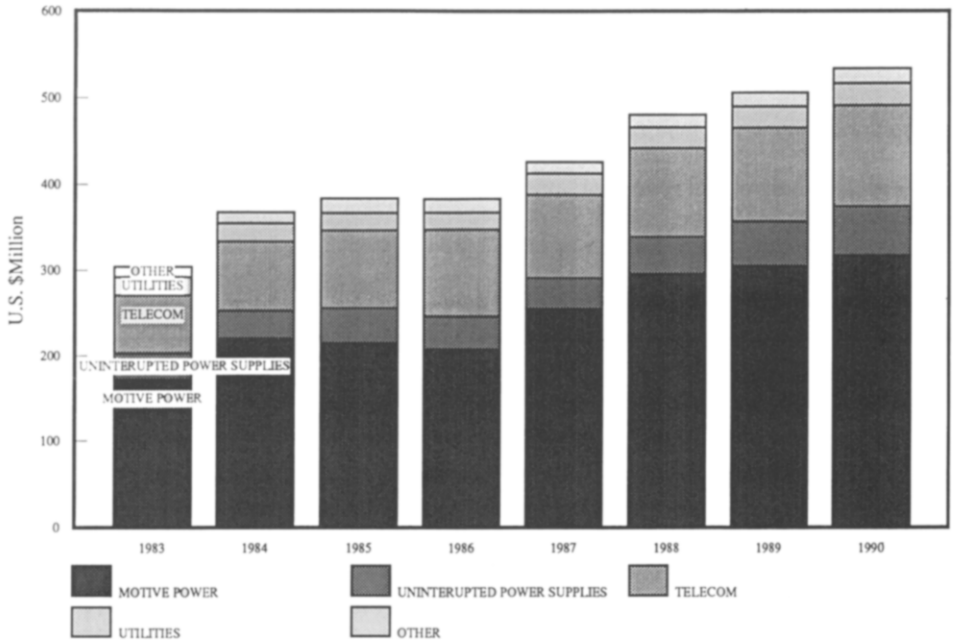

Fig. 2. Market segments — industrial battery market in United States.

requiring the introduction of cleaner fuels and the zero-emission vehicle (ZEV) under an accelerated timetable. By 1998, 2% of cars in California will have zero emissions, with this proportion rising to 5% in 2001 and 10% by 2003.

In the light of the first proposition, the outlook for sealed lead/acid batteries is very promising, provided the deep-cycling limitation can be overcome, and provided the industry takes account of the fact that a growing market for VRBs means a correspondingly smaller market for the high-maintenance counterparts. If the industry follows the right path into high-technology, high-quality, sealed battery production, the future is very encouraging for increased-volume use of lead/acid batteries in more diverse applications.

Proposition III

The third proposition concerns the outlook for the supply of lead, and it argues that *in the long term, the lead price will hold few surprises for lead consumers*.

Battery production, as an end-use of lead, is increasing as other uses decrease (Fig. 3). This trend has been consistent since 1982, and is expected to continue for the immediate future. It means that lead suppliers must continue to concentrate on battery manufacturers — their most valuable customers — and to provide the best possible marketing and technical service. For example, Pasminco has embarked on a quality assurance (QA) programme in order to guarantee that all sales meet international standard ISO 9003 in product quality and presentation. All raw material suppliers consider product quality, and supplier-consumer cooperation, as paramount in serving the future interests of all the involved parties.

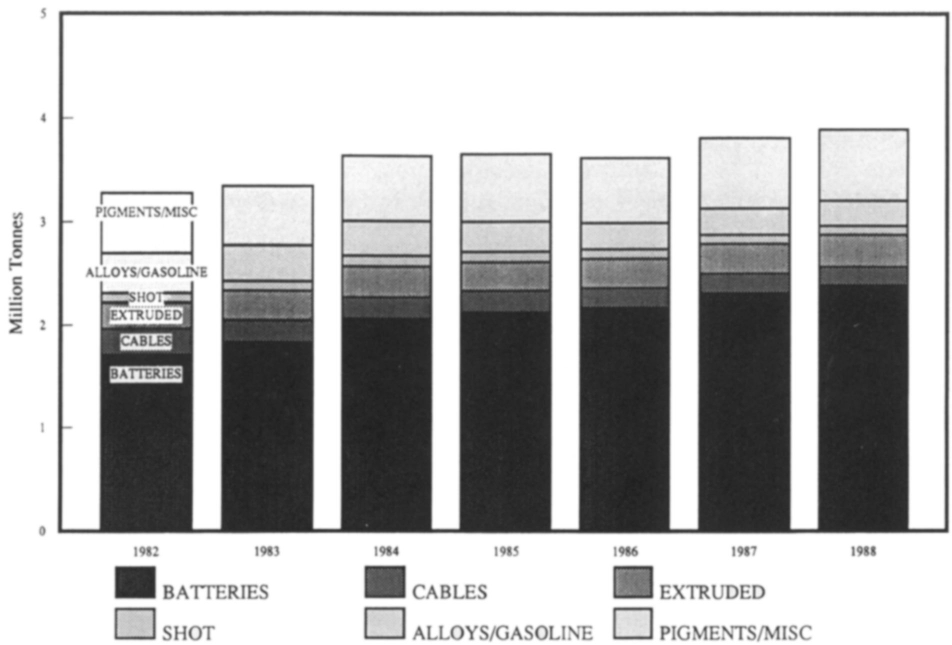

Fig. 3. Principal uses of lead; world lead consumption.

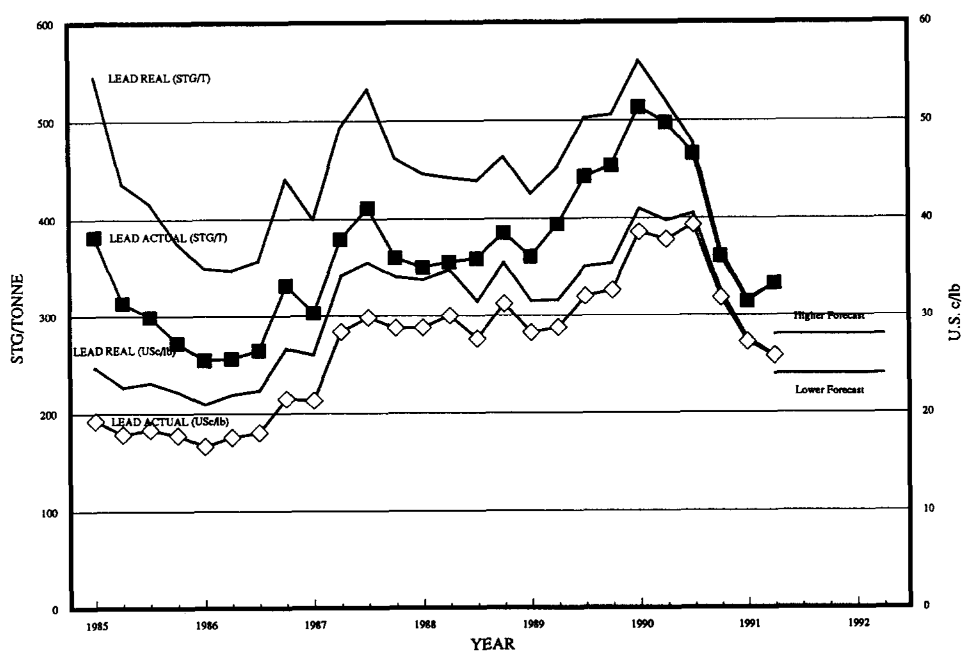

Fig. 4. Lead price 1985–1991. Quarterly average LME (London Metals Exchange): £stg./tonne (left-hand scale) and US c/lb (right-hand scale). Basis for real prices: June 1991.

Lead consumers are enjoying lower commodity prices (Fig. 4). The current price per tonne of lead, in pounds sterling, is lower now in real terms than at any time since 1985. In money terms, the 1991 price is at the same level as it was in early 1987. Furthermore, the current price of lead is more stable than it was in the first half of the year, when the price came under pressure due to weak demand. The temporary instability in 1990 was caused by low stocks and shortages of physical metal as a result of the high level of economic activity, including automotive batteries end-use, in the two preceding years.

The outlook both for the remainder of 1991 and for 1992 is a continued weak demand. Small refined metal surpluses are anticipated in both years, and the five week's supply in stock at the end of that period should reduce any price rises due to temporary shortages of metal thereafter. An average price of US 26 c/lb (340 £stg./tonne) is predicted for this year, between a bottom limit of US 24 c/lb (310 £stg./tonne) and a high of US 28 c/lb (360 £stg./tonne). After 1991, the lead price should move slightly higher, due to two causes: (i) rationalizations from the period of low metal prices; (ii) the drop in US primary refined output due to the introduction of environmental legislation.

Secondary lead production will be below trend this year, because of the impact of low primary lead prices on scrap supply. This impact will be historically less due to legislation in Europe and the USA that encourages higher scrap collection during periods of low lead prices. Secondary production, therefore, should be stable in 1991. By 1995, secondary output worldwide should account for over half of total refined lead, thanks to consistent rises due to increased secondary processing capacity, legislation favouring secondary lead, and a higher demand for replacement batteries.

The ramifications of proposed legislation in the USA — to require consumers to use a certain proportion of recycled lead in their products, or to pay a surcharge on the primary lead they use — is not yet clear. Whatever the outcome of this legislation, which is under review at the moment, it is believed that large-scale lead production, as a co-product of silver and zinc, will continue for the foreseeable future. Overall consumption will grow at the present slow rate, and end-use will be increasingly dominated by lead/acid batteries. From the battery manufacturers perspective, the outlook is for stability in the lead price and higher quality service from the suppliers. This is a very positive prospect for the Asian battery industry.

Proposition IV

The fourth, and final, proposition is also the most sensitive. Environmental issues are becoming a more and more important part of the political agenda, throughout the world. The future of the lead/acid battery is secure in logical terms, because it delivers an efficient product at a reasonable price. But the lead/acid battery cannot continue to exist without lead, and lead is not a material favoured either by the environmental lobby, or by industrial health and safety watchdogs.

Historically, lead has been a dangerous metal. It has been blamed for the decline of the Roman Empire (the Romans drank wine from lead goblets) and the British Empire (water was supplied through lead plumbing in the 19th century). More recently, lead levels in fortified wine products have been blamed on the lead traditionally used to seal them. It appears that a total ban on lead bottle seals will result, at least in parts of Europe.

Emissions from leaded petrol, and the effect of lead-based paint pigments can also be added to the list of environmental hazards. All these dangers are real: they are all reflected in the falling end-use of lead in most market sectors — except battery production. There is no point in trying to pretend that lead is an innocent victim of a bad historical press. It can be a hazardous material. Nevertheless, this does not necessarily need to be the case. The ill-effects of lead use belong to history, to the time before the potential dangers were known. Now, know-how and techniques are available to treat lead with the respect it requires, and to handle it in an environmentally-sensitive and responsible manner.

Notwithstanding safer procedures in the handling of lead, the progression towards highly restricted procedures in Europe and North America is unstoppable. Its effects will soon wash over the Asian battery industry — either through local regulations, or through import barriers set up by the American and European administrations. Asia can sit and wait for restrictive legislation and a public campaign against lead contamination, based largely on historical evidence. Alternatively, Asia can take a proactive step and introduce a code of voluntary self-regulation now. This would demonstrate a commitment to environmental and safety issues, and would forestall an otherwise inevitable, and possibly crippling, regulatory crack-down.

The Asian/Pacific and Korean share of world automotive battery production has grown substantially in the period since 1983, while the Japanese, European and North-American production levels have remained virtually constant (Fig. 5). A growing share of a growing market — that is the future of the Asian battery industry, provided that the above comments about the efficiency of the lead/acid battery, the growing trend towards VRB designs, and the future stability of lead supply are all supported by a deliberate campaign by each and every member to introduce best practice for the safe production and handling of lead.

A lead-handling code of practice should be developed (Table 1). With commitment from all parties in moving towards best practice in the issues covered by the code,

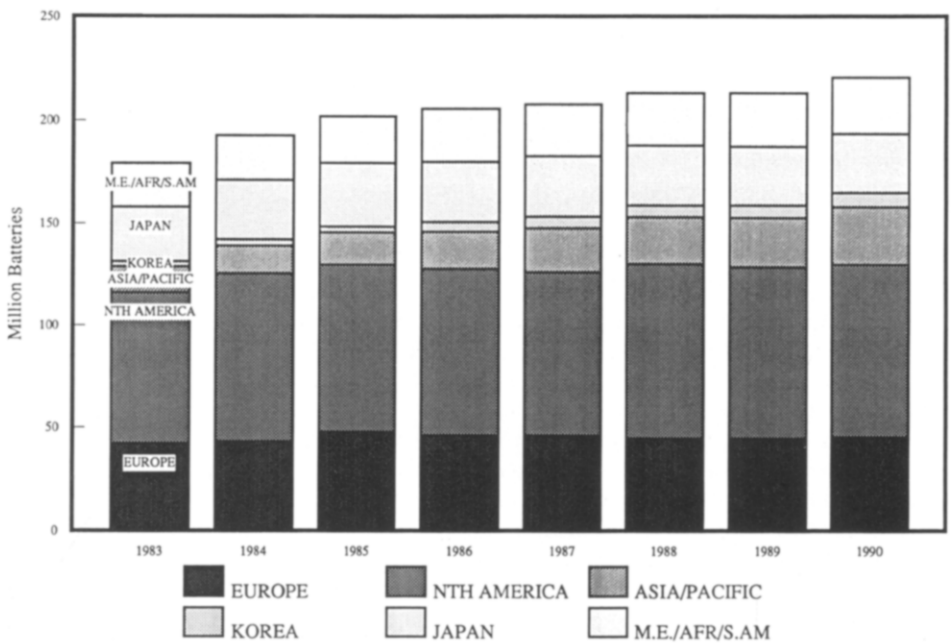

Fig. 5. World production of automotive batteries.

TABLE 1

Lead Handlers Code of Practice: items to be considered

Workplace and occupational health management
Workplace monitoring
Biological monitoring and health assessment
Control of exposure
Environmental management
Waste minimization and control
Air emissions minimization and control
Recovery of spent batteries and lead scrap

and under the guidance of ZALAS, this initiative could go a long way towards guaranteeing the long-term sustainability and prosperity of the Asian battery industry.

The Basle Convention on Secondary Lead Recovery ensures that unless the processing of lead/acid battery scrap is environmentally safe, the scrap cannot be exported. This convention has already been adopted by most European governments, and it is certain to gain wider acceptance in future. As mentioned above, the Asian battery industry can do nothing, and wait for the Basle Convention to be followed up by a new Convention governing primary lead production, or lead use, or both. Alternatively, the industry can take the initiative, as a unanimous voice under ZALAS, and make the running in proving to governments and administrators that its members are aware, responsible and united in the effort to sustain and grow.

The fourth proposition is, therefore, that *environmental pressures in Europe and North America provide long-term opportunities for the expansion of the battery industry in Asia.*

The long-term viability of lead/acid battery production in Asia depends on the effective management of the hard issues, and on a willingness to face up to occupational health and safety and environmental concerns. Some form of voluntary industry code, negotiated and agreed between all participants, and promoted by ZALAS, can obviate any need for restrictive legislation that could threaten the Asian battery industry in the medium term. Adoption of the agreed voluntary code can then occur at a pace that will not hamper operations, and will provide a new window of opportunity for battery producers in the region to fill the market gap that will be created by the increasingly restictive requirements imposed on European and North-American producers.

A vision for the Asian battery industry

The four proprositions discussed above provide the foundation for a vision for the Asian battery industry (Table 2).

The battery market has become a global market. Producers must think about what their competitors in other regions are doing. High-technology manufacturing plants are producing high-quality product for world consumption. In the Asian region, many plants dedicated to export production have been opened. Companies and regions cannot depend on trade barriers, cultural differences or special relationships to protect them from competition, or from the introduction elsewhere of low-cost high-technology.

TABLE 2

A vision for the Asian battery industry

I.	The lead/acid battery is the only practical, economic and safe means of storing electrical energy for the foreseeable future
II.	The future is encouraging for increased volume-use of lead/acid batteries in more diverse high-technology applications
III.	The outlook for lead supply and price holds few surprises for lead consumers
IV.	Environmental pressures in Europe and North America provide long-term opportunities for expansion of the battery industry in Asia, provided that environmental and occupational health concerns are managed.

A global market demands world-competitive producers, with a world-class organization that uses the most modern technology to produce quality batteries at the lowest possible cost. These bench-mark producers are acutely aware of the world market and its trends, and are prepared to respond immediately to changing conditions and environments. Their managers know the battery industry inside-out, but they also know how to use the latest business practices to further their companies' goals and interests.

Even small- to medium-sized producers, who are not geared to export markets, require the same levels of competitiveness to protect their market share from efficient and aggressive global producers. Competitive producers are gaining their competitive edge from predicting and using changes in the automobile industry, currency fluctuations, new manufacturing technology, relative wage structures and protective trade barriers — to name just a few of the variables that impact on business success in the battery industry.

Japanese companies have expanded overseas, and redoubled their efforts to produce low-cost batteries at home. In Korea and Indonesia, producers are installing the most up-to-date manufacturing facilities to produce good products at low prices. In North America, inefficient producers have been eliminated, while the efficient producers expand and consolidate their market share. Battery distribution is becoming concentrated into fewer, more efficient outlets. In Europe, producers are rapidly converting to lower-cost manufacturing processes, and, around the world, new producers are importing technology and capital from the most efficient operators to update and improve their competitive capability.

In the race for a sustainable competitive advantage, the Asian battery industry has been winning: as witnessed by the consistent increases in global market share. There are good signs for the Asian region to develop into the world's production base for lead/acid batteries. Demand for Asian products will continue to be strong, especially if the technological refinements discussed above fulfil their promise. The supply of raw materials to the Asian sector is secure and within a steady price regime. Furthermore, it is possible to deal with the problems seen to be looming on the horizon with timely and affirmative action.