

## ELV and appliance recycling in Japan

# Japan sets world-beating benchmark

Over recent years, the Japanese government has laid the legislative foundations that have allowed domestic companies to invest heavily in the development of innovative solutions to the recycling of end-of-life vehicles and household appliances. In this article, Recycling International examines how the system of targets, fees and subsidies translates into a robust recycling reality.



Hironichi Ishii, President of licensed Japanese vehicle dismantler Eco-R.

**H**ironichi Ishii, the young and charismatic second-generation President of licensed Japanese vehicle dismantler Eco-R, stands in the middle of his company's vehicle repair garage and points at a small white hut.

'That's the painting booth,' he tells me. 'It reflects the *mottainai* style.'

It's an odd construction to find in a factory: a white clapboard house, distinguished by the geometric pattern painted on its lower half. Inside, workers paint bumpers and other parts for damaged vehicles purchased from insurance companies and repaired for export. According to Mr Ishii, *mottainai* is a nearly untranslatable word that suggests a sense of regret when something isn't utilised to its full potential. 'It is a very old, traditional concept in Japan,' he adds, 'and it is something that I try to bring into our company.'

### Guiding principle

*Mottainai* extends far beyond Eco-R. Over the last decade, in fact, it's been enshrined as one of the guiding principles behind Japan's world-leading end-of-life vehicle (ELV) and appliance recycling laws and systems. Already, for example, the Japanese have achieved a 70% recycling ratio for ELVs and are poised to achieve an astonishing

95% by 2015. But even in advance of the 2015 deadline, Japan's ELV recyclers and, to a lesser extent, its appliance recyclers have achieved levels of environmentally-sound recycling and reuse that exceed those practised anywhere else in the world - including the EU, which is responsible for many of the systems, concepts and technologies adapted by the Japanese.

*'On-line car auctions are taking place in Japan at any given time.'*

To be sure, such advances evolved from a less sophisticated recycling past. Indeed, Japan's post-World War II industrialisation was undeniably rapid and dirty. Despite a few token laws along the way, Japan's contemporary environmental consciousness did not emerge until the 1970s and the immediate aftermath of the mid-seventies oil shocks.

'Eco-R has changed with the industry over the years,' Mr Ishii tells me, and nods at a set of photographs that reflect the company's history, including an early photo of a haphazard pile of cars awaiting processing. Founded by Mr Ishii's father in 1964 and still based in Ashikaga, a 90-minute drive north of Tokyo, the company was once an 'old-style' car recycler where money, and



Flattened car bodies and stripped white goods piled loosely beside a pre-shredder at Phoenix Metal Group, East of Tokyo.

facturers and importers are responsible for the proper recycling or disposal of the three most difficult-to-process ELV-related wastes: air-bags; fluorocarbons from air-conditioning units; and, most importantly, automotive shredder residue (ASR).

The ELV law requires a 50% recycling rate by 2010 and a 95% rate by 2015, with the manufacturers and importers responsible for meeting the goal. Thus, in co-operation with other companies, the Japanese automotive industry has expended significant financial resources to facilitate and ultimately lower the cost of domestic ELV recycling.

### Tracking system

According to one account, Japan's vehicle manufacturers and importers spent a combined Yen 15 billion (US\$ 150 million) alone on a complicated electronic manifest system which allows a vehicle owner - and the reserve fund which dispenses money for recycling - to track his or her ELV from the point of collection through the entire recycling process.

As it happens, though, Eco-R and other dismantlers receive only a very small percentage of the fee as part of their role in collecting and directing the air-bags and fluorocarbons to the

not the environment, was the overriding concern, Mr Ishii concedes. 'We realised then that we needed to be more careful with our resources.'

As we talk, Mr Ishii types up a list of Japan's important environmental laws dating back to the 1970s. Some were inspired by declining landfill space and others by very public protests against industrial pollution; yet more were directly inspired by the dumping of ELVs on Japan's remote islands.

By the mid-1990s, Japan's traditional vehicle recyclers were either closing up or modernising. If they didn't, they were doomed: in 2002, Japan passed its complicated and visionary Law for the Recycling of End of Life Vehicles. When it was implemented in 2005, strict licensing and oversight procedures guaranteed that only the best-equipped and cleanest recycling operations would endure in Japan. In advance of the change, Eco-R upgraded its already industry-leading operations. But there was one problem: the expected number of vehicles entering the waste stream was going to require more space than was available to Eco-R at its original Ashikaga loca-

tion. So, not long after the law emerged, the company opened its new 22 500 m<sup>2</sup> facility.

### Reserve fund

There are two basic principles behind Japan's ELV law. The first is that vehicle owners should be obligated to pay for the cost of recycling their vehicles. Thus, the law imposes a recycling fee to be paid at the time of vehicle purchase, change of registration or inspection. Fees depend upon the model and vary between Yen 7000 (US\$ 70) and Yen 18 000 (US\$ 180) for passenger vehicles. The money is paid into a reserve fund, and then paid out as the vehicles are recycled. Currently, fees have been paid on approximately 93 million cars for a total reserve fund of roughly US\$ 10 billion. Annually, the system processes 3.5-3.7 million vehicles at a cost - paid by the reserve - of roughly Yen 35 billion (US\$ 350 million).

The second principle is that vehicle manufacturers and importers should be responsible for the safe and environmentally-sound recycling of vehicles. Specifically, this means that manu-



Workers at Eco-R repairing damaged vehicles purchased from insurance companies which are destined to be exported.



According to Japan's ELV law vehicle manufacturers and importers are responsible for the safe and environmentally-sound recycling of vehicles.

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Bidding terminal at Eco-R for the perpetual set of on-line car auctions taking place in Japan at any given time.

relevant facilities. They are not actual recyclers of those materials. As Mr Ishii points out, the dismantling business could function with or without a subsidy; there's enough supply and demand for the recycled parts and materials to justify the business regardless of the ELV law. Outside Eco-R's conference room window, recently-arrived cars are dropped and await their turn on the recycling line. Prior to the global economic crisis, Eco-R was processing 4500-4800 cars per month, according to Mr Ishii. Since the onset of the crisis, it has handled nearer 4000 cars, sourced from leasing companies, insurance firms, car dealer trade-ins, drop-offs and auctions.

Auctions are of particular interest to Mr Ishii, and he leads me into the large office where one of his employees activates a computer with two joysticks. It looks like a video game machine, but it's actually a bidding terminal for the perpetual

set of on-line car auctions taking place in Japan at any given time. Once the system is booted, a detailed description of a car appears with photos and location. Seconds later, bidding begins in Yen 3000 (US\$ 30) increments, with interested parties nationwide sitting at similar terminals and bidding using similar joysticks. Then, just seconds later, it's over and another auction begins. Typically, there are eight auctions ongoing at any given moment in Japan. 'Before the economic crisis, the bidding was crazy because people were bidding on the steel, not the cars,' Mr Ishii tells me. 'Things are back to normal now and that's good for the business.'

### Fit for high heels

Mr Ishii takes me into the parking area where cars are stacked two-high, and then into the

*'Mottainai' is a the guiding principle behind Japan's ELV and appliance recycling laws.'*

first of several dismantling warehouses where the cars are placed on to specially-designed, forklift-able metal pallets into which oil can drain without leaking on to the floor. 'I always want this factory to be a place where ladies can come and walk in high heels,' he tells me. There aren't any high heels in the dismantling warehouse, but there are dozens of Eco-R's 120 workers engaged in the orderly business of dismantling vehicles. Air-bags and fluorocarbons are removed first and set aside for shipment to processors licensed - and subsidised - to handle them. After that, the greatest emphasis is placed on recovering re-usable parts and inputting them into the company's used auto parts database. On average, 15 000 parts are catalogued in it at any given time.

At one end of the warehouse, workers fill out catalogue forms for car doors, noting any nicks and dents. These are also photographed - including close-ups - for the database. Afterwards, workers wrap the parts in plastic and store them in the warehouse. Because Eco-R is a member of the national used parts database, potential purchasers around the country are able to order, inspect, purchase and ship Eco-R's parts. The business is also international in char-

acter: according to Mr Ishii, the company ships parts to 50 countries as well as around Japan.

### Quickest money

In fact, Eco-R has been a major exporter of auto parts and repaired vehicles since its formation. But like so much else in Japan's vehicle dismantling industry, the 2005 law accelerated the trend, and today roughly 20% of the vehicles which enter the Japanese recycling system are exported. The remaining vehicles are disassembled and recycled, though significant portions of those vehicles might also be recycled and re-used. At Eco-R, roughly 30% of the incoming vehicles are re-used to some extent; 30% are exported; and 30% are scrapped. The other 10% are repaired and placed back on the road. 'The export market is the best,' Mr Ishii explains. 'It's the quickest money. With the domestic market, we have to store the parts.'

A warehouse beside the repair shop is festooned with the national flags of dozens of countries. But they're not decorations: they're markers for shelves of parts destined for export to those respective markets. For Eco-R, the Philippines, Australia and Ghana are the most important markets, with Africa in general showing exceptional growth. The EU, however, imports almost nothing, while the USA accounts for roughly 5-10% of the material, mostly in the form of Honda engines.

It is a fast-moving business that requires a good understanding of the tax rules in various markets, as well as the market itself. To prove the point, Mr Ishii shows me a demure little saw mounted on what appears to be a hydraulic platform. 'We use this to cut cars in half,' he explains.



Eco-R recovers all fluids from the ELVs.



After dismantling, Eco-R places great emphasis on recovering re-usable parts and in putting them into the company's used auto parts database.

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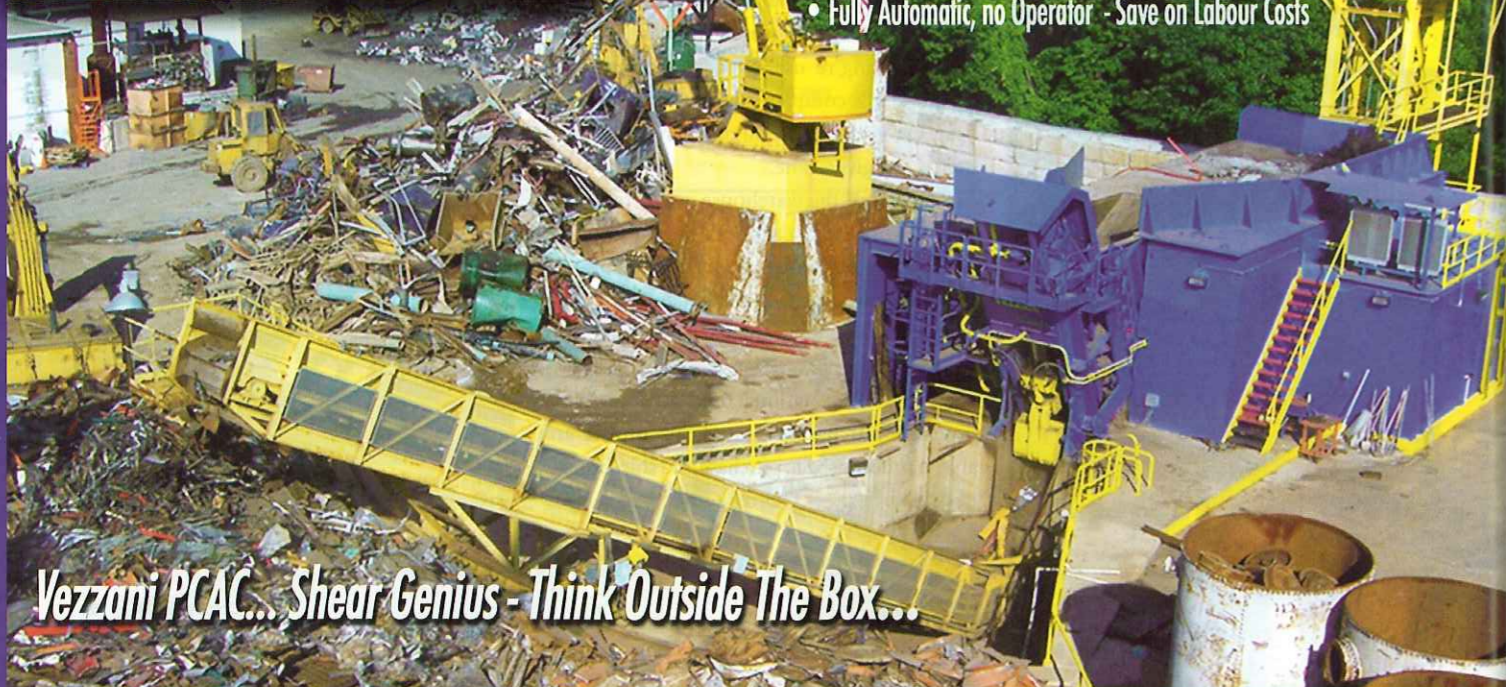


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JAPAN

'So then we can ship the car as scrap and not as a used car. Saves tax.' Despite what might appear to be vehicle-ending damage, the halved vehicles have a ready market in Africa where they're particularly valued for their front ends.

The international warehouse connects to a scrap bay where four hydraulic cranes rip and tear at the vehicle bodies and motors that couldn't be salvaged for re-use. It's a noisy, dirty and supremely efficient place where scrap is baled and loaded for shredders and shears elsewhere in the region. 'Maybe for us the next challenge is to figure out how to handle the e-waste in the automobiles,' Mr Ishii says. 'The next revision of the ELV law will think about that. There's quite a bit of value in there that's not being properly recycled.'

### Where ELVs and appliances meet

East of Tokyo, a truck is being unburdened of flattened car bodies by a hydraulic grapple crane at Phoenix Metal Group's new 20 000 m<sup>2</sup> yard in Chiba Prefecture. They are piled loosely beside a pre-shredder, among additional car bundles, stripped white goods and a motley assortment of demolition scrap being fed into the company's new 3500 HP Lindemann shredder, one of the largest and most advanced in Japan. 'We spent a lot of time planning this plant because it must be able to handle the new and future regulations,' says Toru Suzuki. He is President of Suzutoku Ltd, a division of Suzutoku Holding Group, the sprawling, family-owned Tokyo-region recycling conglomerate that opened this new plant in April 2009.



Takashi Mizuguchi, Managing Director of Phoenix Metal Group.



In one of Eco-R's scrap halls, hydraulic cranes rip and tear at the vehicle bodies and motors that couldn't be salvaged for re-use.

We turn away from the shredder and into a well-lit warehouse where thousands of used air-conditioners are stacked in steel cages. 'Everything about appliance recycling is decided by the government and manufacturers,' says Mr Suzuki as we pass them. 'Even the design of those cages.' We pass many dozen more cages, some filled with televisions and some with refrigerators. Altogether, Suzutoku Holding Group processes 700 000-800 000 individual appliances per year, and this plant is designed to process 300 000 of them. It's a significant percentage of Japan's total which, Mr Suzuki claims, amounts to roughly 10 million units per year.

### Home appliance law

Despite some significant differences in the funding mechanisms, Japan's Law for the Recycling of Specified Kinds of Home Appliances is closely related to the ELV law, and many of the largest Japanese recyclers operate appliance and ELV operations that take advantage of specific synergies between the two waste streams, such as the need to recover fluorocarbons and to shred and recycle plastics. Likewise, consumers are responsible for paying recycling fees when they dispose of their appliances, and manufacturers are responsible for the actual safe recycling of those devices.

But there is also a crucial difference: unlike the ELV law, which mandates that recycling fees are paid at the time of purchase or registration change, the home appliance law requires that the fee be paid at the time of disposal. And the

fees are not cheap: in 2008, they ranged from Yen 1785 (US\$ 17.85) for a small television to Yen 4830 (US\$ 48.30) for a large refrigerator. This factor, combined with the lack of a registration scheme (similar to the ELV manifests) for appliances, has resulted in a significant 'invisible flow' of appliances - presumably, into dumps and developing countries. In fact, according to a December 2006 report to the Japanese government, nearly half of Japan's old appliances are *not* recycled in authorised recycling centres. Nonetheless, the half that *are* visible provide Phoenix Metal Group with more than enough work - despite the economic crisis and a recent unwillingness among consumers to purchase new appliances to replace their old ones.

According to Mr Suzuki, the government-mandated recycling ratios determine much of what happens at Phoenix Metal Group. Higher ratios generally require more intensive recycling or, at the manufacturer's end, better designs for recycling. For the moment at least, the requirements are still relatively modest - but they are increasing: refrigerators must meet a 70% recycling ratio by weight (insulation is a significant contributor to the un-recycled 30%); and traditional televisions must meet a 55% requirement.

### Awaiting guidance

At Phoenix, most of a large warehouse is devoted to an orderly but complicated set of dismantling lines staffed by approximately 40 workers. At the near end, televisions are conveyed along



On average, 15 000 parts are catalogued in Eco-R's used auto parts database.



Eco-R company ships used car parts to more than 50 countries worldwide.

a disassembly line, their cases removed, circuit boards segregated and various metals set aside. The picture tubes are cut open, vacuumed and granulated. 'We ship the glass to Malaysia,' explains Mr Suzuki. 'That's the only place where they make the new CRTs from the old ones. A big problem, though.'

## 'Most of Japan's ASR is outsourced for processing.'

We pause by a heavy bag filled with circuit boards that, he tells me, will be shipped to a northern Japanese smelter for processing. Nearby, several large flat panel televisions are gathering dust in a storage rack. When I ask Mr Suzuki how they'll recycle them, he shakes his head. 'Not so easy. We are still awaiting guidance from the manufacturers. But we must take them.' Next, we approach a worker feeding washing machine parts into a plastics granulator. The resulting shred is packed and sent back to the manufacturer for re-use. He explains: 'Sometimes we are required by the manufacturer to send it to them, sometimes to someone else. It's their requirement. Very difficult sometimes.' Air-conditioners are processed at the far end of the space, where they're attached to lines that

recover Freon. After that, they're quickly dismantled and sorted into constituent parts and materials. Nearby, refrigerators undergo the same process. When they're stripped to their barest elements, they're conveyed out to the shredder yard where they join washing machine and dryer bodies.

### Flexible shredder

We walk outside and watch pre-shredded scrap conveyed into the new Lindemann. 'Today, we are doing demolition scrap,' Mr Suzuki tells me from beneath the new shredder. 'But our shredder is very unique because it can switch between ELVs and appliances. It is designed for both.' As we walk behind it, he points at a freshly-painted set of blue pipes that run up and down the machine. 'That's our Freon recovery system,' he tells me. 'The refrigerators usually have some gas left in them so we use that when we shred them to get the remaining gas.'

Meanwhile, in an adjoining warehouse, clean shredded ferrous scrap is slowly dropping from a conveyor belt on to the concrete floor. Behind it, shredded 'heavies' are dropping into a bin which will be transported to a flotation plant at another Suzutoku facility. In an adjacent warehouse, the ASR too flows along conveyors on to concrete floors. Although some Japanese recyclers have undertaken their own ASR processing operations, in part to garner a percentage of the hefty subsidy, Suzutoku has chosen to send its ASR to another processor and to focus instead on its core businesses. 'As you can see,' Mr Suzuki tells me, 'we have really worked to perfect the systems that we have.'

### ASR innovator

Two hours south of Tokyo, eCONeCOL - a 57-year-old family-owned recycler located in the foothills of Mount Fuji - has deployed an array of separation technologies to deal with the ASR that it generates in its ELV and appliance manufacturing operations. Shinobu Tachibana, the English-speaking Deputy Director of the 200-employee company's sales department, leads me through several of the enterprise's yards in a sprawling, elevated industrial park. eCONeCOL has long prided itself on being a technical innovator, and it has long had the scale to fund such innovation. In 2008, it enjoyed sales of US\$ 300 million; and though its overall numbers will be reduced this year, it is continuing to spend on technology.

'So this is where we do most of it,' Mr Tachibana explains as we pause at the doorway of a building within earshot of the company's busy 1250 HP shredder. Inside, a worker in hard hat and gloves stands beside a conveyor belt that dumps a surprisingly clean stream of seat cushion foam from the company's ASR processing line into a heavy-duty plastic bag. I place my hand inside and press down: there's barely any resistance from hard substances.

Nearby, a different conveyor empties mixed plastics into a bag; further along, another conveyor releases fingernail-sized chips and chunks of mixed non-ferrous metals. It's an impressive and expensive system that utilises repeated passes through eddy currents, flotation, trampels and other technologies. 'As a business, this kind of separation line is not possible without the ASR payments from the recycling system,' Mr Tachibana concedes.

### Current concerns

Mr Tachibana invites me into a van and we drive along the industrial park's winding roads to another of the company's nine sites. As we turn into the yard, we pass a vehicle dismantling operation that handles as many as 1000 ELVs per month - when the economy is good. 'That Nissan,' Mr Tachibana tells me, pointing at a car just then being disassembled. 'We can buy it for US\$ 400 and sell the parts for US\$ 2000.' But the concern at the moment is what happens to the car parts that can't be resold or recycled in the traditional manner.

We step out of the van and into an open-air warehouse where conveyors, air and water send ELV and appliance dust through a three-level, U-shaped rollercoaster of technologies that, on the first pass, produces copper of 60% purity. 'And if we want to, and the market justifies it, we can



The control room of Phoenix metals' new 3500 HP Lindemann shredder.

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Many of the largest Japanese recyclers operate appliance and ELV operations that take advantage of specific synergies between the two waste streams.



Toru Suzuki (left), President of Suzutoku Ltd. To his right, his uncle Takao Suzuki, Chairman of the Suzutoku Holding Group.

go to 90% with more passes,' Mr Tachibana claims as he beckons me to follow him up and down narrow, steep staircases, ladders and walkways. When we reach one end of the system, I lean over a balcony and watch workers secure bags now filled with circuit boards, plastics and copper. Nearby, on the other side of the U, a new container of shredder residue arrives for processing.

### Technological marvel

eCONeCOL's in-house solution is a technological and engineering marvel, but it's expensive and relatively uncommon. As a result, most of Japan's ASR is outsourced for processing. Of those facilities that accept it, the biggest and best known is the Onahama Smelting & Refining Co., Ltd, located nearly two-and-a-half hours by train from Tokyo in the fishing port of Onahama. It's an imposing facility, comprising 457 000 m<sup>2</sup> of warehouses, factories, power plants, offices and storage areas. And it is a closed one, too: management is not keen to show off the technology that has made the plant such an innovative success. Founded and still owned by a group of shareholders led by Mitsubishi, Dowa Metals & Mine Company and Furukawa Metal & Resources, Onahama manufactures 250 000 tonnes of copper cathodes annually, and was Japan's

pioneer in the safe and clean processing of ASR. The 414-employee facility was established in 1963 as an answer to industrialising Japan's increasing demands for copper supply. It began operations in 1965 with an output of 6000 tonnes per month of electrolytic copper; at that time, it was Japan's largest copper producer. By 1973, production had increased to 20 000 tonnes per month – just in time for the mid-1970s oil shock. The high fuel costs were nearly ruinous for the facility, and it began to explore alternative fuels. In 1980, the company began to use shredded used tyres as fuel, but though this was an improvement on oil, it was still a commodity for which competition was fierce. However, ASR – then a waste destined for landfills – was not. Onahama began to research the use of this troublesome waste as a fuel source and, in 1993, it began to use ASR in its retrofitted reverberatory furnaces. At the time, it was a cost-saving measure based upon unstable fuel costs; today, it's a profitable business subsidised by recycling fees and supported by the Japanese government.

### Much higher temperature

The parking area outside of Onahama speaks to its role as a major ASR processor. In the mornings, trucks are lined up, awaiting an electronic dispatch via large signs arrayed throughout the area. When their number is called, they drive into the facility and dump their loads into a monumental storage area filled with yellow

*'Many large Japanese recyclers operate both appliance and ELV operations.'*

dust. Shosaku Hayashi, Assistant General Manager at the plant, leads me and several plant executives up metal staircases and around darkened walkways that surround the furnace. Then we turn a corner and enter a well-lit and quiet control room. 'There is the ASR,' he tells me, pointing at a grainy black and white closed circuit camera focused upon the roof-top point at which conveyors of ASR release thick clumps of the material into one of the company's two reverberatory furnaces. Inside, the temperature averages 450°C – much higher than that in an average incinerator. This

ensures that dioxin – a regular product of incinerating ASR at lower temperatures – forms only at barely detectable levels which are below even Japan's stringent requirements on the emission of the toxic gas. An additional oxygen plant pumps the gas into the furnace, promoting the efficient incineration of rubber and plastic resins. On the plus side, Onahama recovers the roughly 5% copper contained in the ASR. Even better, the furnace's off-gases heat the company's boilers, providing the entire facility with fully 40% of its total power requirements.

### Allowing for variation

Later, in a conference room, Mr Hayashi goes over the technical aspects of the furnaces and their development, along the way telling me that the furnace is designed to allow variation in the composition of the ASR stream. 'Because the auto industry is trying to lower recycling costs,' he explains, 'the nature of the material changes too.' Overall, he says, the material is of good quality for the company's uses, though there are concerns about moisture and mercury content.

As we walk out of the main office building, I'm reminded that Onahama isn't the only plant in Japan that uses ASR for fuel. 'But it was the pioneer,' he reminds me. 'And it still is. We are always working to improve our technology and efficiency with our partners.'

Over the course of a week's worth of visits to Japan's vehicle and appliance recyclers, I heard several executives express the same sentiment with the same level of optimism. And there is reason to believe that such optimism is warranted: the ELV law is due for a five-year review next year, and there are several proposals on the table to improve its efficiency and cost structure. Meanwhile, several major players in the industry are quietly looking to extend the system to China in some form, and it's possible that some kind of prototype partnership will emerge in the next year or two. Whatever happens, Japan's ELV and appliance recycling systems will continue to serve as the standard by which other national recycling systems are measured. □

Adam Minter is a Shanghai-based journalist who writes about business and culture for US and European publications. He also maintains a blog at: [www.shanghaiscrap.com](http://www.shanghaiscrap.com)