GLASS provides information & referrals on lead poisoning & lead contamination prevention & management, with the goal of eliminating lead poisoning globally & protecting the environment from lead. GLASS is run by The LEAD Group Incorporated ABN 25 819 463 114

global lead advice & support service

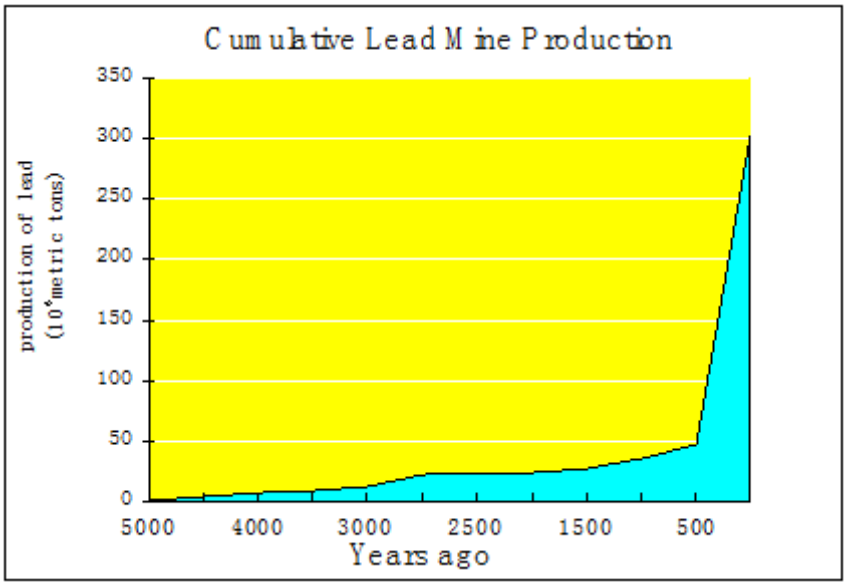
"GREEN LEAD" – OXYMORON OR FUTURE VISION?

Elizabeth O'Brien[a], Cornelia Dost[b], Bei Qu[c]
[a] Manager, [b,c] Interns,
Global Lead Advice & Support Service (GLASS) run by The LEAD Group Incorporated

You take the lead out of the earth,
you throw the corpses in,
one crop is as good as another
as long as the cash keeps pouring in,
the wheels must never stop turning,
the machine must be obeyed,
the future has got to be fuelled
and there's a price to be paid.

(adapted from *Who reaps the profit? Who pays the price?* Rosselson, 1981)

I'm here to talk about the price. There's a lot of lead out there (Figure 1)



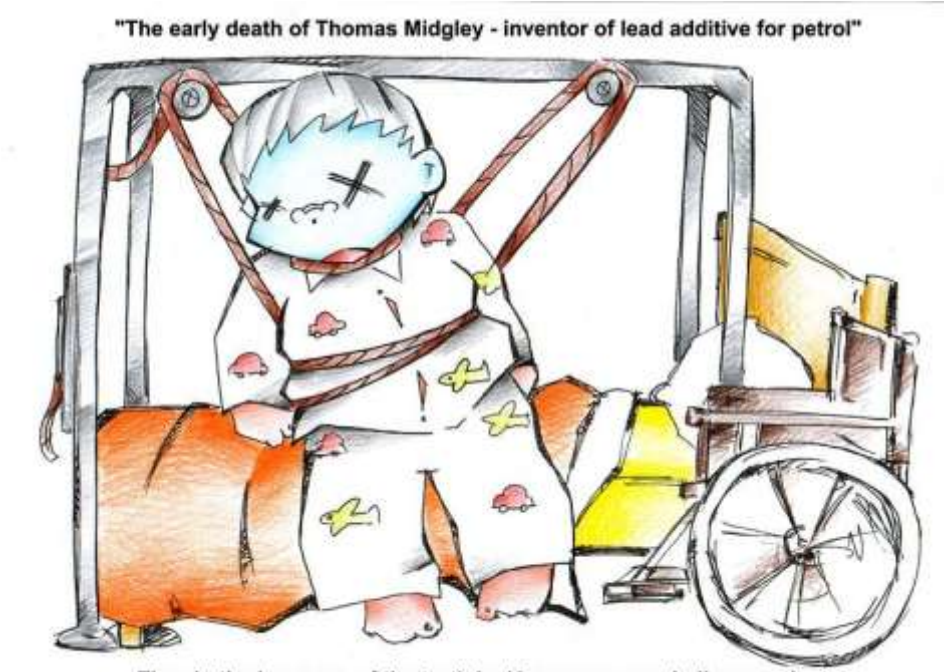
(NRC, 1993)

"Since ancient times, lead has brought us great benefits but also innumerable poisonings, particularly amongst workers and children" (UNEP, 2002), said Executive Director Klaus Toepfer of the United Nations Environment Programme.
The authors of this paper have tried to analyze both sides of the question in the title of this speech – "green lead" as an oxymoron as well as a future vision. Therefore different sources were used that should make the difficulty, but also challenge, of this paper's question, clearer.

Jamie Lincoln Kitman contends that: "The makers of leaded gasoline systematically suppressed information about the severe health hazards of their product for decades, even though they knew from the mid-1920s on that leaded gasoline was a public health menace" (Fenton Communications, 2000).

According to US experience the phase out of leaded petrol is essential in reducing the rates of lead poisoning among children. Especially in developing countries using leaded petrol combined with factors such as high population density near roads, poor-quality automobiles, high rates of iron deficiency due to poor diet, hot climates and dusty conditions contributes to a dangerous level of lead exposure. Many studies have already established that the phasing out of leaded petrol leads to an improvement in the blood lead level of inhabitants especially among children who are more likely to be affected *(e.g.* Bangkok, Mexico City*)* (Falk, 2003).
Accordingly, a lot of international health agencies, national governments and several main donor organizations started to concentrate on the phasing out of leaded petrol, arguably the most dispersive form of

lead. The global phase-out will be the first great environmental health policy success story when it is achieved but no industry group is pushing for that to happen earlier than 2010 – which will be 38 years after the process began in the US. Due to an immense lack of product stewardship the following countries still have to phase out leaded petrol and need help with environmental as well as health related regulations. And still the question remains who of the countries that already made the contribution to a cleaner environment by phasing out of leaded petrol is exporting their mined lead to make the lead additive for petrol in other countries? Is Australia one of them since it is the biggest exporter of lead worldwide? (Figure 2, Phillips , 2005 and poem by Midgley, ~1926)



Time hath shown me of the truth in, 'As ye sow, so shall ye reap'
Taken from "Lots of Living" by Thomas Midgley

The following list consists of 67 countries listed by the International Fuel Quality Center as at 16th November 2004 (no updated list from IFQC will be available until the end of 2005) and a further 23 countries (* = asterisked) listed as still selling leaded petrol in the matrices provided on the Partnership for Cleaner Fuels and Vehicles (PCFV) website of the United Nations Environment Program (UNEP) (accessed 26th August 2005). Whenever we have acquired information about the ban being achieved in a particular country which conflicts with either the IFQC or PCFV information, we have struck-through the country name and given the reference sources (which appear below the country list) and added the year the ban was achieved, if provided. However, if the information gathered on any country from two sources is in conflict, the country has been coloured red, as have all the countries for which there is still a listing on either PCFV's or IFQC's list of countries still selling leaded petrol for which no source claims a phase-out success.

Table 1: List of countries possibly still to ban leaded petrol as at 16th September 2005.

Latin America

1. Cuba

~~Mexico~~ * [a] (year?)

~~Montserrat~~ *

Peru-~~[a] (2004)~~

~~Uruguay~~ * [a] (2003)

2. Venezuela

Europe, C.I.S.

3. Albania

~~Belarus~~ [b] (1998)

4. Bosnia
5. Croatia

~~Cyprus~~ * [c] (2004)

6. Kazakhstan

~~Kyrgyzstan~~ [b] (2002)

7. Macedonia
8. Moldova
9. Romania
10. Serbia
11. Tajikistan
12. Turkey
13. Turkmenistan

~~Ukraine~~ [b] (2001)

14. Uzbekistan

Africa

15. Algeria
16. Angola
17. Benin
18. Botswana
19. Burkina Faso
20. Burundi
21. Cameroon
22. Central African Republic
23. Chad
24. Comoros *
25. Congo (Brazzaville) *
26. Congo, Democratic Republic of * [NB IFQC just lists Congo]
27. Cote d'Ivoire
28. Djibouti
29. Equatorial Guinea
30. Gabon
31. Gambia
32. Guinea
33. Guinea-Bissau
34. Kenya
35. Lesotho

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

36. Liberia
37. Madagascar
38. Malawi *
39. Mali
40. Morocco
41. Mozambique *
42. Namibia
43. Niger
44. Reunion *
45. Sao Tome & Principe *
46. Senegal
47. Seychelles
48. Sierra Leone
49. Somalia
50. South Africa
51. Swaziland
52. Tanzania
53. Togo
54. Tunisia
55. Uganda
56. Zambia
57. Zimbabwe

Asia

58. Bhutan
59. Cambodia
60. Fiji *
61. Indonesia
62. Laos
63. Maldives *
64. Marshall Islands *
65. Micronesia, Federal States of *

~~Mongolia~~ [d, e]

66. Myanmar
67. Nauru *
68. Niue *
69. North Korea
70. Palau *
71. Solomon Islands *
72. Timor L'Este *
73. Tokelau *
74. Tonga *
75. Tuvalu *
76. Vanuatu *

Middle East

77. Afghanistan
78. Iraq
79. Jordan
80. Syria
81. Yemen

---

a. ***Personal communication*** **(9 Sept 2005) Ing. Miguel Moyano, Projects Manager, ARPEL (Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean), mmoyano@arpel.org.uy, Tel: 598-2-4106993, Fax: 598-2-4109207, Javier de Viana 2345, 11200 Montevideo – URUGUAY, www.arpel.org**

b. **PCFV (Partnership for Cleaner Fuels and Vehicles) of the UNEP (United Nations Environment Program), "Central and Eastern Europe + Central Asia Lead Matrix" last update on 29 December 2004, www.unep.org/pcfv/Documents/MatrixCEELead.pdf (accessed 18 July 2005).**

c. **PCFV (Partnership for Cleaner Fuels and Vehicles) of the UNEP (United Nations Environment Program), "Central and Eastern Europe + Central Asia Lead Matrix" last update on July 2005, www.unep.org/pcfv/Documents/MatrixCEELead.pdf (accessed 16 Sep 2005).**

d. ***Personal communication*** **(14 Sept 2005) Shoa Ehsani, Partnership for Clean Fuels & Vehicles, Division of Policy Development and Law, UNEP, P.O. Box 30552, UN Avenue, Gigiri, Nairobi, Kenya shoa.ehsani@unep.org, Tel: (254 20) 62 5035, Fax: (254 20) 62 3861, www.unep.org/pcfv stating: "About the Central Asian countries, our data is based on various sources (such as Mike Walsh's updates) and we endeavor to get the latest data. Sometimes we get conflicting data as in the case of Kazakhstan and Tajikistan, we have data that indicates otherwise. For example, the UNEP Governing Council 2003 data [According to "The Case for Banning Lead in Gasoline", published by the Manufacturers of Emission Controls Association (MECA), Washington DC, January 2003(Available online at www.meca.org/galleries/default-file/lead0103_(final).pdf) Kazakhstan has already achieved the phase out of leaded gasoline (see, 'Table 1 Unleaded Gasoline Sales Only', page 7). This information from MECA is also referred to in Annex 2, page 21 of a publication distributed by the Governing Council of the UNEP on the 10th of December 2002 for the Twenty-second session of the Governing Council/Global Ministerial Environment Forum in Nairobi, 3-7 February 2003, entitled "Progress in Phasing Out Lead in Gasoline", A note from the Executive Director (Available online at www.unon.org/css/doc/gc22/GC22_inf/inf23_e.pdf)] also shows that Mongolia is unleaded, but we have data indicating otherwise. At the same time, a country may still be in dual mode e.g. almost unleaded and they have a small percentage of leaded gasoline. In summary, most data we have is from a secondary (or a couple of secondary) sources, to get absolutely authentic and accurate information on the real world status of a country, one needs to contact the relevant ministry directly.**

e. ***Personal communication*** **(15 Sept 2005) Tanvi Nagpal, East Asia Environment, tnagpal@worldbank.org, The World Bank, Washington, DC, www.worldbank.org stating: "Mongolia does not use leaded gasoline. It imports only unleaded gasoline from China, Russia and Kazakhstan. The typical octane numbers are 80,92, and 95."**

The idea for the term "Green Lead" as well as the concept which stands behind that term, come from the outstandingly successful Australian mining company BHP Billiton. "Green Lead™ is the vision of mining, processing, transporting, treating, manufacturing, storing, using and recycling lead – with zero harm from lead exposure to people and the environment. Green Lead is the identification of impacts associated with lead, the establishment of standards to minimise these impacts and certification of organisations and eventually lead products that achieve these standards. It will focus initially on lead used in batteries" (Roche and Toyne, 2003).

Undoubtedly, the idea of this concept is good and much-needed. However, it is still uncertain and of high concern whether this concept can be carried out and how many millions of people will be lead poisoned in the meantime.

As the initiators of the "Green Lead" Concept concentrate on lead in batteries the authors will look now at the main use of lead nowadays.

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

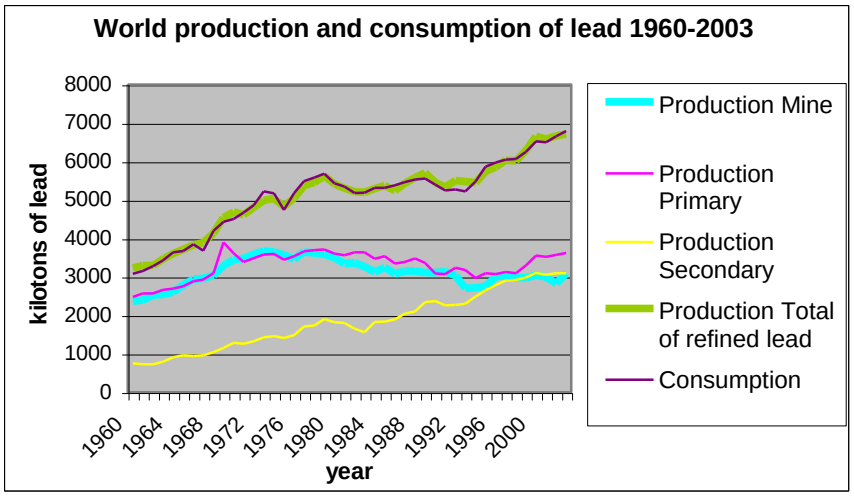
BATTERIES

“100% recyclable”

The Battery Council International claims: “the recycling rate for the years 1999 – 2003 is 99.2%.” “Compared to 55% of aluminum soft drink and beer cans, 45% of newspapers, 26% of glass bottles and 26% of tires, lead-acid batteries top the list of the most highly recycled consumer product" (Adam and Davidson, 2001).

According to that figure one might believe that the demand for primary lead should decrease but Figure 3 below shows a slightly different development. Figure 3 makes clear that the production of secondary lead has risen in the past few years whereas the production of primary lead has been relatively steady and the production of mined lead declined only marginally. The world market for lead is about: 6.8 million tons per annum. The International Lead and Zinc Study Group (ILZSG) estimates that 77.4% of this total amount went into batteries - equivalent to 5.26 million tons. World mine production in 2003 was 3.1 million tons. Western world secondary lead production represented 65% of total refined metal production (Burrell, 2005).

Figure 3



(Australian Commodities Statistics 2004)

Why is there still a steady demand for primary lead?
The reasons could be as follows:

Lower costs of producing primary lead

According to the Lead Development Association International the main disincentives of recycling lead are low costs of raw materials to produce virgin lead and fairly high collection and transportation costs for a low value product. “Some lead products are not recycled, either because it is not economic to do so at present, or simply because it is not practical to do so.” (Imperial College Consultants Ltd., 2001).

65% recovery rate from used lead acid batteries

According to Dr Peter Hurley of Blake International Limited, an OH&S consultancy in the UK, battery makers can only use two thirds (65%) of what is recovered from used lead acid batteries. “Even in the US, much of the recovered lead is exported. The reason this is so is because they use lead-antimony alloy, but cannot use that alloy in the anode plate of the battery as its too corrosive in that application. If they used lead-tin alloys then they could reuse nearly all the material they recovered/recycled, provided they could keep it separate from the lead-antimony. But they don't, because they can't. Face it, when they're recycling batteries, who discriminates between a calcium, selenium, tin or antimony alloy battery? And how can any recyclers, let alone consumers tell the difference?

“A lead-tin battery will last up to five times longer than a conventional lead-antimony battery, and the battery maker can't get 5 times the profit from the better battery. The greatest part of the battery market is for

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

replacement batteries, as these batteries are sold via auto-factors to the users it makes the battery maker the most profit per unit, and it would be this sector that would be impacted the most. Sales to car-makers are big volume but low unit profit. Switching to lead-tin could potentially cause a 90% reduction in the profitability of the battery makers if the car-makers would not pay more.

"Also the consequence of all that efficient recycling could cause a minimum of 70% reduction in demand for fresh mined lead. Bad news if you're a mining company. Face it how many mining companies put the environment ahead of profit in their thinking. So the big question is; with such a big environmental advantage to be gained from this technical switch, will the battery industry move away from lead-antimony voluntarily? Answer - Some niche makers have, others want to but some big players won't play ball. Unless they all do so the secondary lead feed-stock will continue to be contaminated by antimony and 1.1 million tonnes lead alloy will still go missing every year. I would very much like to know where it goes missing to. If anyone has the answer let me know." (Peter Hurley, 2005a)

Large-scale international marketing

Since more and more lead is exported to overseas markets, this also increases the difficulty for local battery companies to collect and recycle all the batteries they produce.

In 2004 Australia was the largest exporter of lead ore and concentrates, and the second largest exporter of refined lead. In the last financial year (2003/04) Australia produced 247 kilotons of primary lead and only 35 kilotons of secondary lead. Furthermore, 231 kilotons of refined lead (including primary and secondary lead) have been exported. The consumption of refined lead (primary and secondary lead) has been up to 60 kilotons in Australia only (Australian Commodity Statistics, 2004).

Put succinctly by Dr Peter Hurley, "The world market for lead is about: 6.2 million tonnes. There is 3 million produced from mining each year. The car battery makers consume 3.2 million tonne recycled lead and 1.4 million tonne new mined lead, which they need because the maximum they can use is 65% secondary recycled lead (due to anodic corrosion). Of the 4.6 million tonnes used to make batteries every year world-wide only 3.5 million tonnes gets recycled. My problem is I don't know where the other 1.1 million tonnes goes." (Hurley, 2005b)

Increased Demand and Consumption

Recently, lead acid battery consumption within OECD countries continues to rise and even more in the developing countries with fast growing industrial nations like China. Many of these countries do not have any or enough domestic supply. Asia is experiencing a large growth in the automobile market. This means the demand for batteries therefore also increases. Up to now this incredible demand for lead cannot be satisfied by secondary lead only. In addition, the growing market for batteries creates a lag of 4-5 years between use and recycling. Thus, the imports of primary lead increase as well as the demand for scrap material.

Moreover, consumers of lead acid batteries in many countries do not keep records of sales and recycling rates and therefore nobody seems to know the exact figures for the amount of lead that is circulating worldwide. However, it will take a while before the statistics are complete as many of the recyclers in the developing world operate without proper licenses or "informally" and therefore do not provide Government agencies with recycling tonnages (Burrell, 2005).

Besides those problems that seem to hinder the recycling rate of lead from reaching and exceeding 100%, there is still the fact that a hazardous product cannot be recycled 100%!

"Just as the primary plastics industry promoted plastics "recycling" when citizens in industrial countries began fighting for plastics packaging bans, the lead-acid battery industry is using the cloak of "recycling" to hide the impact of its products' wastes, and to thus reduce the threat to its 'status quo' use of toxics in production processes" as fittingly stated by the authors of Greenpeace article 'The Myth of Automobile Battery Recycling' (Cobbing and Divecha, 2005).

For now it seems that "green lead", even when applied only to the lead in batteries, will remain an oxymoron and it will be difficult and challenging to reach and exceed 100% recycling rates. 100% would be the recycling rate if all the batteries that were made in one year were recycled, but because so much lead is "out there" the rate of recycling must be greater than 100% for many years to come, in order to bring back all the batteries not recycled in their year of manufacture – globally this is at least 35% of batteries for many

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

decades. That means the lead problem will continue to exist for a very long time and consequently lead poisoning and environmental degradation goes on, especially in many developing countries.

E-EQUIPMENT

E-equipment is another main lead use in the world. In 2003 almost every second Australian household was in possession of a computer and more than 36% of Australian households had Internet access at home. The increase in the use of new technology is enormous and Australia is one of the top ten countries using IT (Ha, 2003).

But with new and more electronic equipment at home and at work, problems of waste management arise. Experts are expecting a major increase in the following years in the volume of computer and TV monitors that will not be used anymore. One main reason for this is the replacement of cathode-ray tube (CRT) monitors by liquid crystal display (LCD) screens. Consequently, this could mean a massive dumping of CRT monitors (BAN and SVTC, 2002). Bearing in mind that the cathode ray tube in a standard monitor contains an average of 1.7 kg of lead (CEIA, 2001)! A whole computer contains approximately 6.3% lead. Lead is used in metal joining, radiation shield/CRT and Printed Wiring Boards (PWB). The life span of a computer is only two years on average. Experts estimate that between the years 1997 and 2007, more than 500 million computers will become obsolete in the United States. 500 million computers contain 1.58 Billion pounds of lead that has to be dealt with (BAN and SVTC, 2002).

As noted by UNEP (2005): "Every year, 20 to 50 million tons of electrical and electronic equipment waste ("e-waste") are generated world-wide, which could bring serious risks to human health and the environment."

It has become appallingly obvious that our technology has exceeded our humanity as Albert Einstein fittingly stated some years ago. What happens to all the used material and products which are not needed anymore?

Although we like to think that e-waste could be recycled properly it still goes to recycle markets in the developing world or is dumped in state owned landfills.

"ZERO HARM"

Damage exported

When one recycles a hazard, one is left with a hazard – and are we not all trying to eliminate hazards?' (Puckett, 2003)

Each year Australians discard about 8,000 tonnes of used batteries. According to Canon Australia the country could reduce or eliminate its export of used batteries with the help of a domestic battery recycling facility (Canon, 2005). According to Klaus Toepfer of the United Nations Environment Programme, "The recycling of lead-acid batteries is one of the greatest potential sources of risk, especially for exposed workers in the informal sector in many developing countries. The safe recycling of these batteries requires strict environmental and occupational standards that can only be ensured by specialized firms, of which only a few are found in developing countries" (UNEP 2002). Moreover, operating costs of recycling facilities (for instance in terms of labour, health and environmental costs) are far lower, which makes the export of scrap materials more competitive and economically efficient (Cobbing and Divecha, 1994).

Figure 4: A Chinese child sits amongst a pile of wires and e-waste. (Greenpeace 2005)

In addition, large numbers of e-equipment are exported to many developing countries. In China alone, for example, 4 million PCs are discarded per year (UNEP, 2005a).

Lead contains toxic materials that heavily pollute the environment. Electronic products contain toxic chemicals that find their way into the ground and end up in the atmosphere later via evaporation.

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

During the smelting and refining process particulate material (including lead and other heavy metals) and acidic materials (sulfur dioxide) gets into the atmosphere. Also the discharge of contaminated industrial waste and the leakage of acidic electrolyte during battery storage are of high concern (Hay and Noonan, 2001). Because of that, internal costs, and environmental controls have arisen in the industrialized world. Some smelters even had to close.

Nonetheless, there are many smelters in developing countries which continue to pollute the environment and expose the workers, and through them also their children, to significant health risks.

One of the main recycling ports in China is the town of Guiyu where it is common to see open burning of plastics and wires and smelting of circuit boards to reclaim metals. The workers, some of whom are children or have children who must come to work with them (see Figure 4), generally work without facemasks or protective clothing. Because of a lack of technical knowledge on how to recycle electronic goods safely, people are exposed to hazardous metals which harm their health. Though the workers are exposed to toxic dusts and fumes they are still willing to do this kind of job to earn money for their daily life (about 3 Yuan per hour which is nearly A$0.50 cents) (Chinese Environment Law, 2004). The area's soil and water is so contaminated that Guiyu's inhabitants have to go 30 km away from the town for proper drinking water.

Figure 5: Part of a computer with a "NYSE property tag" label at a Chinese e-waste scrap yard. This computer was discarded by the New York Stock Exchange (NYSE) and then dumped in China (Greenpeace 2005)

A river water sample from the Lianjiang river near a Chinese "recycling village" revealed lead levels that were 2,400 times higher than World Health Organization Drinking Water Guidelines. "Sediment samples there showed lead levels 212 times higher than what would be treated as hazardous waste had it been dredged from the Rhine River bottom in the Netherlands." (BAN and SVTC, 2002)

Even part of a computer used by the New York Stock Exchange was discovered on the Chinese dumping ground as Figure 5 shows. What we call "recycling" today is the removal of hazardous material from the first stage and their reuse for further production. Accordingly, these products eventually have to be disposed. We, as a society, should always be aware that we have a responsibility towards future generations. The main goal of any "green lead" program should be minimizing use of lead in products, maximizing recycling, reduction of mining and provision of information and assistance for the safe management of all the lead already in the environment for all eternity.

Facts of lead poisoning worldwide

US research predicts that some 30 million Americans are at risk from early death from lead due to having exceeded a blood lead level of 20 µg/dL at least once in their adulthood (Lustberg and Silbergeld, 2002). If the US rate of exposure – remembering that the US was the first country to begin phasing out the most dispersive use of lead, leaded gasoline in 1972 (50 years after it's introduction) - has such a huge predicted impact in the US, then what must be the impact of lead on the global early death rate and indeed on the life quality of the ageing? The Global Lead Advice and Support Service (GLASS) predicts that researching appropriate advice on treatment or care of the ageing population will be a huge task of lead poisoning management for the future, as we move at least one lifetime away from the 1970s and 1980s, the great era of lead poisoning due to leaded petrol. "With so many people having higher blood lead levels in the past than today, it is little wonder that we associate ageing with many of the effects of lead poisoning, but especially:- poor memory and hearing, falls (from loss of balance), reduced sperm count, loss of libido, strokes and heart attacks (from raised blood pressure), tooth decay, Alzheimer's disease. It is fair to say that all these effects of lead add up to a reasonable description of what we think of as "normal" ageing and it is certainly time that we measured blood lead levels in older people who display these symptoms before discounting their symptoms as just "a natural part of getting old" (Bailey, 2003)

The World Health Organisation (WHO) estimates that there are 120 million people worldwide who are lead poisoned i.e. have a blood lead level greater than 10 micrograms per decilitre (10 µg/dL) (Fewtrell et al,

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

2003). Recent research indicates that the aim should be to get everyone below 5 µg/dL. So it would be more reasonable to see our aim as reducing the blood lead levels of the 240 million people WHO estimates have a blood lead level greater than 5 µg/dL. But actually, looking at the blood lead surveys that have been done, even this huge figure would seem to be an underestimation. Sure, the only Australian blood lead survey of children in 1996 found 7.3% of preschoolers were lead poisoned (and this is probably an underestimate) but in a Chinese meta-analysis more than one third of the children in China were found to have blood lead levels greater than 10 µg/dL. In an Indian survey of 2,031 children and adults in 5 cities, more than half of them had blood lead levels greater than 10 µg/dL (George Foundation, 1999). And in just one African city Johannesburg, which may be representative of all the cities in the 43 African countries still using leaded petrol – 78% of the children were lead poisoned as shown in Table 2.

Henry Falk's *Case Study of Lead Poisoning* (Falk, 2003), reports that people living right next to backyard smelters, mines or shops where lead acid batteries are repaired, typically have a higher blood lead level than 10ug/dL (Falk, 2003). The results of a study by Wang Sun-qin, Zhang Jin-liang in 2004 showed that blood lead levels among Chinese children are very high and are considered to be one potential environmental risk factor for children's development (Wang and Zhang, 2004).

Table 2: Blood Lead Levels (BLL) of children in various countries

Country	Date	BLL (median)	BLL >10 µg/dL
South Africa[1]	2002	11.9 µg/dL	78%
Jamaica[2]	2000		
Rural areas		9.2 µg/dL	42%
Urban areas		16.6 µg/dL	71%-
contaminated area, the site of a former lead ore processing plant		35 µg/dL*	
India – 1852 urban children[3]	1999	-	51.4% [12.6% > 20 µg/dL]
China[4]	2004	9.29 µg/dL	33.8%
USA[5]	1999-2002	1.6 µg/dL	-
Europe/Urban area[6]	N/A	-	0.1 – 30.2%
Australia[7]	1996	5.8 µg/dL	7.3%

* reduced now by implementation of mitigation strategies

[1] Mathee et al., 2002; [2] Lalor et al., 2001; [3] George Foundation, 1999 [4] Wang and Zhang, 2004; [5] CDC, 2005; [6] WHO, 2004; [7] Donovan 1996

It is salutary, to reflect on just how much lead is in a "modern" human, and how badly poisoned some people are, compared to humans of earlier times (see Figure 6).

Figure 6. Lead in human bodies at different times

(NRC, 1993)

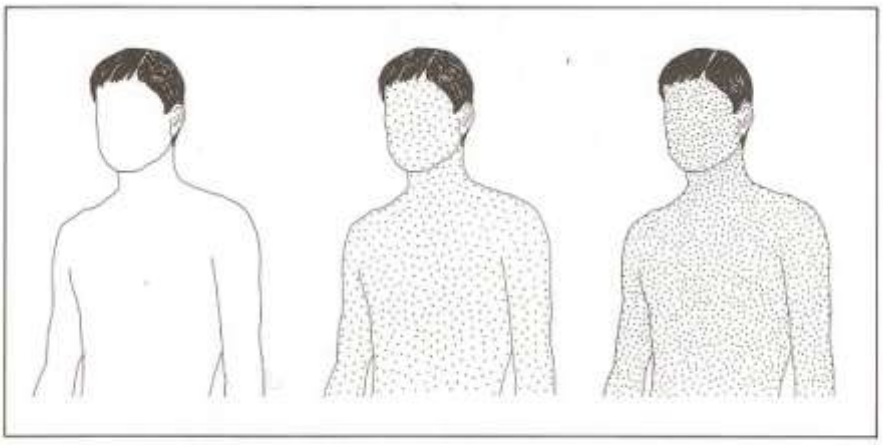


FIGURE 1-1 Body burdens of lead in ancient people uncontaminated by industrial lead (left); typical Americans (middle); people with overt clinical lead poisoning (right). Each dot represents 40µg of lead. Source: Patterson et al., 1991; adapted from NRC, 1980.

The collection rates of leaded products like batteries and e-equipment still needs to be improved. According to the International Lead and Zinc Study Group (ILZSG), of the remaining principal end uses of lead that can be recycled, the collection rates vary between 50% (for uses with difficult access like undersea cabling) to 85% for other industrial uses (Burrell, 2005).

The challenge that remains now is how the Lead Industry, governments, industry and NGOs can help to transfer lead recycling to the formal, regulated sector.

International action

The member states of the EU have already shown some action. In 2006 they will restrict the use of certain hazardous substances (ROHS) in electrical and electronic equipment and prohibit the use of lead in new equipment put on the market with a maximum allowable concentration of 0.1% lead by weight in homogeneous materials, with some exemptions including use in CRT glass. EU legislation addressing waste electrical and electronic equipment (WEEE) specifies that batteries containing more than 0.4% lead by weight must be separated from waste streams and recycled where appropriate (EU 2002b). Furthermore, the European PVC industry has agreed voluntarily to phase out lead stabilizers in PVC by 2015 (EUROPA, 2005).
According to EPA (2005) each European citizen generated 14 kg of electrical and electronic waste in 1998. In total, that is around 6 million tones per year, which represents 4% of the municipal waste. Experts estimate a growing rate of electrical and electronic waste of 3-5% per year. Thus, it is the fastest growing waste stream – it grows three times faster than the average waste stream. Accordingly, people nowadays are likely to generate between 17 and 20 kg each annually (EPA, 2005).

Internationally the Basel convention under the umbrella of the United Nations Environment Programme was adopted in 1989 in Switzerland and entered into force in 1992. The need for the Basel Convention was obvious – it is a legally binding international agreement that addresses the problem of the uncontrolled movement and dumping of hazardous wastes across international boundaries, especially to non-OECD countries (BAN, 2002)

Australia ratified the Basel Convention in 1992 which means that from now on the export of hazardous wastes needs permission otherwise it would be an offence under the Hazardous Waste Act 1989 (Australian Government, 1989).

Australia's Minister for the Environment and Heritage**,** Senator the Hon. Ian Campbell recently stated: "I am concerned with the large and increasing volume of used electronic equipment sent to countries where we know there's a considerable cottage industry involved in recycling e-waste"… "Over the past 18 months my department has been working with representatives of the IT industry, including Original Equipment Manufacturers (OEMs), IT lease companies, recyclers and exporters to develop an acceptable set of clear criteria for defining hazardous e-waste… We're all used to having computers and televisions at home and work and think little of throwing them away if they become old or broken. Unfortunately these items can contain some substances that are harmful to health and the environment, so disposal or recycling of them must be done safely." (Australian Government, 2005).

Manufacturers like Sharp and other major corporations like Intel, Dell, Hewlett-Packard, Sony, Panasonic, Hitachi and IBM have begun to work on eliminating the use of the six harmful substances that are covered by the EU RoHS directive (Sharp 2004).

But nevertheless, in much electronic equipment, hazardous substances still have to be included to make it functional. Thus the aim is to minimize the substances if they cannot be avoided, "e.g. specify lead-free solder, design the product so that it can be upgraded to ensure a longer operational life, and ensure that the product is diverted from landfill at end-of-life." (Centre for design, 2005).

To achieve the set goal a closer cooperation between all involved members of a product life cycle is required (e.g. electronic equipment and automobile manufacturers). This will be partly reached through the United Nations Environmental Programme (UNEP) Cleaner Production Declaration, that governments, like Australia and companies like BHP Research and Technology signed (UNEP, Production and Consumption Branch, 2005). The Mining Sector also initiated the International Council on Mining and Metals. Their 2005 work programme states that ICMM will undertake environmental related activities this year like the promoting and facilitating of materials stewardship, for instance the Materials stewardship outreach – a

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

guidance document on application of materials stewardship in the minerals sector and presentations to key user forums (ICMM 2005).

Role of mining companies

Profit of mining company

Who benefits from mining?

In the first place the mining companies that exploit the minerals and sell it for further processing and use to the global market.

Table 3: Net Profit before tax in Financial Year 2004

Name of Company	Net Profit before tax A$m*
Kagara Zinc Ltd.	3.403
CBH	5.481
Perilya	18.283
Zinifex Limited	77.7
Xstrata plc (Zinc-Lead)	200.96
BHP Billiton Ltd. (Base Metals)	845.146
*Data taken from companies' Annual Reports 2004	

BHP Billiton is one of the companies that made the most profit not only in 2004 but also in this year 2005 ($US6.4 billion total net profit including corporations in other countries) which was the highest profit figure in Australian corporate history. And further growth of net profit is expected for next year ($US8.2billion total net profit) (Freed, 2005).

Responsibility

But it should be more than only profit making. Since the goal of today's society is sustainable development in every respect, almost every mining company has made appropriate commitments in their environment policy. With that, companies take responsibility towards our environment and therefore have to ensure the improvement of inhabitants' quality of life and level of well being especially in those areas which are mainly and directly exposed to lead.

The primary strategy for non-renewable resources, like lead, is to maximize its utility. Lead, like other related metals is theoretically infinitely recyclable. Therefore an ecologically efficient approach is needed to focus on "mining the infrastructure of society" (e.g. cars, electronics, buildings) to recapture the metals and reutilize them.

Doubling the product-life of goods would mean that only half of the raw materials and energy production is needed. This consequently would halve the amount of post-consumer waste.
Rio Tinto, like BHP and other major mining companies understand the meaning of sustainable development as they state in their environmental policy:

"Product stewardship is an all embracing term for the way we address products, their uses and management at end of life. It includes production efficiency, releases to the environment, and ecological and health risk assessments, as well as hazard classification, life cycle assessment and recyclability." (Rio Tinto 2003)

Furthermore they support communities with 5 year partnership programmes.

"Through continuing participation in forums with non government organisations and partnership programmes, Rio Tinto endeavours to contribute to emerging debates, to gain information and, ultimately, to improve performance." (Rio Tinto 2003)

"BHP Billiton businesses aim to make a valuable contribution to their local communities, not only by providing employment opportunities but also by supporting organisations that help to create a healthy and sustainable social fabric in these communities." (BHP 2005)

"BHP Billiton has a Corporate Community Program that focuses on Australian and international partnerships and projects." (BHP 2005)

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

BHP tries to follow that idea by implementing a Green Lead Product Certification. By designing an environmental label, products that are certified as meeting the Green Lead criteria will be easily identified (Roche and Toyne, 2003).

Manufacturers need to come up with new designs and better mechanisms to collect the recoverable material and reuse it for a more efficient and longer product life cycle. The consumers' possibility to bring used products back to the producer is just the beginning of the solution-finding process. BHP, for instance, is 'in active discussion with a major car manufacturer to enlist them in the Green Lead cycle, both as a user of Green Lead batteries, but also to assist in the battery recovery process' (Roche and Toyne, 2003).

One concept that includes the described ideas is the 'Extended Producer Responsibility' (EPR). One might think that with set concepts and goals we could get closer to 100% recycling. But according to Thorpe and Kruszewska (1999) "many industrial sectors are particularly alarmed at the prospect of EPR and are lobbying to dilute their responsibilities for used products. Instead of EPR, they favour 'Extended Stakeholder Responsibility' that transfers much of their liability onto consumers, or the even weaker term 'Product Stewardship'."

As the philosopher Immanuel Kant stated (1784) "Take the courage to make use of your own intelligence", the developing world, especially decision makers like those who are at the beginning of the lead cycle (miners and manufacturers) should take the responsibility of their produced electronic equipment, car batteries, and the like and should not see the 3rd world countries as a dumping ground, thinking to be charitable because people benefit from obtained lead out of car batteries and electronic equipment.

The reason why it has always been difficult to convince societies with theoretical logical arguments to rethink the overuse of natural resources is because of the expected concomitant drastic structural change in the economy and society. Thus, people that are directly affected refuse to accept the necessary changes because they see the loss of wealth and welfare which would be, of course, only temporary compared to the win-win situation for people and the environment at the end.

Problem and Challenge at the same time

In Australia, mining companies take a very vital role and have the responsibility for the protection of the environment from lead worldwide and many companies are already starting to take up this responsibility. However, sometimes they will face problems and challenges like:

Firstly, facing the large range of lead products overseas, it seems very difficult for them to achieve the task of a 100% recycling rate alone. Corporations along with other stakeholders such as communities and community based organizations need to enhance the mining companies' influence in terms of awareness raising for the set goals of "Green Lead".

Secondly, whether the concept of "green lead" can be carried out successfully or not, it is a fact that the lead problem will continue to exist for future generations. Until there is successful implementation of the concept of "green lead" the public needs to get informed about how they can protect themselves from poisonings and immediate information and advice will help those who are already affected.

Thirdly, to maintain a transparent system in the "Green Lead" concept, mining companies need partners who can help to meet those challenges and problems. Therefore, mining companies should make use of their influence over government by suggesting and supporting an hypothecated tax. Mining companies have to pay royalties to each state in Australia and the government should make a certain percentage available to community services such as GLASS as an hypothecated tax.

The needs of people cannot be achieved through ignorance; it can only be attained through understanding. Just as most of the mining companies run community services, The LEAD Group also established a service to help people seeking lead related information. But unlike most of the mining companies the people that The LEAD Group's service helps, are found all over the world.

GLASS

We as a charity organisation cannot sit by and wait until the goals of sustainable development are achieved. Therefore, a credible information service is needed to respond to continuing community concerns about the prevalence of lead hazards in homes, public buildings and workplaces. Governments and industry need to invest in providing a credible information service. GLASS has and must continue to fill this gap. Without GLASS, people might call several government departments or nongovernmental groups when

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

seeking information, wasting time as they are passed from person to person, often emerging unsatisfied. No one but GLASS is equipped for handling complex inquiries about lead. GLASS is an international referral service, and a cost-efficient way of providing credible environmental health services that people trust. GLASS is the community information service on lead managed by The LEAD Group, a community organisation incorporated in 1992 with the aim of eliminating childhood lead poisoning and protecting the environment from lead.

As of May 2005, the LEAD Group's information service has been operating with government funding for exactly ten years. We have received over one million dollars in government support for GLASS and it's predecessors. A similar level of funding is required until green lead becomes a reality.

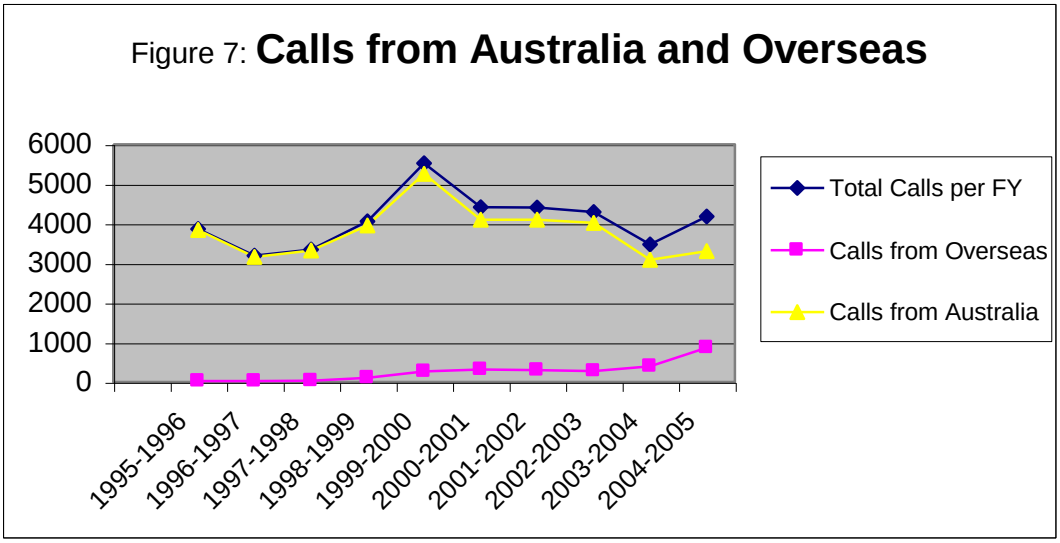
Over the last 10 years, GLASS has directly handled over 41,300 calls about lead hazards. We have developed the systems, technology and staff to provide an efficient and credible service that assists the public and professionals alike with information, advice and referrals. GLASS is based in a two-room office in Summer Hill, Sydney, NSW, and operates with a national free call phone number.

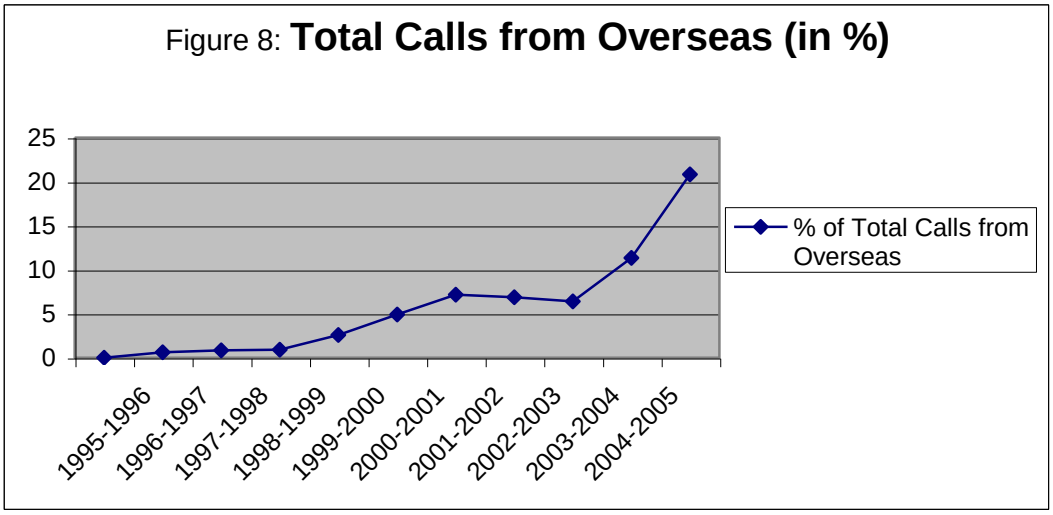
Main Tasks

1. *Information & referral*
   GLASS handles approximately 300-500 inquiries a month from people worldwide seeking advice, information and referrals, including post, fax and email inquiries from over 64 countries.
2. *Technical network support*
   If GLASS receives an inquiry which we have limited knowledge of, we seek the advice of The LEAD Group's Technical Advisory Board, Global Lead Network, Adult Blood Lead Epidemiology and Surveillance (ABLES) of the US Centers for Disease Control and Prevention (CDC), Plumbism & Autism Network (PAN), Lodged Lead Shot & Bullet Support Group (LLSBS) & Lead Workers e-groups etc, and our aim is to answer every lead question put to us.
3. *Lead resources database*
   Nearly 8,000 lead references are stored in our indexed Microsoft SQL database, the largest publicly accessible resource on lead in the world, and over 1,500 of these are in a searchable web-published database on our website.
4. *Referral database*
   Over 4,500 experts, products, service providers, community groups and responsible parties are recorded on our searchable database, soon to be web-published if funding allows.
5. *Information development*
   Fact sheets, newsletters, articles and lists are continually developed and updated to meet specific demands (e.g. nursing mothers, tenants, on ceiling dust, health effects of lead, countries still using leaded gasoline etc) A proposed online Lead Forum and e-newsletter could also be easily developed if funding were provided.

   Call records

   Our call database records the nature of all contacts allowing easy tracking & performance





From Figure 7 you can see that our peak call rate occurred during 1999-2000 which coincidentally is the time of our peak level of government funding which enabled the employment of 7 paid staff. Figure 8 demonstrates the striking increase in the level of calls on our service (mainly by email) from overseas, now that we have one of the world's most popular lead web-sites.

6. *Information distribution*

   Information packs are assembled and sent to inquirers without charge, including to enquirers overseas. Bulk copies are provided to relevant events, conferences or other distribution points. GLASS has distributed 904,503 lead information products by fax, mail or email between June 1995 and June 2005.

7. *Web site* www.lead.org.au

   has provided over 250,000 web-users with news and information on global lead poisoning prevention and provides GLASS with increasing numbers of email clients, providing 41% of the 1,200 new enquirers (clients) in the last 12 months. Enquiries from outside Australia made up 21% of our calls in FY 2004-5.

8. The LEAD Group represents the global community on the *United Nations Partnership for Cleaner Fuels and Vehicles* (PCFV).

Fundraising

1. Since June 2005 GLASS has asked the following lead companies and industry organisations for funding:
2. BP Australia
3. Caltex
4. Holden
5. Citibank (Citigroup Fund)
6. Philip Morris
7. Ian Potter Foundation
8. Minerals Council of Australia
9. Minerals Council of NSW
10. Mars Metal MarShield Canada
11. Lead Development Association (LDA) International
12. ILMC

Mining Companies:

1. Perilya
2. Rio Tinto
3. Xstrata
4. Zinifex
5. BHP Billiton
6. Thiess
7. CBH Resources Limited
8. Ivernia West Inc.
9. Kagara Zinc Ltd.

For the listed organizations and companies no positive answer has been received as at 23 September 2005.

The LEAD Group also applied for funding from the ministers of health and environment of Australia and NSW. Unfortunately, the Ministers do not see themselves responsible for funding the service. But the Hon. Senator Ian Campbell pointed out his hope that 'the lead mining industry and major manufactures of lead

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

products in Australia will look favorably upon this presentation and take the opportunity to support the organisation.' Thus the organisation hopes that Australia's mining companies consider the Minister's advice and decide on sponsorship of GLASS.

Feedback from our service users

To demonstrate that GLASS has been successful over the years since its inception here are some statements from clients of the service:

- "Thank you so much for responding to my questions regarding the stained glass lampshade (with leaded tin solder), and for your terrific website" says an overseas email client.
- "The Office of Childcare, Children's Services Advisers, child care providers and parents regularly use the expertise of the Lead Advisory Service and find it an invaluable service. I commend you for your important work"
- "Thanks, you have been 10 times more helpful than anyone else I have called today", says Federal Government employee.
- "We are engineers doing properly contained abrasive blasting of red lead paint on sewerage system components at the Sydney Water Treatment Plant [after much advice given] I see you are an encyclopaedia there with all this information."

Conclusion

105 years ago when the Australian constitution was written the concept of "the environment" was somehow left out. Perhaps they thought the planet was flat and all the waste and pollution would just fall off the edges. And the federal government consequently has no powers to create environmental regulations. So today we have the ridiculous situation whereby the federal government cannot say to a producer – you must phase lead out of your products by a certain date. Instead they have to invite all the state governments and industry and environment groups to talk about what would be possible and they put the resulting lowest common denominator into a National Environment Protection Measure and then extend the deadline by a few years when one company whinges. So this is the process we can all look forward to for the Product Stewardship NEPM. For instance, now that the Vinyl Council of Australia has said it will take them til 2010 to eliminate lead stabilisers in PVC, the Product Stewardship NEPM will not bring that forward to any more reasonable time. It's up to community groups like mine to ask the obvious: if they can take lead stabilisers out of potable water PVC piping by 1998, why can't they take them out of all PVC sooner than 2010? We don't want to see the "Green Lead" campaign hide the facts about lead for another 50 years and only achieve safe management of lead acid batteries globally more than 38 years after that.

The LEAD Group suggests:

- To effectively protect the environment and human health requires networking at all related levels (regional. national and international) and interaction with responsible governments to establish and implement regulations as urgently needed
- Find alternatives to minimize the use of lead in all products
- Maximize the utilization of all lead containing products
  Control the trade of scrap materials
- Make sure the recycling of lead follows health and environmental guidelines in every country
- Partnerships with non-profit-organizations dedicated to lead management information online, on-target, credible and up-to-date, like us, to make sure that everybody gets the information he or she needs to protect themselves, their families and the environment from lead.

There is a lot to be done for a sustainable future and we are convinced that by funding GLASS, industry can help decision makers to get closer to that goal since we form the locus in the network of stakeholders among the government, industry and community. So far we have put a huge effort into sponsorship and fundraising applications and this has hindered us from our main work, which is namely to keep providing this essential service and strive for a truly green lead future within our lifetimes.

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

REFERENCES

1. **Abare (2004),** ***Australian Commodity Statistics***
2. **Addam, J. Davidson, G. (2001),** ***LEAD-ACID BATTERY RCYCLING RATE REMAINS STRONG*** ***More Than 90 Percent of Lead is Captured From spent Batteries*****. Retrieved: 1 September 2005.**
3. **Australian Government. Department of the Environment and Heritage. (1989),** ***The Hazardous Waste Act*****. Retrieved: 29 August 2005.**
4. **Australian Government Department of the Environment and Heritage (2005)** ***Tighter criteria for e-waste export*****. Retrieved: 29 August 2005.**
5. **Bailey, Alycia (2003)** ***Lead, Ageing and Death*****, The LEAD Group. Retrieved: 30 August 2005.**
6. **BAN - Basel Action Network. (2002),** ***About BAN*****. Retrieved: 29 August 2005.**
7. **BAN - Basel Action Network, Silicon Valley Toxics Coalition (SVTC). (2002),** ***Exporting Harm – The High-Tech Trashing of Asia*****, Retrieved: 30 August 2005.**
8. **BHP Billiton Ltd. (2004),** ***Annual report 2004***
9. **BHP Billiton Ltd. (2005), Community Programmes and Support Foundation. Retrieved: 16 September 2005.**
10. **Burrell, I. (2005), E-mail contact with the LEAD Group on recycling of lead-acid batteries, International Lead and Zinc Study Group, London.**
11. **Canadian Environment Industry Association (CEIA). (2001),** ***Computer Recycling Infrastructure in Canada*****, Retrieved: 5 September 2005.**
12. **Canon. (2005),** ***ICT Industry seeks Australian battery recycling solution*****. Retrieved: 2 September 2005.**
13. **CBH Resources Ltd. (2004),** ***Annual report 2004***
14. **Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination Survey. (2005),** ***Blood Lead Levels-United States 1999-2002*****, MMWR. 54,20: 513-516. Retrieved: 31 August**
15. **Centre for Design. (2005),** ***Mission statement*****. Retrieved 30 August 2005.**
16. **Chinese Environment Law (2004),** ***It is inevitable to avoid environment pollution in Guiyu*** ***for its electronic rubbish industry*****, Retrieved: 31 August 2005.**
17. **Cobbing, M. Divecha, S. (2005).** ***The Myth of Automobile Battery Recycling*****, Greenpeace. Retrieved: 2 September 2005.**
18. **Donovan, J. AIHW. (1996),** ***Lead in Australian Children: Report On The National Survey Of Lead In Children*****, Canberra: Australian Institute of Health & Welfare**
19. **Environmental Protection Agency (EPA) (2005),** ***Questions & Answers on EU Policies on Electric and Electronic Waste*****, European Commission Representation in Ireland. Retrieved: 8 September 2005.**
20. **EUROPA. (2005),** ***Environment – waste*****. Retrieved: 2 September 2005**
21. **Falk, H. (2003),** ***International Environmental Health for the Pediatrician:*** ***Case Study of Lead Poisoning*****, Pediatrics. 112; 259-264. Retrieved: 30 August 2005.**
22. **Fenton Communications (2000)** ***Hidden History Of Leaded Gasoline*** ***Reveals Industry Conspiracy To Conceal Dangers - Lethal Product Still Marketed Throughout World.*** **Media release of 20 March 2000. Retrieved 23 September 2005.**
23. **Fewtrell, L; Kaufmann, R; and Prüss-Üstün, A (2003), Annex 4: Estimating the global disease burden of environmental lead exposure; and Annex 5:** ***Calculation spreadsheet for lead, EXTRACT FROM Lead: Assessing the environmental burden of disease Environmental burden of disease series No. 2.*** **World Health Organisation (WHO), Retrieved: 30 August 2005.**
24. **Freed, J. (2005),** ***China syndrome stokes BHP*****, The Sydney Morning Herald 25th August 2005.**
25. **George Foundation, The (1999),** ***Project Lead-Free Findings*** ***- A study Of Blood Lead Levels In Approximately 22,000 samples taken in 7 major Indian Cities.*** **Retrieved 4 March 1999.**
26. **González, P. (2004),** ***Mining Royalties*****, International Development Research Center Canada. Retrieved: 6 September 2005.**
27. **Greenpeace. (2005),** ***A Chinese child sits amongst a pile of wires and e-waste*****, Picture. Retrieved: 28 August 2005.**
28. **Greenpeace. (2005),** ***Part of a computer with a "NYSE property tag" label at a Chinese e-waste scrap yard*****, Picture. Retrieved: 28 August 2005.**
29. **Ha, T. (2003),** ***E-waste*****. Retrieved: 30 August 2005.**
30. **Hay, J.E. Noonan, M. (2001),** ***Anticipating the Environmental Effects of Technology, Overview of lead recycling,*** **United Nations Environment Programme, Division of Technology, Industry, and Economics. Retrieved: 14 September 2005**
31. **Hurley, P. (2005a),** ***Recycling of lead-acid batteries*****, e-mail by Dr. P. Hurley to the LeadWorkers e-group, moderated by The LEAD Group, Sydney, Australia, July 27, 2005.**
32. **Hurley, P. (2005b),** ***I am trying to find out about the logistics of battery recycling*****, e-mail by Dr. P. Hurley to the LeadWorkers e-group, moderated by The LEAD Group, Sydney, Australia, July 18, 2005.**
33. **Imperial College Consultants Ltd (2001),** ***"LEAD: the facts"*****, Lead Development Association International. Retrieved: 5 September 2005**
34. **International Council on Mining and Metals (2005), ICMM 2005 Work Programme. Retrieved: 13 September 2005**
35. **Kagara Zinc Ltd. (2004),** ***Annual report 2004***
36. **Lalor, G. Rattray, R. Vutchkova, M. Campbell, B. Lewis-Bell, C. (2001),** ***Blood lead levels in Jamaican school children*****, The Science of The Total Environment 269: 171-181**
37. **Lustberg, M. Silbergeld, E. (2002),** ***Blood lead levels and mortality*****, Arch Intern Med. 2002 Nov 25;162(21):2443-9. Retrieved: 2 January 2003**

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au

38. **Mathee, A. von Schirnding, Y. E. R. Levina, J. Ismail, A. Huntley, R. Cantrell, A. (2002),** ***A survey of blood lead levels among young Johannesburg school children*****, Environmental Research 90,3: 181-184.**
39. **Midgley Jr, Thomas, (undated, probably 1926 or earlier)** ***Lots of Living,*** **in** ***From the Periodic Table to Production: The Life of Thomas Midgley, Jr – The Inventor of Ethyl Gasoline and Freon Refrigerants*** **by Thomas Midgley IV, Stargazer Publishing Company, Corona California, 2001.**
40. **NRC – National Research Council: Committee on measuring lead in critical populations (1993),** ***Measuring lead exposure in infants, children and other sensitive populations*****, National Academy Press Washington D.C.**
41. **Perilya Ltd. (2004),** ***Annual report 2004*** **Available:**
42. **Phillips, Lauren (2005) Cartoon:** ***The early death of Thomas Midgley – inventor of lead additive for petrol*****, Sydney, 23rd September 2005.**
43. **Puckett, J. (2003),** ***Recycling: no excuse for global environmental injustice*****, The Basel Action Network (BAN). Retrieved: 30 August 2005.**
44. **Rio Tinto (2003), Product Stewardship. Retrieved: 9 September 2005.**
45. **Roche, M. Toyne, P. (2003),** ***"Green Lead" a new approach to product stewardship*****, 14th International Lead Conference, Frankfurt: 21-22 October 2003, Retrieved: 8 September 2005.**
46. **Rosselson, Leon (1981),** ***"Who reaps the profit? Who pays the price?"*** **on the specially recorded protest album** ***"Nuclear power no thanks!!"*** **recorded at Gateway Studios, London, 1981.**
47. **Sharp. (2004),** ***Creating super green products*****. Retrieved: 2 September 2005.**
48. **SmithBucklin Corporation, Market Research and Statistics Group. (2005),** ***National Recycling Rate Study. Chicago*****, Battery Council International. Retrieved: 30 August 2005.**
49. **Thorpe, B. Kruszewska, I. (1999),** ***Strategies to promote clean production extended producer responsibility*****, Northern Alliance for Sustainability [ANPED], Based on a 1995 EPR Briefing by Iza Kruszewska / Beverley Thorpe published by Greenpeace International. Retrieved: 12 September 2005**
50. **United Nation Environmental Programme (UNEP) (2002),** ***New Basel guidelines to improve recycling of old batteries*****, UNEP News Release 22/05/2002/40. Retrieved: 31 August 2005**
51. **United Nations Environment Programme (UNEP) (2005a),** ***E-waste, the hidden side of IT equipment manufacture and use*****. Retrieved: 2 September 2005**
52. **United Nations Environment Programme (UNEP), Production and Consumption Branch (2005),** ***Cleaner Production Declaration – Signatory List*** ***updated to January 2005*****. Retrieved: 13 September 2005**
53. **Wang Sun-qin, Zhang Jin-liang. (2004),** ***Blood Lead Levels of Children in China*****, Journal of Environmental Health 21,6: 355-360**
54. **World Health Organization (WHO) (2004),** ***Children's intellectual potential at risk*** ***European ministers finalize the Budapest Conference agenda*****, Regional Office Europe. Retrieved: 1 September**
55. **Xstrata (2004),** ***Annual Report 2004***
56. **Zinifex Ltd. (2004),** ***Annual report 2004***

The LEAD Group Inc. PO Box 161, Summer Hill, NSW 2130, Australia. Phone: +61 2 9716 0014 Fax: +61 2 9716 9005 www.lead.org.au