



INEMI

International Electronics Manufacturing Initiative

Environmentally Conscious Electronics (ECE) Roadmap

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Advancing manufacturing technology

ECE Roadmap/Technical Plan

- **Agenda**
 - What has changed
 - Summary ECE Gap Analysis and iNEMI project plans
 - Discuss future iNEMI projects & priorities



What has changed?

- With the original **RoHS implementation date past**, many of the previous gaps have been closed
 - **High reliability product exemption end dates** will drive additional activity
- **Rapidly developing legislation and voluntary environmental stewardship initiatives** are driving additional environmental activity
 - **Materials** - RoHS revision, REACH & regional requirements (China RoHS, CPSC, etc)
 - **Energy** - energy efficiency requirements (EuP, Energy Star, etc), certification & labeling requirements (S Korea, China, etc), product carbon footprint
 - **Recycling** – eco-label design for reuse/recycle criteria (EPEAT, TCO, etc), R&D in recycled content materials and design for reuse/recycle
 - **Eco-Design** – rapid interest in LCAs globally
- Industry is reactive, iNEMI needs to help its members become more **pro-active** with decisions based on sound science and environmentally beneficial practices



Summary of 2009 iNEMI ECE Roadmap

Roadmap Section	Gaps to Be Addressed	iNEMI Projects Addressing Gaps
Materials	<ol style="list-style-type: none"> 1. Pb-free conversion 2. BFR-free PCBs 3. PVC Alternatives for cables 	<ol style="list-style-type: none"> 1. 9 Pb-free projects, emphasis on high reliability applications 2. 3 BFR-free Laminate projects 3. PVC Alternatives Project
Energy	<ol style="list-style-type: none"> 1. Harmonization of energy regulations/standards 2. Emerging product carbon footprint initiatives 	New Product Carbon Footprint project proposed (next slide)
Recycling	<ol style="list-style-type: none"> 1. R&D for increasing recycled content in products 2. Product design for reuse/recycling 	Project proposed, prioritize in 2010
Eco-Design	<ol style="list-style-type: none"> 1. Building block approach to LCAs 	<ol style="list-style-type: none"> 1. Eco-Impact Evaluator Project

What Else Should We Address in iNEMI?



Product Carbon Footprint (PCF) Project – New Proposal

- **Phase 1 (publish by March 2010) – work with the iNEMI Eco-Impact Evaluator project team to develop an industry PCF white paper that would include:**
 - Overview of regulatory and market trends on PCF
 - IT as an enabler for the low carbon economy (SMART 2020 report, etc)
 - Generic LCA profiles for different product types (phones, PCs, servers, etc)
 - “Hot spot” analysis - what can we influence in the PCF based on the profiles? Links to existing programs like E-Star, 80 Plus, EICC/CDP, recycled content, etc that are already addressing these “hot spots” in our industry
 - Recommendations for future research, reference existing/new iNEMI projects. Identify leading universities for potential partnership for Phase 2-3.
- **Phase 2 (early/mid-2010)– conduct research on “hot spot” areas identified in Phase 1, develop multi-year recommendations/roadmap for industry to develop meaningful PCF metrics and improvement opportunities across the lifecycle:**
 - Raw materials (extraction to final assembly)
 - Logistics/transportation
 - Consumer use phase, including repair/upgrade
 - End-of-life management (reuse/recycle)
- **Phase 3 (late 2010/early 2011) - publish results in prominent journals/symposia and share with other trade groups that are active in governmental policy (e.g. ITI, Digital Europe, Tech America)**



Back-Up



Environmentally Conscious Electronics – 2009 Roadmap

Gaps

Materials

- Technical viability and supply chain readiness for Pb-free high reliability products – server, storage and networking equipment
- Technical viability and supply chain readiness for Pb-free high reliability products – medical, aerospace, test equipment
- Assess the technical viability of alternatives to HBCDD (a brominated flame retardant) and DEHP, BBP and DBP (phthalates) in electronic products
- Technical viability of alternatives to HFRs in printed circuit board laminates (iNEMI HFR Free Laminate project)
- Technical viability and environmental life cycle assessment (LCA) of alternatives to cables (iNEMI PVC Alternatives project)
- Development of standard scientific methodologies to assess true life cycle environmental impact of materials and potential trade-offs of alternatives

Energy

- Promotion of basic principles for effective energy efficiency requirements (TP7)
- Identify and position the supply chain for emerging product carbon footprint requirements, leverage existing activities where appropriate (EICC, GHG Protocol, CDP, etc)

Recycling

- Track evolving country/state legal recycling requirements (TP1)
- Establish a sustainable recycling infrastructure and technical qualification of recycled materials market for use in new products
- Identify product design features that will enable cost-effective, environmentally-responsible reuse/recycling (Basel, R2 guidelines, EPEAT, etc)
- Increased global communication and cooperation within industry regarding recycling challenges – such as use of materials that hinder efficiency or increases hazards of the recycling process (TP4)

	2009	2011	2013	2015	Need
Technical viability and supply chain readiness for Pb-free high reliability products – server, storage and networking equipment	[Yellow bar from 2009 to 2013, Green bar from 2013 to 2015]				R,O
Technical viability and supply chain readiness for Pb-free high reliability products – medical, aerospace, test equipment	[Yellow bar from 2009 to 2015]				R
Assess the technical viability of alternatives to HBCDD (a brominated flame retardant) and DEHP, BBP and DBP (phthalates) in electronic products	[Yellow bar from 2009 to 2011, Green bar from 2011 to 2015]				R,O
Technical viability of alternatives to HFRs in printed circuit board laminates (iNEMI HFR Free Laminate project)	[Yellow bar from 2009 to 2015]				R
Technical viability and environmental life cycle assessment (LCA) of alternatives to cables (iNEMI PVC Alternatives project)	[Red bar from 2009 to 2011, Yellow bar from 2011 to 2015]				S,R
Development of standard scientific methodologies to assess true life cycle environmental impact of materials and potential trade-offs of alternatives	[Yellow bar from 2009 to 2011, Green bar from 2011 to 2015]				S
Promotion of basic principles for effective energy efficiency requirements (TP7)	[Yellow bar from 2009 to 2015]				X
Identify and position the supply chain for emerging product carbon footprint requirements, leverage existing activities where appropriate (EICC, GHG Protocol, CDP, etc)	[Yellow bar from 2009 to 2011, Green bar from 2011 to 2015]				X
Track evolving country/state legal recycling requirements (TP1)	[Yellow bar from 2009 to 2015]				R
Establish a sustainable recycling infrastructure and technical qualification of recycled materials market for use in new products	[Yellow bar from 2009 to 2011, Green bar from 2011 to 2015]				R,O
Identify product design features that will enable cost-effective, environmentally-responsible reuse/recycling (Basel, R2 guidelines, EPEAT, etc)	[Yellow bar from 2009 to 2015]				X
Increased global communication and cooperation within industry regarding recycling challenges – such as use of materials that hinder efficiency or increases hazards of the recycling process (TP4)	[Yellow bar from 2009 to 2015]				

Green = No Gap Issues or Resolved

Yellow = Known Gap Mitigation Techniques

Red = No Known Solution – Development Required

iNEMI
R = Research
O = Optimization

S = Standard

X = No Action/Outsource

Environmentally Conscious Electronics – 2009 Roadmap (continued)

Gaps

2009	2011	2013	2015	Need
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Design

- Develop building block approach to LCAs in IT industry (iNEMI Eco-Impact Evaluator Project)
- Develop international green procurement standards (TP1)



R
S

Green = No Gap Issues or Resolved

Yellow = Known Gap Mitigation Techniques

Red = No Known Solution – Development Required

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Environmentally Conscious Electronics Implementation Plan -2009

<p>DRIVERS</p> <ul style="list-style-type: none"> - Legislative/Regulatory - Market Competitiveness - Sustainable Development - Customer Requirements 			
<p>ATTRIBUTES</p> <p>Elimination of materials of Concern Information Management Legislative Knowledge End-of-life Recycling Energy Efficiency Product marking Substance Bans (RoHS 1.0) Recycling Targets Waste Minimization Recycled Content</p>	<p>ATTRIBUTES</p> <p>Elimination of materials of Concern Information Management Legislative Knowledge End-of-life Recycling Energy Efficiency Product marking Substance Bans Recycling Targets Waste Minimization Recycled Content Lifecycle Analysis</p>	<p>ATTRIBUTES</p> <p>Elimination of materials of Concern Information Management Legislative Knowledge End-of-life Recycling Energy Efficiency Product marking Substance Bans (RoHS 2.0) Recycling Targets Waste Minimization Recycled Content Lifecycle Analysis Lifecycle cost models Halogen Free Laminates/Components Substance Alternates</p>	<p>ATTRIBUTES</p> <p>Elimination of materials of Concern Information Management Legislative Knowledge End-of-life Recycling Energy Efficiency Product marking Substance Bans Recycling Targets Waste Minimization Recycled Content Lifecycle Analysis Lifecycle cost models Halogen Free Laminates Substance Alternates Energy Efficiency/Reporting Dematerialization New separation tech's Recycled materials market Designer tools/legislation</p>
<p>DEPLOYED TECHNOLOGY</p> <p>Design tradeoffs for DfE Halogen free laminates</p>	<p>DEPLOYED TECHNOLOGY</p> <p>LCA Early Adopters Life Cycle Cost Models Halogen Free Laminates Substance Alternates</p>	<p>DEPLOYED TECHNOLOGY</p> <p>Dematerialization New separation technologies Energy efficiency/Reporting Recycled materials market Designer tools/legislation</p>	<p>DEPLOYED TECHNOLOGY</p> <p>ESM Standards</p>
<p>RESEARCH AND DEVELOPMENT</p> <p>Life Cycle analysis/Cost Models Halogen free laminates, components Banned substance alternates Supply chain impacts of mining</p>	<p>RESEARCH AND DEVELOPMENT</p> <p>Dematerialization New Separation Technologies Energy Efficiency/Reporting Recycled materials market Designer tools/legislation EHS impacts of nanotechnology</p>	<p>RESEARCH AND DEVELOPMENT</p> <p>ESM standards International Green Procurement Standards EHS impacts of printed electronic materials</p>	<p>RESEARCH AND DEVELOPMENT</p> <p>Low temperature Pb-free solders Alternative materials assessment/REACH</p>

2009

2011

2013

2015



Environmentally Conscious Electronics (ECE) Road Map Overview

- **Current Projects under or cross cutting to the ECE TIG**
 - BGA Rework
 - Pb-Free Rework Optimization
 - Pb-Free Wave Soldering
 - Tin Whisker Accelerated Test
 - Tin Whisker Modeling
 - Tin Whisker User Group
 - Halogen-Free (*joint with Board Assembly and Substrates TIG*)*
 - High-Reliability RoHS Task Force
 - Availability of SnPb-Compatible BGAs
 - Component and Board Finish Reliability*
 - Low Temp Nano-solder (joint with Board Assembly TIG)
 - Halogenated Flame Retardant (HFR)-Free Leadership Project
 - PVC Alternatives Project
 - Eco-Impact Evaluator Project



Review Gaps / Technical Needs Categorization, Prioritization

Gaps >5 year requirements with Category (D=Design, SI=System Integration, M&R=Materials and Environment, E&E=Energy and Environment and MP=Mfg. Processes)

1. M&R: Sound science to **evaluate alternate materials, processes and products** that anticipate environmental stewardship goals
2. D: Designer tools to easily make **environmentally conscious design decisions and meet reporting requirements** for the growing array of legislation (energy, material content, LCT, LCA, human ecology, environmental stewardship, etc.)



Gap Analysis Bar Chart

- Chart shows expected status of gaps with no iNEMI project intervention
- Color Bar Definitions:
 - **Green** = No Gap Issues or Resolved
 - Typically short term leading up to an identified forecast gap
 - **Yellow** = Known Gap Mitigation Techniques
 - Typically identifies a known gap with known work-around
 - Likely to be a less efficient and/or lower quality solution
 - Usually moves to a red bar when mitigation is impossible or ends when a forecast technology shift eliminates the gap
 - **Red** = No Known Solution – Development Required
 - Red bar begins when development solution is required
 - Red bar ends when planning horizon ends or gap disappears due to a forecast technology shift

