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**The Evolving
Direction for
Environmental
Programs in the
Electronics Industry**

***Bob Pfahl
SPJW
January 25, 2010***

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Outline

- **Overview**
- **Past Activities**
- **Today**
- **The Future**
- **Conclusions**

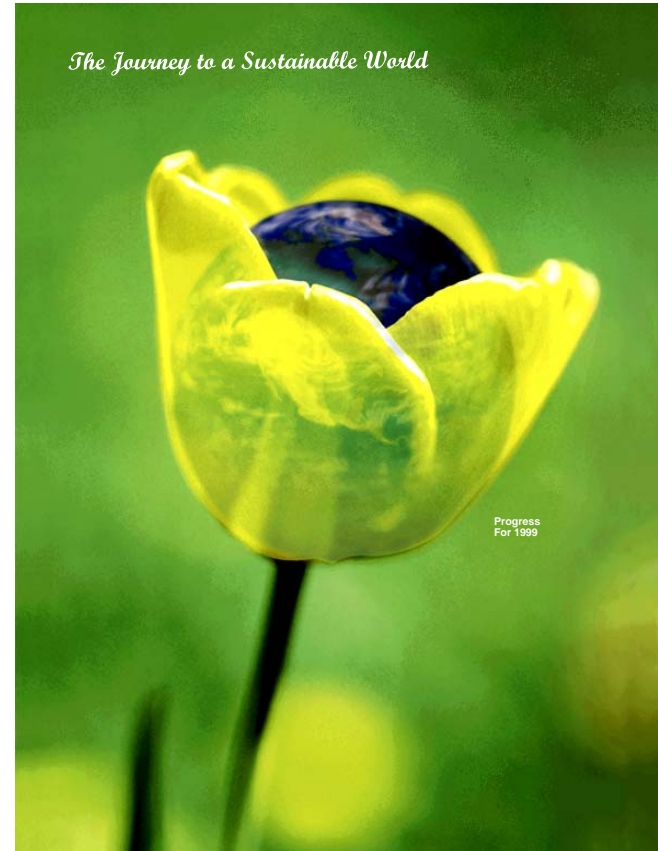
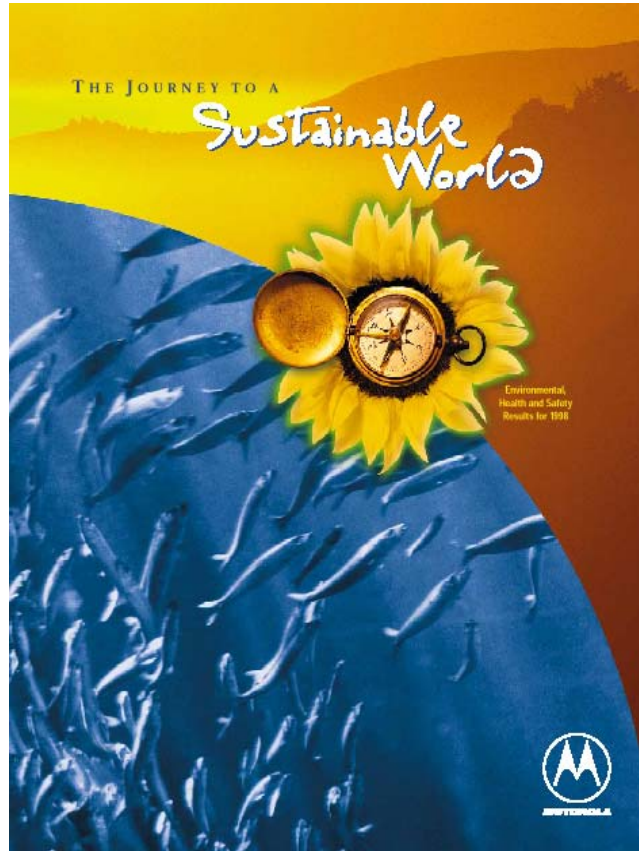


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Overview:
*From a 2001
Presentation*

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Environmentally Preferred Electronic Products for the Global Market



Dr. Robert C. Pfahl

**Director of Environmental Technology
Motorola Advanced Technology Center
Schaumburg, IL**

Environmental Performance Drivers

- **Societal Concerns**
 - Sustainability
 - Global Warming
 - Pollution
- **Societal Responses**
 - Public Policy
 - Consumer Action
- **Regional Differences**

Environmentally Preferred Product Attributes

- Are Highly Recyclable
- Use Non-Hazardous Materials
- Minimize Use of Energy
- Minimize Use of Matter



1983
First Portable
Cellular Phone
DynaTAC



1996
First Wearable
Cellular Phone
StarTAC



1999

iNEMI Environmentally Conscious Electronics (ECE) Roadmap

Since 1996 iNEMI has proactively roadmapped the technology needs to produce Environmentally Conscious Electronics

2009 ECE Roadmap Focus Areas:

- **Materials**
- **Energy**
- **Recycling/Reuse**
- **Eco-Design**
- **Sustainability**



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Past Activities: Elimination of Hazardous Materials

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Elimination of Hazardous Materials

- **Elimination of CFCs for Cleaning Electronics**
 - Measurable Impact on the Environment
 - ICOLP
 - 1990-1995
- **Elimination of Pb in Electronics**
 - European Legislation
 - iNEMI, NIST, and others
 - 1998-2006-2012
- **Elimination of Halogenated Flame Retardants & PVC**
 - Japanese Firms, iNEMI
 - 1998-2015?

Transition to Pb-free Assembly

- **1998 iNEMI Roadmap Identified the Gap**
- **Phase I Project developed the alloy, process, components and reliability from 1999-2002**
- **Phase II Project expanded the technology base to include rework, wave-soldering, and reliability of lead finishes**
- **Phase III Project teams addressed these supply chain transition issues identified in the 2002 Roadmap**
- **Phase IV Projects worked to optimize and standardize manufacturing processes and communication processes**
- **Phase V Projects addressed the needs for High Reliability Products**

Results:

- **The iNEMI efforts accelerated the establishment of SAC alloys as the standard and reduced the effort in the industry to reach a compatible solution.**



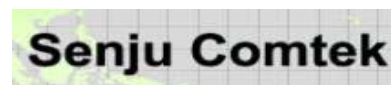
Transition to HFR-free Assembly

- 1998 Roadmap Identified the Gap
- 1999-2007 Japanese Suppliers Developed BFR-free laminates used in select applications
- 2007 US EPA and iNEMI began linked programs to evaluate the technical & environmental readiness of BFR-free laminates
- 2008 Recognition that industry needed to be proactive:
 - Develop technology for >0.1 inch boards
 - Develop BFR-free technology to meet next generation electrical and mechanical requirements
- 2009 Establishment of project for alternatives to PVC
- 2009 Release of iNEMI Position on “Low Halogen”

“Low Halogen” (“BFR/CFR/PVC-Free”) iNEMI Position Statement

- All printed board and substrate laminates shall meet Br and Cl requirements for low halogen as defined in IEC 61249-2-21 and IPC-4101B

The maximum total halogens contained in the resin plus reinforcement matrix is 1500 ppm with maximum chlorine of 900 ppm and maximum bromine being 900 ppm.
- For components other than printed board and substrate laminates: Each plastic within the component contains < 1000 ppm (0.1%) of bromine [if the Br source is from BFRs] and < 1000 ppm (0.1%) of chlorine [if the Cl source is from CFRs or PVC or PVC copolymers].





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Today:
*Transition from
Materials to
Proactive
Programs on
Energy &
Sustainability*

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Materials

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Materials

Short Term Needs - Identified in 2009 Roadmap

- **A strategy and action plan to facilitate low risk conversion of high-reliability applications to Pb-Free solders**
- **Prepare for possibility of additional substance restrictions under RoHS and/or REACH (HBCDD, phthalates)**
- **Proactive programs to convert to halogenated flame retardant (HFR) - free and PVC-free material alternatives**

Technology Challenges of HFR-Free

- **Mechanical Properties**

- HF materials are ~10% stiffer (8 layer .062” board)
- **Lower mechanical stress limits**
 - HF has ~20% worse cold ball pull performance
 - Increased tendency for pad cratering
 - higher rework risk

- **Electrical Properties**

- HF materials have broader range of Permittivity (Dk) values
 - Reduced margins for high speed busses
 - Especially critical for next generation (e.g. DDR3)

HFR-Free Leadership Program

22 Global Firms



DELPHI



FLEXTRONICS



Elec & Eltek 依利安達



Electronic Materials





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Energy

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The Big Picture

Climate/ Energy Example



How do we get the facts and data?

- Standardized Product Lifecycle Assessment
- Identifies opportunities & issues
- Allows identifying what counts most

Global CO2 Emissions

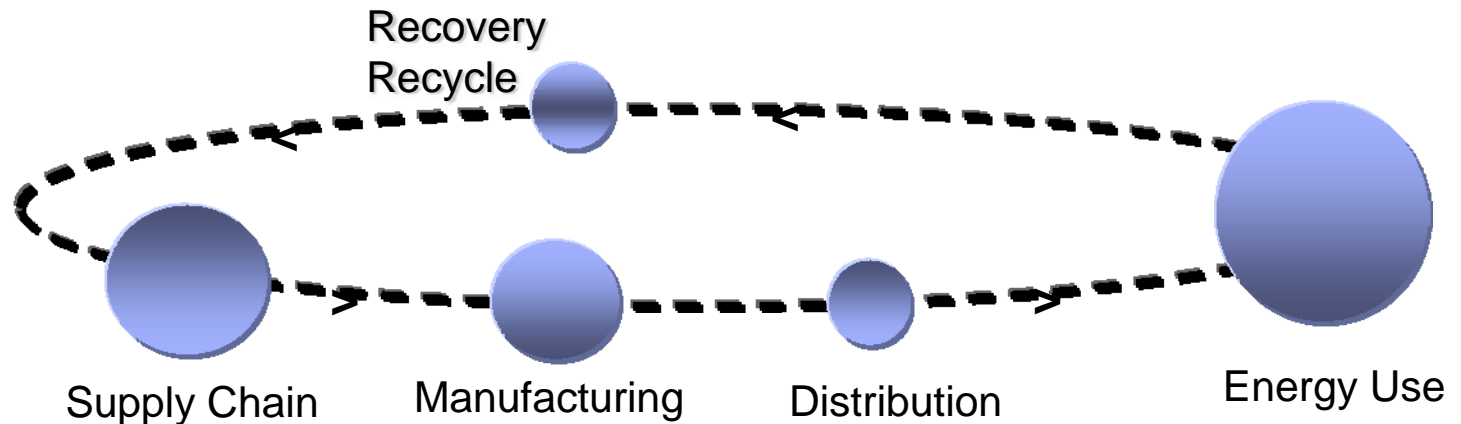
~ 40 Billion tonnes

~2%

ICT Sector
~ 850 Mil tonnes

PC Sector

~ 320 Mil tonnes



Sources: Smart 2020 Report 2008; IDC; Gartner





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Sustainability

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Sustainability Requires Balancing Competing Objectives

- **Environmental Regulations do not always lead to sustainability**
 - **Legislating the use of corn based ethanol in automobile fuels without considering environmental, social and economic impacts**
 - **Legislating the use of Compact Fluorescent Lamps without requiring the development of a recycling infrastructure for the mercury in the lamps.**

Sustainability

Electronics as solution to climate change

- Smart city planning
- Smart buildings
- Smart appliances
- Dematerialization
- Smart industry
- I-optimization
- Smart grid
- Integrated renewables
- Smart work
- Intelligent transport

Potential Impact: Reduction of 1 billion tons of Green House Gas emissions.





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Future Thrust

*Becoming more
proactive in our
environmental
collaboration*

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Sustainability Summit

“The electronics industry must develop a strategic vision of sustainable electronics” iNEMI BoD

- iNEMI held a Sustainability Summit, September 22-23, 2008 at Motorola, Schaumburg, Illinois, USA
- Motivation for the workshop was a recognition that the electronics industry should act strategically on environmental issues. The workshop featured:
 - Industry and Academic Speakers covering 6 areas of interest
 - Breakout Groups to brainstorm options and priorities
 - Action Groups on selected topics proposed.
- The goals of the workshop were to:
 - Evaluate opportunities for industry collaboration on proactive environmental programs.
 - Form and execute the required industrial collaborative programs.
 - Define academic research needs to support these programs.
 - Stimulate funding for the necessary research.

iNEMI Environmental Forums

“The electronics industry must develop a strategic vision of sustainable electronics” iNEMI Board of Directors

- **“iNEMI Sustainability Summit”, September 22-23, 2008, Motorola, Schaumburg, Illinois, USA**
- **“2008 Intel Forum on Environmentally Friendly Materials”, November 11-12, 2008, Shanghai, China**
- **“Environmental Leadership Forum” October 8, 2009; at SMTAI, San Diego, CA, USA**
- **“iNEMI-Intel Global ICT Environmental Initiatives”, October 27-28, 2009; Brussels, Belgium**

Results from Forums

- **Two LCA Projects Established**
 - Eco-Impact Evaluator for ICT Equipment
 - PVC Alternatives
 - LCA comparing PVC versus PVC-free cables
- **Five Initiatives Under Evaluation**
 - Develop market for postconsumer plastics as feedstock for “Green” products (ex. Polycarbonate, ABS)
 - Develop applications for post consumer blended plastics
 - BFR-Free Connectors
 - Increased Harmonization of Regulations
 - Develop Carbon Footprint metrics

iNEMI Product Carbon Footprint (PCF) Position Paper

- **iNEMI and many of its member companies recognize the significance of climate change and believe it is best to work collectively as an industry at multiple levels of the supply chain to address this challenge.**
- **iNEMI supports the development of robust PCF tools for the ICT industry which would enable consistent and comparable PCF calculations.**
- **This Position Paper will be published in the next several weeks.**

Summary of Future Thrusts

- **To produce environmentally-conscious electronics the industry must continue to keep pace with:**
 - Continuing emergence of material restrictions
 - Energy efficiency requirements and renewable energy
 - End-of life requirements
 - Holistic Eco-design requirements
 - Sustainable business practices
- **As many of these issues are shared by industry, it's best to work together!**



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Conclusions:

*The Journey to a
Sustainable World
has Just Begun*

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Concluding Thoughts

- **New global environmental requirements continue to multiply – faster than industry can effectively respond**
- **Industry needs to be more proactive in developing solutions that:**
 - **Are based on science and engineering, delivering value to customers**
 - **Are available in advance of new regulations**
 - **Can influence future regulations and stakeholder groups for more sustainable results**
- **iNEMI and its members plan to play a significant role in preparing industry for these future needs.**
- **Sustainability will be a major undertaking for industry as well as society.**
- **Electronic solutions can help to empower people to live a more sustainable lifestyle**



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