



**INEMI**  
International Electronics Manufacturing Initiative

## Research Priorities 2012

*Carol Handwerker*

Advancing manufacturing technology

# **iNEMI – Sustainability and the Environment**

- **iNEMI and Sustainability – Vision and Pathways**
- **The iNEMI Research Methodology**
- **R & D Priorities – Identification, Proposal Development, Implementation**
- **2011 iNEMI Roadmap – Research Priorities**
- **Projects Underway**
- **Opportunities for New Initiatives**
- **Road Forward**

# The iNEMI Environmental Vision

- **We will take the initiative to fully leverage the iNEMI roadmap and aggressively drive the key environmental gaps and opportunities in and through the manufacturing electronics supply chain**
  - **Focused collaborative research with universities and key governmental labs working in sync with industry.**
  - **Proactive member led environmental improvement projects that close the technology gaps.**
  - **Strengthen ties with policy decision makers. Ensure sustainable solutions are put in place.**
- **Problems will be attacked with scientific depth and rigor and the solutions implemented will be far reaching and sustainable.**

# International Members Across The Total Supply Chain

The International Membership	Incorporated Location; Number of Members			
	North America	Asia Region	Europe	Totals
INEMI Member Business Type				
OEM	15	2	2	19
ODM/EMS (inc. pkg. & test services)	4	7	-	11
Material Suppliers	8	12	11	33
Equipment Suppliers	8	1	2	11
Universities & Research Institutes	8	2	3	13
Organizations/consulting	11	1	2	13
<b>Totals</b>	<b>54</b>	<b>27</b>	<b>20</b>	<b>102</b>

## Key Observations:

- New members joining to participate in Environmental and Packaging Projects and in collaborative R&D opportunities
- 170% Growth in Europe Since 1/1/2010; 60% Industry Growth Overall
- 160% Growth in University/Research Institutes Since 1/1/2010
- ✓ Total Global Supply Chain Integration



# Research Institutes and University Members



# iNEMI Actions in Environmental Area

- Roadmap of Environmental Conscious Electronics (since 1996)
- Established the Environmental Leadership Steering Committee to set strategic direction & priorities

**Bill Bader – iNEMI – Chair**

**Marc Benowitz – Alcatel Lucent – iNEMI BOD Member**

**Todd Brady - Intel**

**Mary Liz Burns – I.H.S. and iSuppli**

**Carol Handwerker – Purdue**

**Joe Johnson – Cisco**

**Nils Nissen – Fraunhofer IZM**

**Scott O’Connell – Dell**

**Tom Okrasinski; Alcatel Lucent**

**Grace O’Malley – iNEMI Europe**

**Tamim Sidiki – DSM Engineering Plastics**

**Joyce Taylor – HP**

**Rob Taylor - Lenovo**



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  - Issued iNEMI position papers on Product Carbon Foot printing and Definition of Low Halogen
  - Issued white paper on Timeline for Conversion of Notebook and desktops to HFR-Free and PVC free
  - Issuing White Paper on Environmental Material Data Management & Reporting in Q3 2012
- **Leading Projects on**
  - Characterizing and improving Pb-free reliability - since 2000
  - Characterizing PVC alternatives & HFR-free high reliability - since 2009
  - Developing LCA tools for ICT products since 2010 – Two active well-led teams
- **Defining Environmental Research Priorities**
  - Six environmental research proposals in hand; webinars being arranged.
- **Organizing workshops**
  - Electronics Goes Green 2012

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# Society Driven

Health & wellness



Transport & mobility



Security & safety



Energy & environment



Communication



E-society

Source: NXP

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# Key Mega Trend

Key Mega-Trends (>\$1,100 billion spend<sup>(1)</sup>)



*require*

High-Performance Mixed-Signal Solutions

Application-optimized analog and digital solutions that help our customers to truly differentiate their products in terms of features, cost and time to market

*to address*

Highest Growth Segments in 8 Priority Application Areas



Source: NXP

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# 2011 Research Priorities Process

- **Step 1:**

- Traditional Process of Technology Chapters Accountable for identifying Research Needs
- Extraction of those needs by the iNEMI Research Committee
- Utilize focused workshops to further identify needs
  1. Electronics and Medical Packaging WS – Berlin Oct 2010
  2. *Environmental Research Stakeholders – Vienna – Nov 2010*
  3. *Alternative Energy WS – Santa Clara – Oct 2010*
  4. *Environmental Leaders WS – Phoenix – Feb 2011*
  5. Medical Electronics WS – Santa Clara – May 2011
  6. MEM's WS – Brighton England – Sept 2011

- **Step 2:**

- Roll up all inputs and prioritize critical needs by August 2011

# Step 3: Group & Prioritize Similar Needs

Research Need	Focus Area	Research Area
Environmental Design Tools: 1. Simplified LCA Tools for High End Computing, 2. LCA for cradle to grave technology comparisons	environment	design
System Design Approach for: 1. modeling and simulation tools accepted by supply chain for 3D designs, 2. MEMS design rules for supply chain, 3. System Assembly Tolerances	minaturization	design
Implementable Traceability Solutions for environmental and medical applications	environment	Info. manage
Low cost fine line (8/8) capabilities for continued scaling of 1st and 2nd level interconnects	minaturization	manufacturing
Alternative low-temperature materials and processes for mass electrical and physical interconnection of components	minaturization	manufacturing
Development of LED Materials for high efficiency light sources	energy	materials
Pb Free characterization for high reliability and extreme environment applications	environment	materials
Bio based polymers for high performance packaging	environment-m	materials
Human combatable materials: 1 High density flexible organic substrates 2 conductive & isolative materials 3Nanomaterial based composites for electrically activated muscles and exoskeletons	medical	materials
Develop high resolution photo resist for fine line processing; nano copper and silver coated copper links with 10-15 nm particle size	minaturization	materials

## Step 4 : Create Research Proposals - Environmental Examples

1. Establishing shared, peer reviewed data bases (Elsa Olivetti; MIT)
2. **Simplified LCA for key product segments**
3. Simplified LCA for electronic materials (Carol Handwerker; Purdue)
4. **Developing sample business cases on sustainability**
5. **Improved knowledge of user behavior**
6. Eco-Reliability (Nils Nissen; IZM, Colin Fitzpatrick; Limerick University)
7. Environmental evaluation of alternative biopolymers (Nils Nissen; IZM)
8. **White List of acceptable polymeric materials**
9. Material hazard informatics (Julie Schoenung; University of California Davis)
10. Sustainable design and electronics (Callie Babbitt; Rochester Institute of Technology )

Additional proposals that build on iNEMI sustainability priorities.

## **Step 5: Present Proposals to iNEMI Membership & Create Academic & Industry Partnerships**

- **Through webinars starting in Q1 2012**
- **Predefined targeted industry and research institute partners**
- **Include the game plan for public and private funding**
- **Submit proposals to public funding agencies for approval.**
- **Determine priority and support levels for iNEMI industry membership funding support**

# NSF Integrated Education and Research Traineeship Program

## IGERT: Global Traineeship in Sustainable Electronics

Purdue University and Tuskegee University in close collaboration with Global Electronics Industry - iNEMI and individual companies- and International Academic Partners - Fraunhofer IZM - Berlin, Shanghai Jiao Tong University, Tsinghua University – Beijing, Indian Institute of Management – Udaipur, Universidad EAFIT – Medellin

### Vision

Create a new integrative, collaborative model for graduate research and education needed to enable *meaningful and measurable improvements in the global sustainability of electronics.*

Funded by NSF in June 2012

\$3.2M for 28 two-year fellowships over 5 years

External Advisory Board and opportunities for collaboration with industry, NGOs, research institutions



# NSF Integrated Education and Research Traineeship Program

## IGERT: Global Traineeship in Sustainable Electronics

IGERT will create a Ph.D. graduate education and research traineeship to:

- (1) Educate, train and empower scientists, engineers, product developers, economists, and managers as decision-makers, using interdependent dynamic systems, and principles of natural behavior.
- (2) How to agree upon common goals to have difficult, yet productive conversations to make progress
- (3) Develop a curriculum with our industry and international university partners in Germany, Colombia, India, and China and disseminate it widely through Purdue's globalHUB cyberinfrastructure to positively influence the global stakeholders who impact electronics sustainability.
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### Three Research Thrusts

1. Polymers from Nature for Construction & Disassembly
  - **Natural Nanocomposites for Structural Applications in Casings and Boards,**
  - **Bio-based Lignin and Soy-based Resins for Circuit Board Construction**
  - **Biomimetic Marine-Derived Bioadhesives for Device Construction & Disassembly**
  - **Green Replacements for Brominated Flame Retardants**
2. Sustainable Product Design and Manufacturing
  - **Novel LCA Approach for Electronic Products**
  - **Electronic Product Manufacturing Process Characterization and Improvement**
  - **LCA-based Design of Electronics**
  - **Recycling and Reuse of Electronic Devices**
3. System and Supply Chain Issues
  - **Integrating Sustainability Indicators across the Supply Chain**
  - **Corporate Sustainability Behavior – Stakeholder Perception – Corporate Valuation**
  - **Consumer Behavior**
  - **System-wide Effects of Laws and Regulations**



# 2011 and 2013 iNEMI

## Environmentally Conscious Electronics Roadmaps

leading electronics firms have recognized that the Information and Communications Technology (ICT) industry must work collaboratively

- to create global solutions for more energy efficient and sustainable electronics,
- to ensure the materials and manufacturing practices deployed within the ICT industry are themselves sustainable, and
- to develop new electronics technologies for solving broader environmental challenges across the economies of the developed and developing world.

# Directed By The Research Committee

<b>Alan Rae, Nano Materials Innovation Center</b>	<b>Chair</b>
<b>Bob Pfahl, iNEMI</b>	<b>Secretary</b>
<b>Carol Handwerker , Purdue</b>	<b>Co-Chair</b>
<b>Charles Richardson, iNEMI</b>	<b>Ex-Officio</b>
<b>Barbara Goldstein, NIST</b>	<b>Member</b>
<b>D.H.R. Sarma, Delphi</b>	<b>Member</b>
<b>Jie Xue, Cisco</b>	<b>Member</b>
<b>Ravi Mahajan, Intel</b>	<b>Member</b>
<b>Voya Markovich, EIT</b>	<b>Member</b>
<b>Lili Deligianni, IBM</b>	<b>Member</b>
<b>Rolf Aschenbrenner, IZM</b>	<b>Member</b>
<b>Rao Tummala, Georgia Tech</b>	<b>Member</b>
<b>Haley Fu, iNEMI</b>	<b>Ex-Officio</b>
<b>Grace O'Malley, iNEMI</b>	<b>Ex-Officio</b>

