Industry Challenges with China Environmental Product Regulations

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Since the issue of the European Union directive [1] on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) and its predecessor WEEE directive [2], the global electronics industry has been actively interpreting the resulting EU member state regulations, defining responsive business strategies, and implementing the technical and business processes necessary to meet all facets of these directives. Many companies have allocated significant resources to ensure that their products can be marketed within the European Union and are now generally in the final implementation stages of their RoHS compliance strategies.

China is motivated to reap similar environmental benefits for its citizenry and the China Ministry of Information Industry (MII) is actively drafting its own environmental regulations for Electronic Information Products (EIP). Key elements of these China environmental regulations may deviate substantially from the EU RoHS directive. Such deviations could pose severe logistical challenges to the electronics industry.

Known differences to date include the use of government issued labeling requirements for all EIP products and the mandatory use of government certified product compliance testing prior to market introduction. As well, uncertainty exists around the use of an EIP catalogue that will define applicability of the China regulations (potentially incorporating products that are now exempt from EU RoHS). At this time the catalogue does not exist, but efforts are underway to select the products that will be incorporated. All regulations that require business procedures or unique product attributes over and above EU RoHS will drive up production costs and increase product introduction cycle times.

This paper describes the requirements of the China MII environmental regulations as currently proposed, comparing and contrasting the key differences with the EU RoHS directive and highlighting the resulting electronics industry challenges. It discusses the business consequences of complying with multiple directives and emphasizes the need for convergence of all global environmental stewardship programs.

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INTRODUCTION

In June 2002 the Chinese government passed the *Cleaner Production Promotion Law*. As stated within Article 1 the law was enacted to promote cleaner production, increase the efficiency of the utilization rate of resources, reduce and avoid the generation of pollutants, protect and improve environments, ensure the health of human beings and promote the sustainable development of the economy and society [3]. In response to this national environmental directive, the Ministry of Information Industry (MII) drafted a regulation entitled *Management Methods for Controlling Pollution by Electronic Information Product* [4], designed to enforce hazardous materials restrictions within China's domestic electronics market. Three years later, on September 28, 2005, the official World Trade Organization (WTO) notification was issued to declare the intentions of the new MII Methods Law [5].

Over the past several years the MII has been working closely with all levels of the supply chain including raw material suppliers, sub tier suppliers, contract manufactures, and importers to solicit comments and suggestions on this pending regulation. During this time, MII steering committees have been drafting, negotiating, and revising regulatory requirements that are now being proposed to support the People's Republic of China (PRC) MII Methods Law.

On February 28, 2006 the MII Methods Law was officially promulgated, and as indicated in earlier drafts [5], a one year grace period has been allowed before enforcement. The effective date of this new regulation is therefore now set as March 1, 2007.

A critical concern with this timetable is the recognition that it has taken the global electronics industry nearly five years to prepare for European Union (EU) RoHS requirements. Significant amounts of time, money and engineering resources have been invested across all segments of the electronics supply chain to assure that compliant products can be put on the market

in EU member states by July 1, 2006. But, with less than a year for the same global supply chain to comply with an emerging set of environmental regulations put forth by the Chinese government, any substantial differences with existing regulations constitute key areas of concern.

PROPOSED REGULATIONS

There are seven main regulatory bodies governing the China environmental product legislation: the Ministry of Information Industry (MII), the National Development and Reform Commission, the Ministry of Commerce, the General Administration of Customs, the State Administration of Industry and Commerce, the State Administration of Quality Supervision, Inspection and Quarantine (AQSIQ), and the State Environmental Protection Administration. These regulatory bodies are responsible for limiting the use of hazardous substances within China's domestic electronics market within the framework of the MII Methods Law.

Most importantly, the MII is responsible for developing national strategies, regulations, and technical standards associated with the electronics industry. The AQSIQ maintains regulatory control of imported and exported products within China.

The MII Methods Law applies to the production and sale of ten (10) categories of Electronic Information Products (EIP) including computers, specialized electronic products, electronic components and parts products, and electronic material products destined for domestic consumption. It applies to all producers and importers of EIP, but excludes export provisions. It affects all design, materials, and manufacturing processes used for identified electronic products [6].

Provisions of the MII Methods Law are to be implemented with a phased-in approach starting with product labeling requirements, followed by subsequent provisions that include a detailed Product Catalogue and mandatory compliance certification testing. Both the product catalogue and mandatory testing requirements are expected to be implemented after a (yet to determined) period of enforced product labeling. It is expected that on March 1, 2007 the only formal requirement for producers and importers will be compliance with the MII Management Methods labeling requirements. Companies will initially not be required to remove the hazardous substances from their products; simply identify their presence. Restriction of use is expected to follow at a later date, as stipulated in the pending Product Catalogue.

KEY ELEMENTS OF THE REGULATIONS

The MII Management Methods regulation [4] contains four chapters with twenty seven articles in total and is directly linked to the PRC *Cleaner Production Promotion Law*. It outlines the definition of Electronic Information Products, responsible enforcement organizations, numerous regulatory standards, and provision definitions for non-compliance penalties. The regulation document structure consists of two parts: the Management Methods Control document [4] and six (6) regulatory standards documents. Each of the six standards contains implementation requirements that are to be followed to ensure compliance with the overall directive.

Though the MII Management Methods Control document has been officially promulgated, the six regulatory standards have not been finalized or released. A Standards Working Group was established by the MII to address the various technical issues in these standards that require technical or engineering input. The Standards Working Group in turn set up three sub-groups, namely, the Labeling and Certification Sub-Group, the Testing and Concentration Limits Sub-Group, and the Lead free Solutions Sub-Group. All six standards are still being developed but are expected to be promulgated throughout the second and third quarters of 2006.

The six regulatory standards, identified collectively as *PRC Electronics Industry Standards*, are being defined to address the following implementation topics:

(1) Marking / Labeling Requirements.
(2) Maximum Concentration Value (MCV) Limits.
(3) Hazardous Substance Testing Requirements.
(4) Pb-free Solder Materials.
(5) Product Catalogue Definition.
(6) Certification Requirements.

In the following sections, further details are provided for each of the regulatory standards currently under development.

MARKING / LABELING

All marking and labeling requirements are described within Articles 3(3), 11, 13, and 14 of the MII Management Methods document. The standard that is referenced within the Methods document is entitled *Marking for the Control of Pollution*

Caused by Electronic Information Products [7]. This standards document identifies four areas for which clearly visible labels are required. They include:

(a) Environmental Protection Use Period.

(b) Parts containing Toxic Substances with names / levels, and indicate whether such parts are Recyclable.

(c) Packaging Materials used during shipping.

(d) Recycling Label.

The first labeling requirement, the Environmental Protection Use Period, specifies the length of time that a product can be used ensuring its safe use to the consumer and to the environment as stated in Article 3(5). The primary issue with this requirement is that the duration of the environmental protection use period is being left to the manufacturer or importer to determine (Article 11), along with the associated liability for this determination. The environmental protection period will require continued advocacy, as the interpretation of the safe use period, via explicit government guidelines, is a critical issue and requires further industry input and guidance.

The second labeling requirement is intended to summarize any of the identified toxic substances at a product system level. In the figure below an example of the required table is shown. This table is also intended to be included within the product user manual.

Table 1 - Toxic Substance Label example

		Toxic Substance					
No.	Part Name	Pb	Hg	Cd	Cr6+	PBB	PBDE
1.	XXXX			O		>0.1 %*	

*(*assume the MCV is 0.1% for PBB, e.g., with EIP-A)*

If the concentration of a certain toxic substance or element is below the allowed Maximum Concentration Value (MCV), then a O mark shall be used. If the concentration is over the allowable MCV, then a " > " mark shall be used together with the MCV for that substance.

The third labeling requirement concerns product packaging materials. All major constituent hazardous substances in a packaging material must be clearly labeled directly on the shipment package.

Lastly, recycling labels must be affixed to the product to provide direction for appropriate disposal. Requirements for EIP recycling can be found within the China WEEE legislation [8].

Marking and/or Labeling requirements are expected to be applicable to all EIP, regardless of product catalogue listing. All shall be affixed to the product or the associated packaging if size allows. If not, the information shall be reported in the accompanying user documentation.

MAXIMUM CONCENTRATION LIMITS

All identified hazardous substances are described in Article 3(4) and their restrictions are described in the following articles of the MII Methods document: Article 9; Article 10; Article 14, Article 15; and Article 16. These requirements cover the design, manufacturing, and product packaging material requirements of monitored EIP products.

The standard issued by the MII outlining the maximum concentration limits is entitled *Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products* [9]. The listed banned substances and maximum allowable concentration limits are identical to those listed in the EU RoHS Directive. They include lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyl (PBB), and polybrominated diphenyl ether (PBDE)..

In addition to the identified hazardous materials listing and maximum concentration value (MCV) limits, a third classification is required to ensure product compliance. All materials within an EIP must be classified into one of four groupings: EIP -A, -B, -C, or -D. Table 2 below defines each classification and its corresponding definition.

Table 2 - EIP Material Classifications [9]

Classification	Definition
EIP-A	Homogeneous materials composing EIP. Concentration of Pb, Hg, Cr6+, PBB, PBDE shall not exceed 0.1%, while the concentration of Cd shall not exceed 0.01%.
EIP-B	Metal Plate Material in Parts of EIP. Materials shall not be added or used intentionally.
EIP-C	Small elements of the EIP that, under current conditions, can hardly be further split, with a size no bigger than 1.2 mm^3 (the size of a 0805 chip). Concentration of Pb, Hg, Cr6+, PBB, PBDE shall not exceed 0.1%, while the concentration of Cd shall not exceed 0.01%.
EIP-D	Special material or part in EIP, with detailed exemption information.

The standard requires that all identified hazardous materials must be classified per Table 2 with a priority consequence hierarchy listed as -D/-A/-B/-C. This means if a material can be classified as EIP-A, then it should not be classified as EIP-B or EIP-C.

While the EIP-A criteria are consistent with the EU RoHS requirements, there are no corresponding EU RoHS requirements for EIP-B and EIP-C materials. Materials eligible for specific exemptions under EU RoHS legislation have been included and harmonized under the new MII Management Methods regulation as EIP-D. This harmonization of specific materials treatment between the China and EU directives is extremely important to a successful implementation and has been achieved through active MII consultation with industry. There are however several additional requested exemptions still under review within the EU. It is imperative that they too, if approved, be included within the EIP-D list to maintain this consistency of treatment.

HAZARDOUS SUBSTANCE TESTING REQUIREMENTS

On July 18 2005, six testing standards were issued by the AQSIQ to outlay interim test methods required to quantitatively measure the six hazardous substances identified within the EU directive and MII Management Methods regulation. The methods detail sample preparation, separation into homogeneous parts, and analytical procedures. Below is a listing of the test methods currently under development.

- *Determination of Chromium (VI) in Electrical and Electronic Equipment — Part 3:1,5-Diphenylcarbohydrazide Spectrophotometric Method.*
- *Determination of Lead, Mercury, Cadmium, Chromium and Bromine in Electrical and Electronic Equipment — Part 1: Qualitative Screening by Wavelength Dispersive X-ray Fluorescence Spectrometric Method.*
- *Determination of Lead, Cadmium and Chromium in Electrical and Electronic Equipment — Part 2: Flame Atomic Absorption Spectrometric Method.*
- *Determination of Mercury in Electrical and Electronic Equipment — Part 1:Hydride Generation-Atomic Florescence Spectrometric Method.*
- *Determination of Polybromobiphenyls and Polybromobiphenyl Ethers in Electrical and Electronic Equipment — Part 1: High Performance Liquid Chromatography Method.*
- *Determination of Polybromobiphenyls and Polybromobiphenyl Ethers in Electrical and Electronic Equipment — Part 2: GC-MS Method.*

The MII is also drafting its own testing methods standards and, together with the AQSIQ, participates actively in the national standards body and IEC TC111 activities.

The listed test methods have been drafted to ensure uniform enforcement of the MII Management Methods regulation within China. Ultimately, it is expected that these testing standards will transition into International Electrotechnical Commission (IEC) test methods, but until the IEC methods are completed, test methods issued by the AQSIQ will be enforced. IEC test methods are expected to be released during the 3Q2006 timeframe.

Pb-FREE SOLDER MATERIALS

On March 13, 2006, the Lead free Solutions sub-group released the second draft of Pb-Free standards called *Lead free Solders–Chemical Compositions and Forms* [10]. This sub-group has proposed several new Pb-free solder alloys that deviate from the international norms, among them various SnAgCu alloys that include the addition of Rare Earth elements such as Cerium. Though these new solder alloy standards are not currently mandatory for products sold or manufactured in China, the fact that they are being proposed warrants some attention. Such a requirement would represent a historically unusual regulatory intervention into the realm of engineering materials selection. The near total lack of industry data on product reliability and manufacturing process performance with these particular new alloys is of utmost concern.

While discussion is on-going among the solder industry on the potential adoption of the China solder standards for China production, there is a clear preference to instead rely on the traditional development of industrial process and product trials to ultimately arrive at the optimum material set for any given application. For the near term, or until experimental data indicates otherwise, the international community prefers that multinational companies operating in China continue to use the more widely accepted near-eutectic SnAgCu solder alloys for lead free assemblies.

PRODUCT CATALOGUE

Article 18 of the MII Management Methods regulation specifies that a Product Catalogue will be defined that lists all affected EIP products, the categories of toxic substances restricted for use, and the timeline for any restrictions. The specific products that will be included in the catalogue are still being determined. Current indications are that the initial focus of the Product Catalogue will be on consumer products and not high reliability electronic applications.

An important point to note here is that all other EIP products that are not contained within the catalogue still must meet the other requirements set out by the MII Management Methods regulation. Labeling, packaging declarations, and customs inspections for imported products will still apply, regardless of whether the product is listed in the catalogue.

To date, a draft of the Product Catalogue has not been released. The original release date was slated for December 2005, but has since been delayed to July 2006. Once released, there will be a grace period given prior to its enforcement although there is still much uncertainly regarding the length of time that will be allowed. Once released, the catalogue is expected to be reviewed on an annual basis and updated as technical advancements allow. In the long term, it is anticipated that the number of listed products will be systematically increased as technology permits.

CERTIFICATION REQUIREMENTS

Article 19 of the MII Management Methods regulation indicates that mandatory certification testing will be required for EIP products listed within the catalogue. The CNCA (National Certification and Accreditation Administration) under the AQSIQ is entrusted by the Management Method to be responsible for this mandatory certification. It is also responsible for China's "CCC mark" certification and other certification management issues. It is expected that all EIP products listed within the catalogue would have to be granted a certificate of compliance based on the allowable maximum concentration values and tested according to approved hazardous materials testing standards; either the MII testing standard or AQSIQ testing standards.

All certification testing and issued certificates of compliance will need to be conducted using pre-selected (and approved) Chinese laboratories. At present there are (18) laboratories approved by the AQSIQ to provide analytical testing services for products to be exported to the EU market. The AQSIQ is expected to prepare compulsory certification methods in parallel with the MII preparation of the product catalogue.

DIFFERENCES BETWEEN EUROPEAN AND CHINESE REGULATIONS

When comparing the European Union RoHS and the Chinese environmental directives for electronic products, key differences emerge. It is critical for companies operating within the global electronics industry to understand these differences and incorporate them into their corporate compliance plans and implementation.

Several key differences between these two regulatory approaches have been identified. These regulatory distinctions need to be actively managed within all global electronics manufacturing supply chains.

1. **Responsible Parties and Penalties**. According to the EU regulatory approach, the 'producer' (who sells EEE to the final consumer under its own brand name) bears responsibility for enforcing RoHS compliance back through its supply chain. The China legislation expands the scope and responsibility of product compliance to a broader cross-section of the supply chain. Producers, distributors, and dealers can all be held responsible. Neither the EU or China have formally identified the penalties of non-compliance. For most businesses, the anticipated penalty is not perceived as an undue business risk. The simple loss of revenue associated with confiscated product shipments is sufficient motivation for maintaining verifiable compliance.

2. **Environmental Protection Use Period**. China environmental legislation requires the producer to mark their electronic products with a safe environmental protection use period. EU legislation has no such requirement. Although the MII Method Law provides a definition for this use period, the industry still lacks practical instruction on how to obtain evidence necessary to establish the safe use period for any given product.

3. **Compliant Product Catalogue**. The EU RoHS directive provides only a general list of affected products and applications via its predecessor WEEE directive, Annex 1B [2]. China legislation will provide a detailed product catalogue that lists all EIP products subject to MII hazardous substance restrictions. EIP products currently exempted from the EU RoHS directive such as medical devices and spare parts, will nonetheless have to comply with China marking, inspection, and certification requirements, if they are to be sold in China.

4. **Compliant Product Review Periods**. European Union legislation specifies that technical reviews of current exemptions to specific RoHS requirements will be held once every four years. China legislation has indicated that reviews of the product catalogue content will be conducted annually. This interval is short relative to the product development cycle for more complex electronic products. As such, there is some industry concern that changes to the product catalogue may leave insufficient time to react in the marketplace. Companies will therefore need to proactively advocate their position regarding pressing technical challenges to the MII on an ongoing basis. According to the MII, the annual review will be carried out pursuant to actual conditions and relevant technological development. [Article 18 of Management Methods] This could mean that MII will not necessarily undertake catalogue amendments each year if technological advancements do not warrant.

5. **Mandatory Product Compliance Testing**. Certification of environmental product compliance within the EU RoHS framework is established through self declaration. The act of placing an EEE product on the market in any EU member state is presumed under the law to be a declaration of RoHS compliance by the producer. If any governing authority challenges that claim, the producer is expected to provide sufficient documentation to support their claim of compliance. In contrast, Chinese environmental regulation stipulates mandatory analytical testing to verify compliance prior to product sale within China. All EIP products listed in the product catalogue must be tested for compliance before being allowed to enter the market. A mandatory compliance certificate from Chinese state authorities is a "must have" for a product being placed on the market or entering the country.

6. **Compliance Testing Standards**. The EU has chosen not to establish RoHS compliance through mandated analytical testing–they are instead resorting to substance testing only as a final arbitration for those products not demonstrating adequate documentation of compliance. As such, the EU has placed little emphasis on defining laboratory compliance testing protocols. Under Chinese regulation on the other hand, mandatory compliance testing is the basis for ensuring product compliance, thus well developed testing protocols are now in development.

7. **Labeling Requirements**. While the European WEEE directive does require a simple wheeled dustbin icon to be marked on all applicable products, the companion EU RoHS directive has no labeling requirements for either products or product packaging. The MII Methods regulations on the other hand include several labeling requirements applicable to all EIP. These include the Environmental Protection Use Period, the restricted substances content relative to the appropriate MCV, the packaging material identification and finally the appropriate China recycling label.

Other potential differences may yet arise as the MII works to finalize the full scope of environmental product regulations necessary to support China government directives. Of particular interest will be the approach taken with regard to manufacturing standards and processes. While the EU and its member states have to date avoided regulatory intervention into the manufacturing and materials engineering required to achieve product compliance, China has alternately considered the implementation of specific assembly materials 'standards' to be used in the manufacture of compliant products.

INDUSTRY ISSUES AND IMPACTS

Overriding industry concerns regarding global environmental regulations for electronic products reside not so much with the existence of such regulations—most multinational companies recognize the need for sustainable development and support the environmental goals of such efforts—but with the implementation details of these regulations. First and foremost, industry concerns arise from different regulatory requirements being issued from various governing bodies around the world. Second is the lack of timely issuance of unambiguous regulation (timely in the context of allowing realistic response times relative to normal product development cycles).

Motivations for regulatory convergence in the global electronics industry are manifold. Geographic differences in restricted substances would drive regional versions of products. This in turn requires multiple manufacturing processes and creates otherwise unnecessary inventory control challenges associated with multiple versions of various product part numbers and perhaps a variety of component part numbers in manufacturing as well. It restricts the ability to reroute excess product inventory around the globe to manage local supply discrepancies and increases inventory costs. Servicing several different requirements for a given product line ultimately diminishes the economies of scale that typically derive from the horizontally integrated electronics manufacturing infrastructure. Similarly, differences in substance reporting requirements drive additional IT infrastructure to manage additional data collection, storage, and retrieval capability. Overall, managing unique regional environmental regulations is simply not cost effective.

The general rule is therefore that the most stringent product environmental regulations from among all target markets will prevail. Global companies in general can't justify the additional expense of managing products and production based on geography of sale. Products must be designed and manufactured to the most restrictive regulations in order to sell a common product to all markets.

The need for manageable regulatory implementation schedules is a common industry complaint as well. New environmental product regulation almost invariably requires the redefinition of a product, a constituent material, an internal component or a manufacturing process. Such changes require product development and qualification at the producer or at an upstream supplier or both. In some instances, a new regulation may force the obsolescence of an existing product altogether and the acceleration of a new product in the development pipeline. In all cases, there is a measurable and justifiable time interval required to respond to any new regulatory requirement. That required time interval understandably varies with the significance of the regulatory change and the complexity of the product.

With regard to the issuance of pending China regulations, of most pressing industry concerns for timely notification are the formal publication of the first Product Catalogue and the issue of detailed guidelines to determine the Environment Protection Use Period. Since the MII restricted substances and threshold values are the same as those required by EU RoHS, of most urgency is simply the need to know whether any products that are currently entitled to an exemption under RoHS regulation will be included the MII Product Catalogue. Inclusion would demand additional substance restriction (Pb solder elimination) and redefinition of the product and manufacturing processes relative to current EU exempt versions. A substantial grace period (now also undefined) may be necessary to address this situation.

The Environmental Protection Use Period required by the MII Methods regulation is another example of a novel regulatory requirement that will require industry lead time to adopt. Fundamentally, this regulation requires producers to stipulate an expected product lifetime for compliant (Pb-free) product, and yet the industry has effectively no field experience with such product.

The concern for inadequate response time to regulatory changes is exacerbated when the various sources of worldwide product regulation are considered. While any single regulatory agency may provide sufficiently generous implementation schedules to achieve product compliance within a typical development cycle, if another geographic region or country issues more restrictive regulations mid-cycle then the product definition must be redirected mid-stream to meet the new, more stringent, 'standard' – a costly proposition, in terms of both development resources and time to market.

For each of these fundamental industry concerns: global regulatory convergence and regulation timing consistent with product development cycles, the best approach may simply be active engagement of affected companies with the regulatory process. Companies and industry trade groups must be willing to negotiate regulatory details in good faith, staying cognizant of the underlying environmental objectives. Regulatory agencies must also be willing to seek out and accept industry input on key technical and logistical questions.

SUMMARY

The clear message for electronics producers and manufacturers is the worldwide groundswell of support for imposing regulatory restrictions on electronics products in the interest of minimizing environmental impact. Such restrictions are with the electronics industry to stay and will continue to evolve as time goes on.

Of critical industry concern though, is the necessity for global convergence on regulatory approaches to this environmental stewardship. The global nature of the electronics manufacturing supply chain requires that common solutions be available to meet all regulatory requirements. Achieving such convergence requires vigilance by affected companies and industry groups as well as proactive engagement with various regulatory bodies in all geographies. For large multinational corporations, this may take the form of direct representation with various country regulatory agencies. For smaller companies however, it may simply mean active participation with industry trade groups who would subsequently represent their composite interests in direct lobbying efforts.

Successful implementation of global efforts to minimize the use of hazardous substances in electronic products can be achieved without undue economic impact to the industry, but only through active industry collaboration and worldwide regulatory cooperation.

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AUTHORS' NOTE

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This article identifies some of the authors' insights into the practicalities of addressing China's MII Methods Law. Of course, regulations are still unfolding and subject to change. There are several interpretation and implementation issues yet to be resolved. In short, much remains to be learned, and it may be necessary to modify many of the insights identified in this article over time, as more knowledge is gained. In addition, these insights are offered in an effort to further discussion on the issues at hand, and not to instruct others on how they should best address those issues.

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