



INEMI[®]

International Electronics Manufacturing Initiative

**HFR-Free
(Halogenated
Flame Retardant)
Leadership
Program**

ITRI

Taipei, Taiwan

April 15, 2009

Advancing manufacturing technology

Agenda

- **10:00 Introductions**
- **10:15 iNEMI Project Formation Process**
- **10:45 Overview of iNEMI HFR-Free Activities**
- **11:05 OEM Input on Program**
- **11:15 iNEMI HFR-Free Leadership Program**
- **12:00 Lunch**
- **1:00 Signal Integrity status**
- **2:00 PCB Material status**
- **3:30 Open Issues (future meeting schedule, etc...)**
- **3:45 Next Steps and Additional Opportunities**
- **4:15 Adjourn**



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Introduction

Jim McElroy

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Who Are We?

- **iNEMI organization:**
 - Corporate membership
 - Not-for-profit, R&D consortium
 - Collaboration defined by organization by-laws, intellectual property policy, and project agreements.
- **Member companies/organizations:**
 - Leadership OEM, EMS, and Supplier companies
 - Government labs
 - Academic Institutions.
- **Small staff provides services to facilitate collaboration:**
 - Support to help organize & manage projects
 - Communication services for collaboration
 - Manage Relationships with other Organizations.

Global Operations

- iNEMI is headquartered in Herndon, Virginia, USA.
- Started iNEMI China Collaboration in 2003.
- Opened an office in Shanghai and added a team member in Europe in 2007.
- Dr. Haley Fu is leading operations in Asia, based in Shanghai, China.
- Grace O'Malley is representing iNEMI in Europe from her base in Ireland.



OEM/EMS Members



Celestica™



DELPHI

FOXCONN®

FLEXTRONICS



i n v e n t



HUAWEI



MICRO SYSTEMS
ENGINEERING



SANMINA-SCI



Sun
microsystems



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Supplier Members



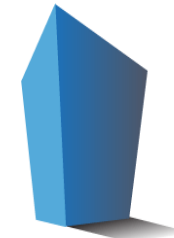
Association/Consortium, Government, Consultant & University Members



ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES®



ITRI
Industrial Technology
Research Institute



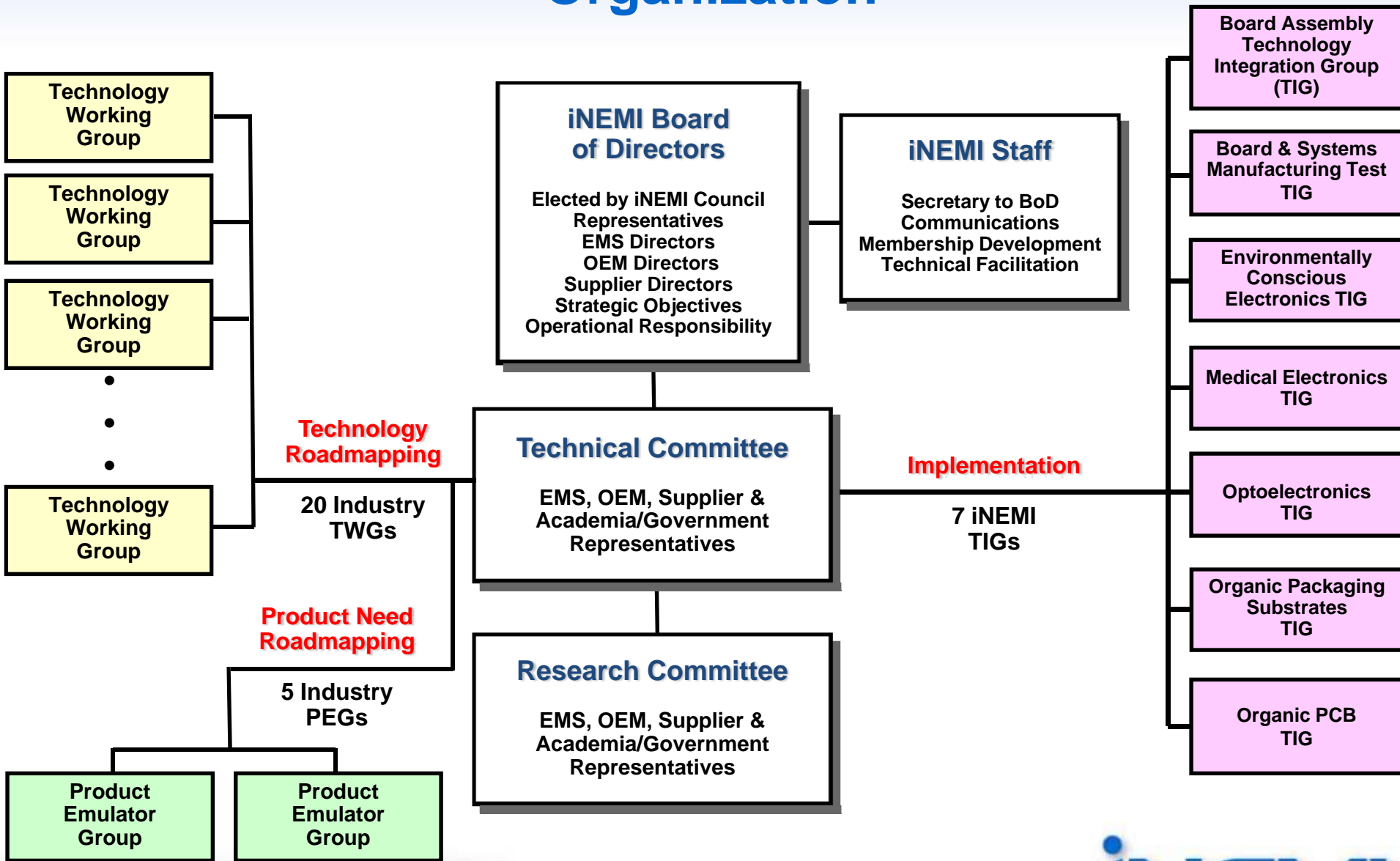
CIT
CENTER FOR INNOVATIVE TECHNOLOGY

NIST

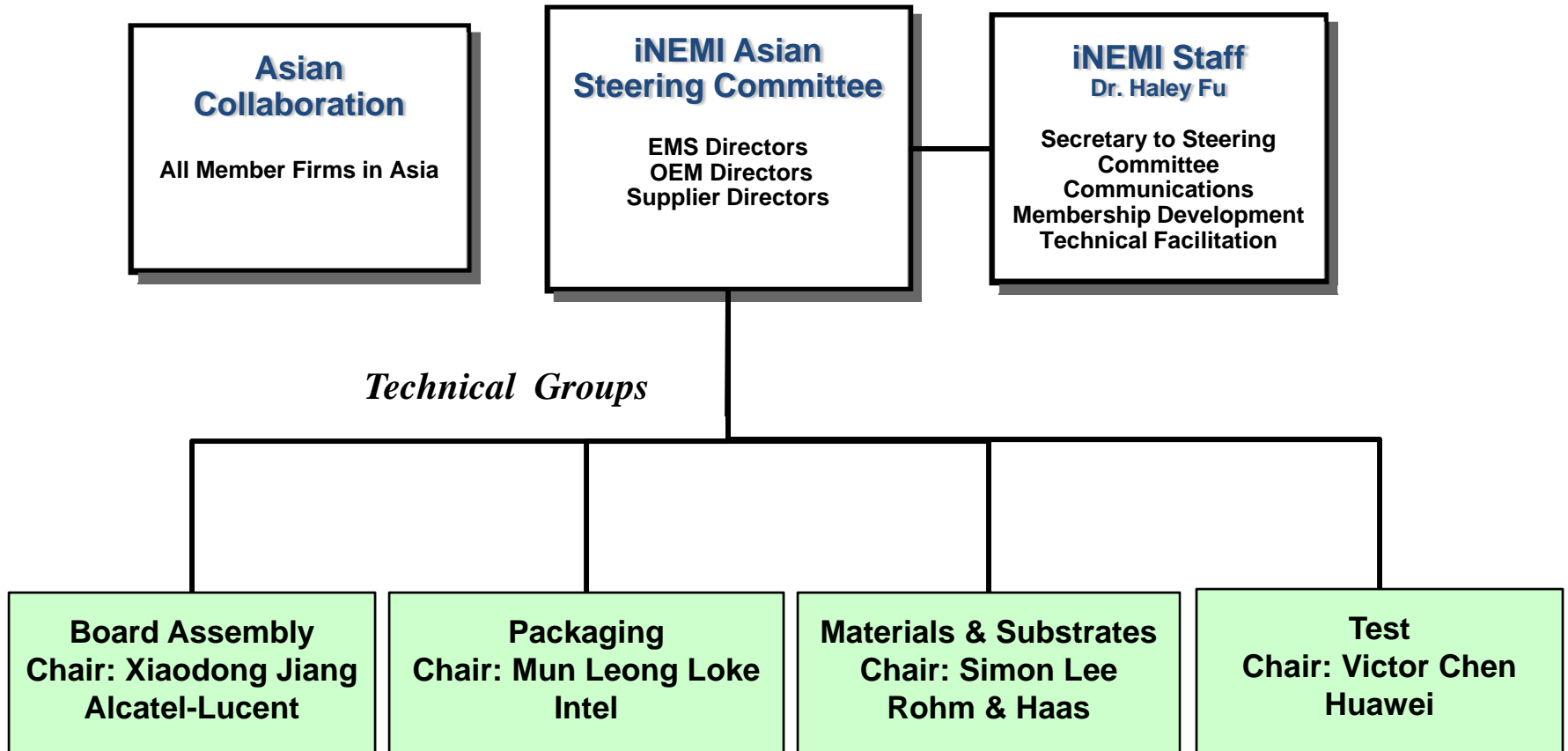
National Institute of Standards and Technology



Organization



iNEMI Asian Organization



Enhance the communication between Asian groups and Global

Board of Directors

Directors

- G Dr. Nasser Grayeli, VP of Assy Technology & Mfg., Intel – Chairman
- G Dr. Marc Benowitz, Director, Reliability & Eng. Infra., Alcatel Lucent
- G Dr. XuDong Fei, Director Technical Strategy, Huawei Technology
- G Kim Hyland, Sr. Director of Mfg. Operations Eng., Cisco Systems
- G Monroe Huang, Chief Engineer, Mfg. Eng. & Customer Sat., Delphi
- G Dr. B.J. Han, CTO, STATS/ChipPAC
- G Dr. Sundar Kamath, CTO, Assembly Technology, Sanmina-SCI
- G Rob Shaddock, CTO, Tyco Electronics
- G Dr. Jean-Luc Pelissier, Chairman & CEO, Francisco Partners CBA Grp.
- G Michael Toben, Director, Pkg. & Finishing Technology, Rohm & Haas

Ex-officio Members

- G Dr. James Olthoff, Deputy Director, EEE Laboratory, NIST
- G Dr. Jie Xue, Cisco, Co-chair, iNEMI Technical Committee
- G Jim McElroy, CEO, iNEMI
- G Dr. Robert Pfahl, VP of Global Operations, iNEMI

Technical Committee

Dr. Robert C. Pfahl, Jr. (iNEMI), Co-Chair TC

Jie Xue, (Cisco Systems, Inc.) Director of Technology & Quality, Co-Chair TC

Mulugeta Abtew (Sanmina-SCI Corporation), Director of Technology Development

Dr. Mostafa Aghazadeh (Intel Corporation), Vice President Chandler Assembly Tech Dev.

Bill Barthel (Plexus Corp.), Manager, Manufacturing Technology Development

Ravi Bhatkal (Cookson Electronics), VP, GM of Engineered Products

Mike Davisson (Agilent Technologies), RoHS Tech Program Manager

Koen Gieskes (Francisco Partners CBA Group), CTO

Barbara Goldstein (NIST), Strategic Advisor to the Director

Dr. Sherwin Kahn (Alcatel-Lucent), Technical Manager, Reliability Engineering

Dr. Carol Handwerker (Purdue University), Professor of Materials Engineering

Dr. Alan Rae (NanoDynamics, Inc.), VP, Technology

Michael Roesch (Hewlett Packard), Manager Reliability and Test Engineering

Ravi Subrahmanyam (Micro Systems Engineering, Inc.), Executive Director, Adv. Tech Group

Dr. Liu Sang (Huawei Technologies), Manufacture Technologies Center

Peter Tomaiuolo (Celestica), Director of Corporate Technology

ZHU Jian (Alcatel-Lucent) Chair, Asia Steering Committee, VP of Core Manufacturing





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iNEMI Project Development Process

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iNEMI Project Management

- **Methodology**
- **Project Management - iNEMI Role**
- **The Project Process:**
 1. **Selection**
 2. **Definition**
 3. **Planning**
 4. **Execution**
 5. **Closure**
- **Project Documents**
- **Successful Projects**

Background

- **iNEMI organizes and facilitates projects**
- **Members define and execute projects**
- **Projects are aligned to the iNEMI roadmap**
- **Topics chosen have generated significant member interest**
- **iNEMI projects are typically in 3 categories**
 - **Research**
 - **Optimization**
 - **Specification**

iNEMI Program and Project Management Role

Act as a catalyst in the identification and execution of programs/projects that close technology gaps.

- Specifically, iNEMI is committed to:
 - Guiding the identification of programs to address industry needs
 - Coordinating the process of defining projects that fit into those programs
 - Facilitating program and project management
 - Providing training for program and project managers
 - Assisting in solving problems that occur during project execution
 - Engaging members to assume the duties of program and project management
 - Ensuring that members have committed to support projects with all necessary resources.

Project Leaders

- **Manage the specific projects per iNEMI project management process:**
 - **Progress to schedule**
 - **Mainly using iNEMI teleconference capability**
- **Report progress to the TIG Program Management Chairs**
- **Responsible for generating the required documents for the project**
 - **Statement of Work**
 - **Project Statement**
- **iNEMI Staff support provided throughout.**



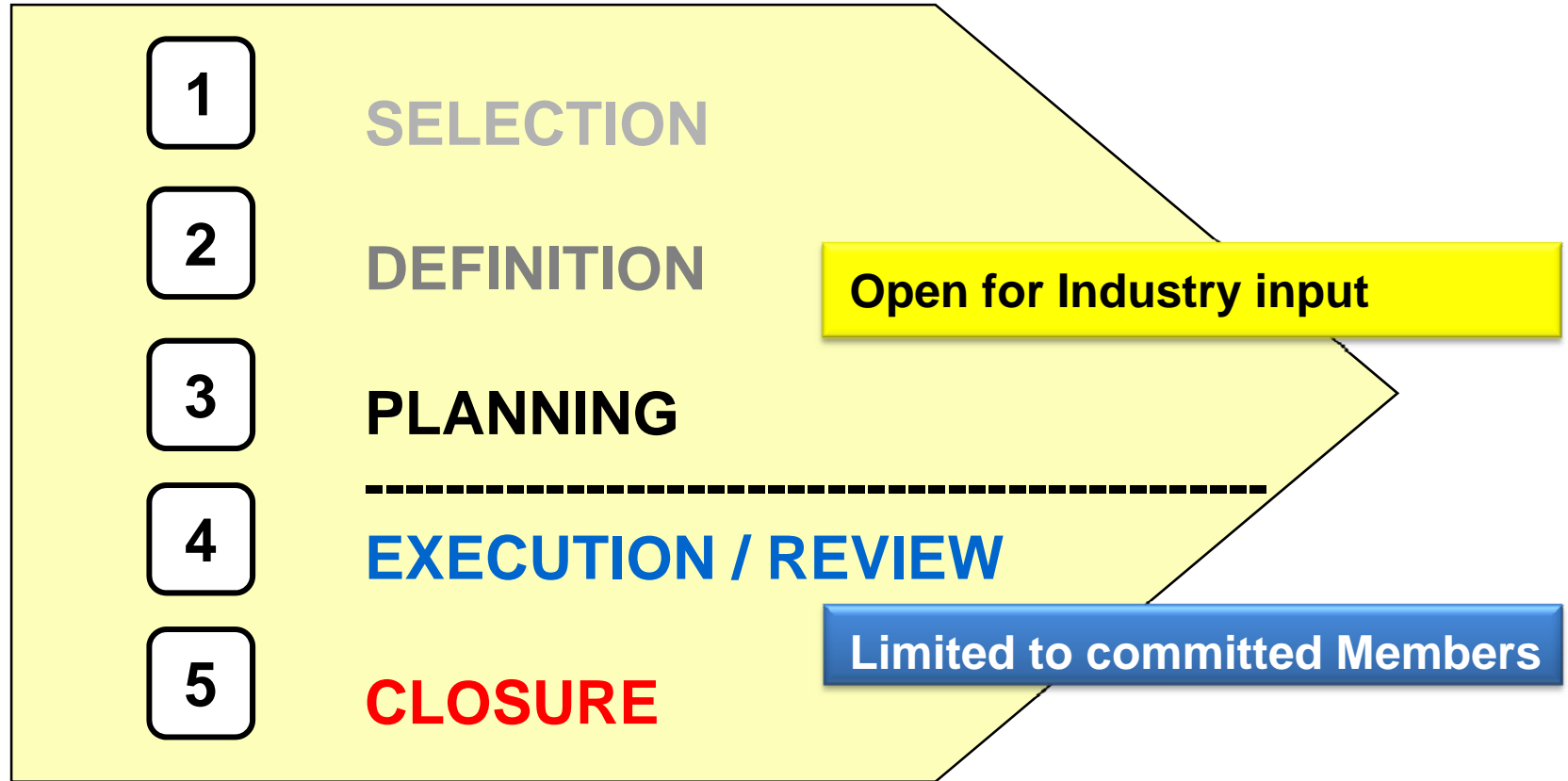
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The Project Process

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The Project Process - 5 Steps



iNEMI Statement of Work – Basic Information

- **Scope of Work – definition of what is to be done**
 - Expected deliverables
 - Major project goals; does the project seed a global solution or is the purpose of the project to contribute one part of a solution to a complex problem?
 - Complex project should be divided into phases
 - Well defined short term goals for each phase
 - Allows for course correction as knowledge is gained
- **Purpose of Project**
 - Explanation of how the project addresses an industry need and how the project is aligned to the roadmap & technical plan
 - Discuss the approach to design of experiments that the project will use to ensure reliability, accuracy, and statistical significance of results
(Research Projects)
 - List all standards bodies considered for the project, explain how each was evaluated and justify the final choice of organization(s) **(Specification Projects)**

NOTE: All changes to SOW must be approved by the TC (version control)



iNEMI Project Statement (PS)

- **The Project Statement (PS) is the official document, signed by each participant's senior management, committing the company to the agreed upon resource and time contributions.**
- **Without the PS, the project could flounder due to lack of participation or confusion as to where the project resources are coming from.**

Profile of Successful Projects

The “sweet spot” of iNEMI projects:

- **Addresses knowledge gap of industry**
 - Common problem
 - Best solved by working together
 - Often a pre-cursor to standards development
- **Addresses capability gap of industry**
 - Restructuring can cause loss of skills at various supply chain nodes
 - Collaborative efforts can focus on ways to reduce impact
- **Brings together a segment of supply chain to provide industry-wide response**
 - OEMs
 - ODMs
 - EMS providers
 - Materials, equipment, software, and/or component suppliers
- **Direct alignment with member companies’ commercial interests.**



HFR-Free Technology Leadership

13 OEM Participants

| Company | Web Site | Type |
|----------------------------|--|------|
| Acer Inc. | www.acer.com.tw | OEM |
| Apple | www.apple.com | OEM |
| ASUSTek Computer | www.asus.com | OEM |
| Cisco Systems, Inc. | www.cisco.com | OEM |
| Dell | www.dell.com | OEM |
| Gemtek Technology | www.gemtek.com.tw | OEM |
| Hewlett-Packard | www.hp.com | OEM |
| Huawei | www.huawei.com | OEM |
| IBM | www.us.ibm.com | OEM |
| Intel Corporation | www.intel.com | OEM |
| Lenovo | www.lenovo.com | OEM |
| Sun | www.sun.com | OEM |
| Tisamax Technical Co., LTD | www.tisamax.com | OEM |

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14 EMS/ODM Participants

| Company | Web Site | Type |
|---------------------------------|--|---------|
| Broad Technology | www.3cems.com | EMS/ODM |
| Celestica | www.celestica.com | EMS/ODM |
| Compal Electronics | www.compal.com | EMS/ODM |
| Flextronics | www.tw.flextronics.com | EMS/ODM |
| Foxconn | www.foxconn.com | EMS/ODM |
| Inventec | www.inventec.com | EMS/ODM |
| Micro-Star International | www.msi.com.tw | EMS/ODM |
| MiTAC International | www.mitac.com.tw | EMS/ODM |
| Pegatron | www.pegatroncorp.com | EMS/ODM |
| Quanta Computer | www.quantatw.com | EMS/ODM |
| Sanmina-SCI | www.sanmina-sci.com | EMS/ODM |
| STATS ChipPAC | www.statschippac.com | EMS/ODM |
| Universal Scientific Industrial | www.usi.com.tw | EMS/ODM |
| Wistron | www.wistron.com | EMS/ODM |

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9 PCB Manufacturer Participants

| Company | Web Site | Type |
|--------------------------|--|-------------|
| Compeq Mfg. Co. | www.compeq.com.tw | PCB |
| DDI | www.ddiglobal.com | PCB |
| Elec & Eltek | www.eleceltek.com | PCB |
| Gold Circuit Electronics | www.gce.com.tw | PCB |
| Ibiden | www.ibiden.com | PCB |
| NanYa PCB | www.nanyapcb.com.tw | PCB |
| Tech Circuits | www.techcircuits.com | PCB |
| Tripod Technology Corp. | www.tripod-tech.com | PCB |
| WUS Printed Circuit | www.wuspc.com | PCB |

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11 Laminate Supplier Participants

| Company | Web Site | Type |
|------------------------------------|--|-------------|
| Doosan Electro-Materials | www.doosan.com | LAM |
| Elite Material Co. | www.emctw.com | LAM |
| Grace T.H.W. | www.graceelectron.com | LAM |
| Guangdong Shengyi Sci. Tech | www.syst.com.cn | LAM |
| Hitachi Chemical Co. | www.hitachi-chemical.com | LAM |
| Isola | www.isola-group.com | LAM |
| ITEQ Corporation | www.iteq.com.tw | LAM |
| Nan Ya Plastics | www.npc.com.tw | LAM |
| Panasonic Electric Works | www.panasonic-denko.co.jp | LAM |
| Shengyi Sci. Tech Co. | www.syst.com.cn | LAM |
| TUC (Taiwan Union Technology Corp) | www.tuc.com.tw | LAM |

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11 Other Participants

| Company | Web Site | Type |
|-------------------------------------|--|------|
| Albemarle | www.albemarle.com | OTH |
| Ciba Corp. | www.ciba.com | OTH |
| Clariant Chemicals | www.clariant.com | OTH |
| Dow Chemical Co. | www.dow.com | OTH |
| ICL Asia Limited | www.icl-ip.com | OTH |
| IST - Integrated Service Technology | www.istgroup.com | OTH |
| ITRI | www.itri.org.tw | OTH |
| MIC Specialty Chemicals | www.micspe.com | OTH |
| Mitsubishi Gas Chemical Co. | www.mgc.co.jp | OTH |
| TSRC Corporation | www.tsrc-global.com | OTH |
| UL | www.us.ul.com | OTH |



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Overview of iNEMI HFR-Free Activities

Bob Pfahl
iNEMI

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Agenda

- **Project Portfolio**
- **Who is currently active in Program**
- **OEM Presentations**

HFR-Free Project Portfolio

Completed projects

- HFR-Free PCB Material Evaluation

Active projects

- HFR-Free High Reliability PCB

New initiatives

- PVC Alternative Initiative
- **HFR-Free Leadership Initiative**
 - HFR-Free PCB Materials
 - HFR-Free Signal Integrity

HFR-Free PCB Material Evaluation

Purpose: Identify technology readiness, supply capability and standards development opportunities for “halogen-free” alternatives to conventional printed wiring board materials

Goals of the Project:

- Identify commercially viable materials
- Benchmark past work and identify critical knowledge gaps
- Design test vehicles and test methodologies
- Leveraging prior investigations, carry out the necessary testing to characterize viable materials
- Analyze results
- Publish recommendations

Results and Benefits:

- Determined the critical tests for evaluating halogen-free laminate materials
- Showed industry the general benefits and limitations of non-bromine based flame retardant laminates
- Participants obtained detailed knowledge of each laminate

HFR-Free PCB Material Evaluation Project Members



Exactly your chemistry.



i n v e n t



ITEQ

INNOVATION • TEAMWORK •
EXCELLENCE • QUALITY



Vitronics Soltec

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BFR-Free High Reliability Project

*Project Leader
Steve Tisdale,
Intel Corporation*

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BFR-Free High Reliability Project

Purpose: Identify technology readiness, supply capability and reliability characteristics for “BFR-free” alternatives to conventional printed wiring board materials and printed wiring board assemblies, based on the high-reliability market segment requirements (large, thick, boards).

Goals of the Project:

- Identify commercially viable materials
- Benchmark past work and identify critical knowledge gaps
- Build on industry knowledge and capability, including the iNEMI BFR-Free PCB Material Evaluation Project
- Design test vehicles and test methodologies
- Leveraging prior investigations, carry out the necessary testing to characterize viable materials
- Analyze results
- Publish recommendations

Status:

- Currently in the testing phase
- Completion of Project in Q1 2010

BFR-Free High Reliability Project Members





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**iNEMI PVC
Alternatives
Project**

*Project Leader
Scott O'Connell,
Dell*

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Background

- **7 of the top 10 global PC manufacturers have set goals to phase-out PVC, where viable alternatives are identified**
 - **These 7 manufacturers represent over 50% of the worldwide market share for PCs (per IDC WW Quarterly PC Tracker for Q1-2008)**
- **PVC alternatives project was proposed at the September 2008 iNEMI Sustainability Summit, approved by the Board**
- **The project will focus on 2 areas:**
 - **Phase 1 - Cradle-to-grave Life cycle assessment (LCA) comparing PVC versus PVC-free cables**
 - **Phase 2 - Technical evaluation of PVC alternatives – electrical, mechanical, safety**

iNEMI PVC Alternatives Project

What the Project IS / IS NOT:

| This Project <u>IS</u> : | This Project IS <u>NOT</u> : |
|--|--|
| Environmental life cycle assessment (LCA) comparing PVC resins (and additives) with PVC-free resins (and additives) for cable applications | Economic, social, safety or toxicological assessment |
| Cradle-to-grave LCA, including end of life aspects (recycling, incineration, landfill, etc) | Cradle-to-gate LCA only |
| Focused on US power cords for PC applications | Other cables or cords (for initial assessment) |
| Gain a better understanding of the electrical, mechanical, and safety aspects of “PVC-free” alternatives. | Development of standards |
| Develop, manage, and execute performance testing of different “PVC-free” alternatives. | |
| Multi-stakeholder project (LCA consultants, universities, etc) | Electronics industry only |



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**HFR-Free Leadership
Program**

**HFR-Free Signal
Integrity**

**HFR-Free PCB
Materials**

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Firms Participating in the Program Development





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OEM Input on Program

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