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Highlights from 2007 iNEMI Environmental Roadmap

Bob Pfahl, iNEMI

Celestica-iNEMI Technology Forum

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2007 ECE Roadmap Focus Areas

To remain competitive, the electronics industry must continue to keep pace with emerging:

- **material restrictions,**
- **end-of life requirements,**
- **customer preferences for energy efficient products,**
- **holistic design requirements.**

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To remain competitive, the electronics industry must continue to keep pace with emerging:

- **material restrictions,**
- **end-of life requirements,**
- **customer preferences for energy efficient products,**
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While meeting increasing reliability requirements:

- **many electronic materials will change over the next decade to meet performance & reliability requirements.**

Strategic Issues from ECE Roadmap

1. **To minimize supply chain chaos and reduce the need to manufacture region-specific products it is critical that emerging international requirements of a given topic do not substantially differ in scope. Harmonization through international standardization is essential. It is equally important that industry harmonize its technical responses.**

2. **The area of Corporate Social Responsibility (CSR) is being driven by multiple factors, including globalization of the world economy, the failure of firms to effectively police themselves and the ability of the Internet to provide almost instant access to information. With environment as one of the pillars of CSR and an area of increasing global concern, there will be increasing need to demonstrate that a firm is actively engaged.**

Strategic Issues from ECE Roadmap

An increasing need to influence & optimize the global regulatory process:

1. **Set regulatory goals that allow flexible compliance strategies**
   - **Recognize diversity of products & business operations**
2. **Support harmonized international standards**
   - **Standards effectively preserve regulatory objectives**
   - **Can be integrated efficiently across different business models and extended supply chains**
   - **Ensures the benefits of technology reach consumers & the community in the most efficient way**

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Pb-free Conversion: Current Situation

- *High Volume Market has converted*
- *High Rel. Market has not converted*

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Industry Readiness

- 9 of 11 telecommunications OEMs polled took Pb-free exemption for solder In network infrastructure equipment.
- A dual component supply chain has resulted:
  - Pb-free components for high volume consumer market
  - Traditional SnPb components for
    - Telecommunications
    - Servers
    - Military products
    - Medical electronics
- Reliability of Pb-Free components with eutectic solder has not been fully demonstrated for long life products.
- Some telecom service providers are now demanding that mission critical equipment remain with SnPb solder.
- Suppliers are not motivated to provide traditional components to small high reliability market.

iNEMI High Reliability Task Group

Objectives

- **Gain a common understanding of the supply chain challenges facing high reliability OEMs/EMS providers who are:**
  - **Taking Pb exemption (e.g. telecom switching, high end servers, etc.)**
  - **Out of scope of RoHS (e.g. measurement equipment, medical)**
- **Share experiences between OEMs/EMS providers on current state of supply base.**
- **Define the gaps and that this Pb-free move leaves for the high reliability products.**
- **Influence supply base to meet ongoing needs of these industry segments.**
- **Understand impact of high volume (consumer product) transition to Pb-free components and assembly.**

Key Take-a-way's iNEMI BGA Workshop*

- Emphasis has been put on RoHS conversion - supply base still surprised that there are significant ongoing needs for SnPb BGAs.
- More education is needed on the unique characteristics of high rel. product lifecycles:
  - High development costs,
  - Long product availability window,
  - Decades of support.
- More consensus and education is needed on remaining knowledge gaps and what must be done to reduce risk.
- The high rel. users have enjoyed the technology, availability, and low cost of consumer driven components:
  - Would like to continue to do so!
  - Staying with SnPb BGAs is moving them away from this paradigm.
- Suppliers are treating SnPb BGAs as custom parts:
  - Limited competition,
  - Limited availability,
  - Less favorable pricing.
- Military and aerospace position (SnPb forever!) is especially problematic.

* iNEMI BGA Workshop, March 1, 2007, at HP in Cupertino

Scenarios

- **Long term solution is to reduce reliability risk of Pb-free components and assembly.**
  - **The economic incentive is compelling**
  - **Well worth technology investment**
  - **Could take several years to complete but this is cumulative, so strides made today are useable.**
- **What can we do in the short term to help encourage the availability of SnPb compatible BGAs?**
- **What can we do in the mid term to close remaining knowledge gaps that the High Rel. segments face?**
- **What can be done longer term to better understand and predict reliability of electronics hardware using Pb-free components and assembly?**

Additional Issues

- **Proliferation of Pb-free metallurgies is significantly complicating the issue of closing knowledge gaps!**
  - **Major issue today with BGA sphere and wave solder**
  - **Surface mount is mainly SAC 305 but supply base is proposing new alloys**
  - **Alloys behave differently**
  - **Can effect form/fit/function**
    - **supplier A part does not behave like supplier B part in mfg. and/or use.**
  - **Users are demanding new part numbers from their suppliers**
- **Transition in reliability concerns**
  - **Initial concerns with SAC alloys were thermal cycling**
  - **Current concern is mechanical failure.**

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Next Steps Beyond RoHS

iNEMI-IPC "Life After EU RoHS" Forum

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Objectives of the Forum

- **Provide a broad overview of the evolving regulatory environment, including the current status of, and issues relating to, the emerging environmental regulations that the electronics industry is preparing for:**
  - **China RoHS**
  - **EU REACH**
  - **EU EuP**
  - **Other environmental regulations (e.g., state laws in the United States)**
- **Share information about industry efforts underway:**
  - **Policy monitoring**
  - **Policy advocacy**
- **Identify gaps that remain to be closed:**
  - **Policy**
  - **Technology**
  - **Identify potential new efforts to close the identified gaps**

Meeting Format

- **Global overview and European regulations (RoHS,EuP,REACH)**
  - **JP Brisson, Allen & Overy**
- **China RoHS**
  - **Tom Valliere, Design Chain Associates**
- **North & South American regulations**
  - **Fern Abrams, IPC**
- **iNEMI proactive approach**
  - **Bob Pfahl, iNEMI**
- **Panel discussion**
  - **All speakers**

Conclusions from Forum

- There are no new major technology challenges from **China RoHS**.
  - Six substances restricted in China RoHS are common with EU RoHS (as well as concentration values).
  - Mandatory government testing is anticipated for China RoHS (no self declarations).
  - China RoHS mandates unique product marking, product information and packaging labeling.
  - Currently no exemptions for China RoHS – but the restrictions only apply to product placed in the catalogue (TBD – but marking, information and packaging labeling required for ALL products).
- **EU Reach** will have a major impact on material suppliers, limited impact on OEMs
- OEMs are aware of and working **EU EuP** requirements
- Biggest new challenge facing supply chain beyond RoHS is the proliferation of green programs from OEMs, many of which are establishing unique requirements to differentiate their products and services. These programs continue to drive the discussion around the needs for greater materials content data.

“RoHS” Timelines

China RoHS

Start **March 1, 2007**

1st Phase: Labeling and content disclosure for hazardous substances

2nd Phase: Restrictions for hazardous substances in selected products (Key Product Catalogue) (start ?)

EU RoHS

Start **July 1, 2006**

Only RoHS compliant products are allowed to be put on the market

Source: J. Müller, China SMT Forum 2007

Implementation of “RoHS”: Marking

China RoHS

Marking requirements accordingly to SJ/T11363-2006 resp.

- Kind and location of hazardous substances
- „Safety Period“ (EFUP) and production date
- Packaging materials accordingly to GB 18455-2001
- Information on recyclability

EU RoHS

No legal requirements for marking, but for communication in the supply chain often applied (many different labels)

Source: J. Müller, China SMT Forum 2007

Scope

China RoHS

- for all in China produced and imported Electronic Information Products EIPs (intermediates and final products); only for a selected part („Key Product Catalogue“) in a 2nd phase substance bans will take effect,
- for the production of EIPs,
- for packaging materials of EIPs.

EU RoHS (= substance bans)

- new EEE (final products) falling under the categories set out in Annex 1A of WEEE directive with exemptions in dependence of scientific and technical progress

Source: J. Müller, China SMT Forum 2007

And Next ... South-Korean WEEE/RoHS/ELV

- "The Act for Resource Recycling of Electrical/Electronic Products and Automobiles" was passed on April 2, 2007
- In force: January 1, 2008
- Scope: Electronic products and automotive electronics
- Targets: Improve recycling and reuse,
  avoid/reduce dangerous substances
  (dirty six and exemptions like EU RoHS)
  Promote DfE/DfR
- Implementation: Declaration of material contents for checks
  Recycling information for all products in scope
  Monitoring via selected laboratories
- English translation (unofficial)
  http://www.kece.eu/data/Korea_RoHS_ELV_April_2007_EcoFrontier.pdf

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Proactive Evaluation of Alternative Flame Retardants

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Proactive Programs

"Industry should take a proactive approach, work with stakeholders, and direct our activities where there is technical/ecological evidence we could and should be doing a better job to protect the environment. We should involve stakeholders in the process of evaluating alternative technologies to determine trade-offs between product functionality, environmental impact, reliability, safety, and cost." Bob Pfahl/Joe Johnson

Bromine Free Substrates

- **Participants:**
  - **US EPA**
  - **Electronics industry through iNEMI**
  - **Other stakeholders including NGOs**
- **Environmental Objective**
  - **Evaluate environmental risk of brominated and alternative flame retardants in PWB substrates**
- **Unique Characteristics**
  - **Industry-led proactive study to evaluate:**
    - **The technology risks of alternatives**
  - **EPA lead partnership to evaluate:**
    - **The environmental risks**

iNEMI Halogen-Free Project

Project Objectives:

- **Build on industry knowledge and capability,**
- **Consider unique market segment requirements,**
- **Identify technology readiness and gaps,**
- **Stimulate supply capability, and**
- **Recommend standards development opportunities**

Anticipated Outcomes

1. **Define electrical performance requirements based on market segment application**

2. **Validate electrical and mechanical properties**
   - **Loss tangent and Dk modeling over required range of signal speed**
   - **Mechanical performance validation for lead free assembly**

3. **Validate material supplier and PWB manufacturer infrastructure capability**

4. **Estimate costs – volume market leader for new material may not achieve cost parity with best-in-class FR4**

The iNEMI Project Part Is / Is Not

This Project IS	This Project Is NOT
Technical evaluation of key electrical and mechanical properties	EHS assessment
Focused on those attributes which are of most value to supply chain.	Biased towards specific laminate suppliers, geographies, or market segments.
Build on learning from prior investigations	Repeat of prior work
Recommendations for standards development or further investigation	Standard Development
Focused on circuit board	Electronic components, Cables

US EPA Design for Environment Program: Alternatives Assessment of Flame Retardants for Electronics Industry

- **Goal: To identify and evaluate commercially available flame retardants and their environmental, human health and safety and environmental fate aspects in FR-4 printed circuit boards.**
- **Scope: The partnership will incorporate life-cycle thinking into the project as it explores the potential hazards associated with flame retardants and potential exposures throughout the life cycle of flame retardants as used in FR-4 printed circuit boards. As appropriate, the scope will include aspects of the life cycle where public and occupational exposures could occur. For example, consideration of exposures from incineration or burning at the end of life will be included, as will exposures from manufacturing and use.**

Project Is / Is Not:

This Project IS	This Project Is NOT
An EHS assessment of both halogenated and halogen-free materials	Technical evaluation of key electrical and mechanical properties of halogenated and halogen-free materials (iNEMI project)
Assessment of environmental and human health endpoints (environmental endpoints include ecotoxicity, fate and transport)	Comprehensive environmental or human health risk assessment
Based on sound science	
Voluntary	Regulatory
Multi-Stakeholder Partnership	

Participants and Roles

EPA is encouraging the participation of individuals from different disciplines & interests to contribute on a range of tasks.

- **Participants to date include:**
  - **OEMs (environmental & product safety representation) and trade associations**
  - **Component and board manufacturers**
  - **Chemical companies (raw material suppliers, flame retardant suppliers, etc) and trade associations**
  - **NGOs – environmental groups, worker unions**
  - **Standards organizations**
  - **Universities**
  - **Governments – US EPA and Sweden KemI**
- **Other participants could include:**
  - **Federal governments**
  - **State governments**
  - **Local governments**
  - **Other national governments**
  - **Electronics recyclers**
  - **Public interest groups**

Summary of Proactive Approach

- **Search for environmentally benign alternatives should be based on good science and technology.**
- **Technology and business risks and the impacts of original process/materials and alternatives should be evaluated prior to legislative action.**
- **Voluntary programs have been effective in the electronics industry.**
- **Stakeholders should be involved in the process from the beginning (both within the firm and within the community).**

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Summary and Conclusions

- *Roadmapping the Industry Needs*
- *Closing the Gaps through Projects*

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Facts/Challenges to the Industry

- **Electronic materials will continue to be modified:**
  - **Reliability verification of these changes is <u>crucial.</u>**
- **Consumer electronics drive the cost and the market:**
  - **High rel. market must develop a viable scenario to:**
    - **Take advantage of consumer components,**
    - **Meet their reliability requirements.**
- **Firms are expected to be socially responsible:**
  - **Industry must establish proactive, science-based programs to address potential environmental risks.**
  - **Stakeholders must be involved in the process from the beginning!**

www.inemi.org

Email contacts:

Jim McElroy

jmcelroy@inemi.org

Bob Pfahl

bob.pfahl@inemi.org

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