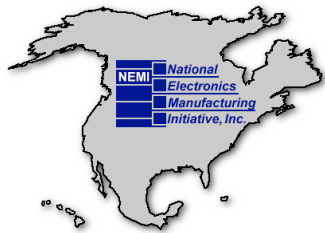




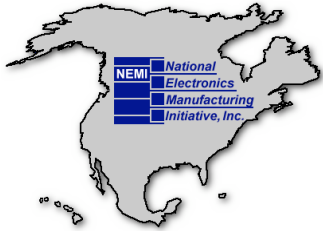
Environmental Programs and Strategies in the North American Electronics Sector

***Dr. Robert Pfahl,
Chair, NEMI Environmentally
Conscious Electronics TWG***

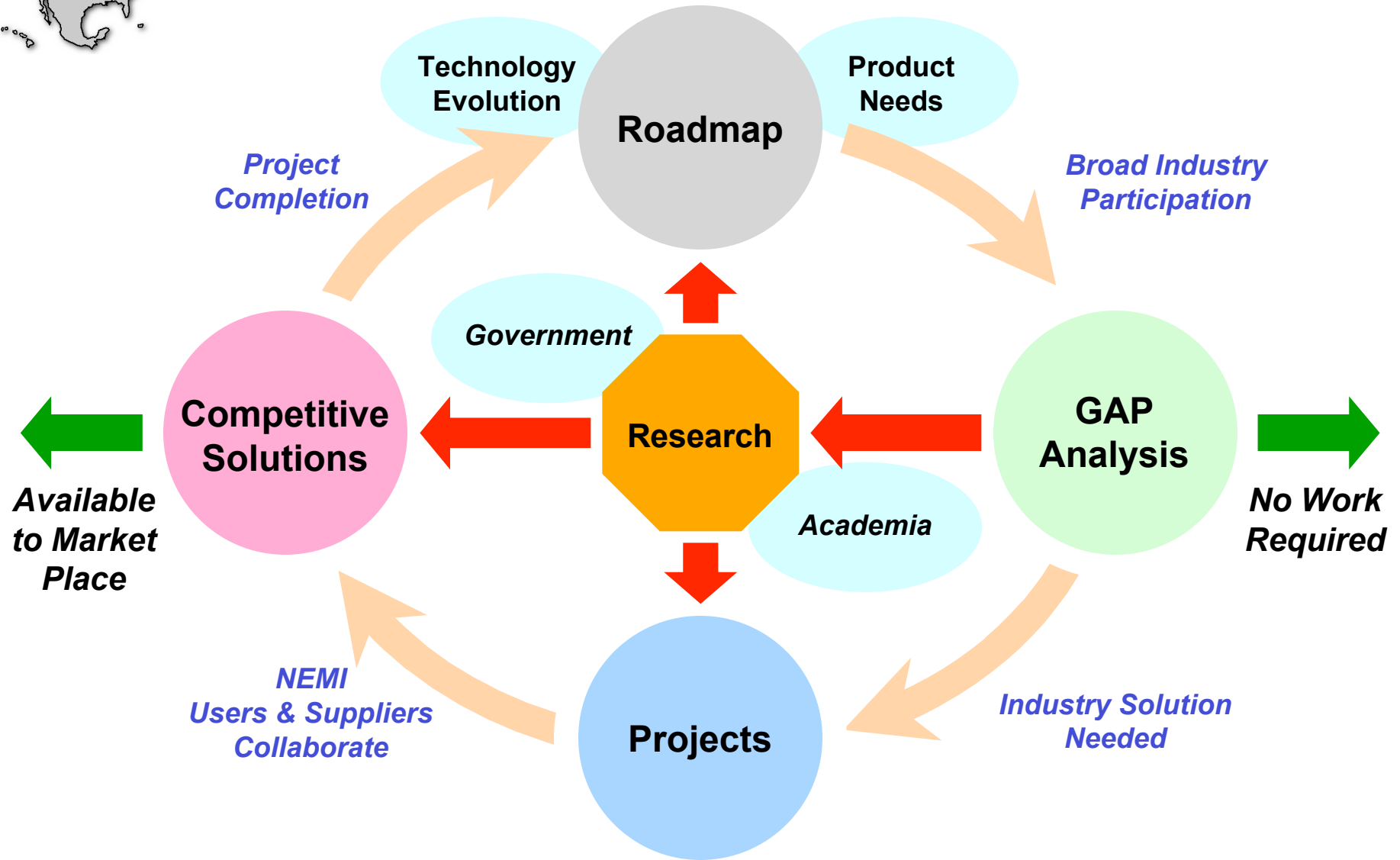


Outline

- **National Electronics Manufacturing Initiative (NEMI) 2002 Environmentally Conscious Electronics Roadmap**
- **Addressing the RoHS Directive**
 - ✓ US Pb-Free Activities (NEMI)
 - ✓ Materials of Concern (EIA)
- **Addressing the WEEE Directive (AeA and NEMI)**
- **Needs and Direction of R&D**
- **Conclusions**

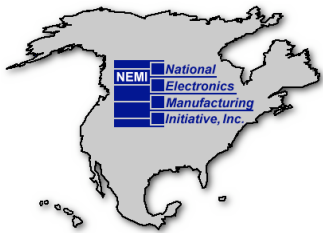


NEMI Roadmap Cycle

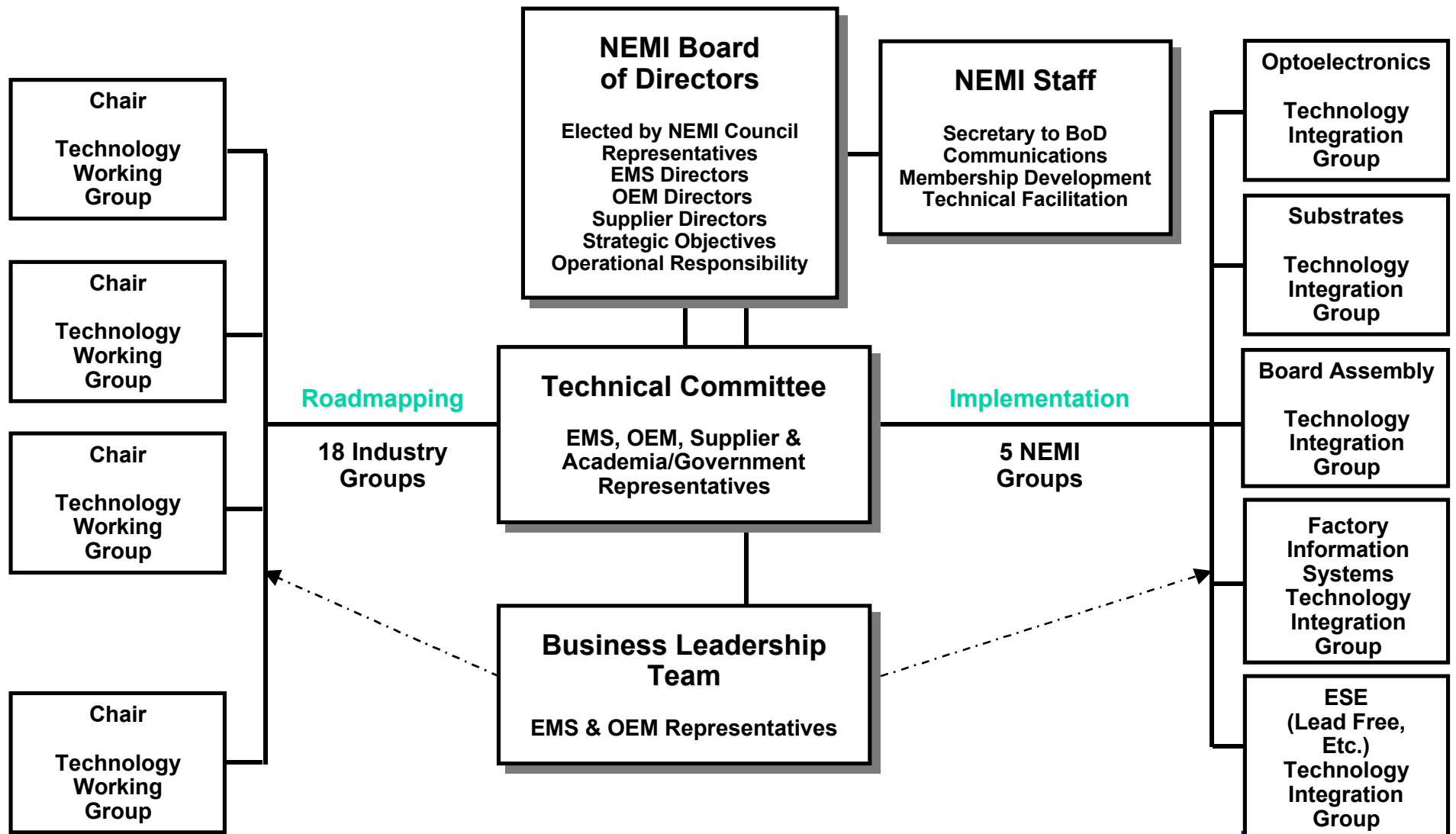


NEMI Implementation Cycle

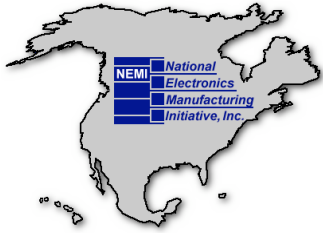
Connect with and Strengthen Your Supply Chain



NEMI Organization



Connect with and Strengthen Your Supply Chain

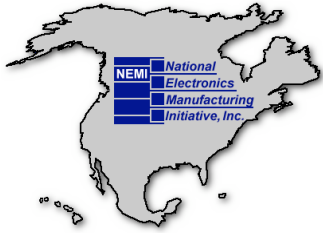


NEMI 2002 Environmentally Conscious Electronics Roadmap

Situation Analysis: Legislative

- **Increasing Environmental Legislative Activity**
 - ✓ **End-of-Life Disposal Legislation in Europe, United States, and Japan**
 - **Electric Home Appliances Recycling Law in Japan (1998)**
 - **WEEE in Europe (2002)**
 - **Automotive Legislation in Europe**
 - **EOL legislation pending in 20 states**
 - ✓ **Hazardous Materials in Europe, Japan, and U.S. States**
 - **RoHS in Europe (Pb, Br-FR, Cd, Hg, Cr+6) (2002)**
 - **Proposition 65 in California**
 - **Hg in New England**
 - **Materials Declaration by Suppliers**

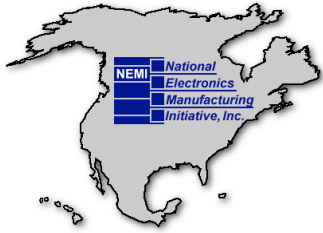
Connect with and Strengthen Your Supply Chain



Situation Analysis: Alternative Technology

- **Alternative Technology Base**
 - ✓ Pb-free solders and process-NEMI TIG Activity
 - ✓ Br-Free PWBs and plastics are commercially available
 - ✓ Cd, Pb and Hg free plastics are available
 - ✓ Cr+6 alternatives are emerging
- **Successful Implementation into Products**
 - ✓ Widespread introduction of Pb-free solders and Br-free PWBs in Japan
 - ✓ Limited introduction of Pb-free solders and Br-free PWBs in North America
 - ✓ High temperature component qualification is an issue
 - ✓ Pb-free components are becoming available; however, lead finishes are still in debate for high reliability applications.

Connect with and Strengthen Your Supply Chain



Situation Analysis: Market

- **Customers**

- ✓ **Industrial**

- **Materials Declarations are required in the Auto Industry and will Penetrate the Electronics Industry**

- **Standard information declarations developed by EIA**
 - **No Automotive Standards**

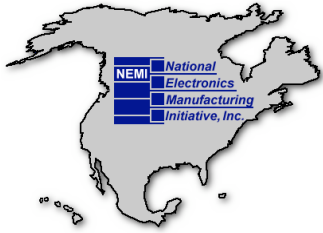
- ✓ **Consumers**

- **Limited Markets**

- **Environmental Labels**

- ✓ **Increasing pressure for labels**

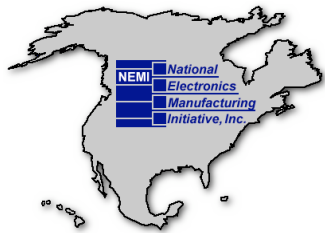
- ✓ **Energy use is widely labeled**



Cross-cutting TWG Issues with Component Manufacturing TWGS

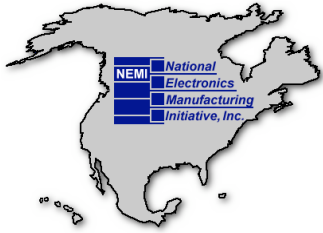
Key Component TWG	Environmental Needs	Time Frame
Interconnect Substrates-Organic	<ul style="list-style-type: none"> •Alternatives to Brominated Flame Retardant •High Temperature Soldering Compatibility 	2002-8 2002-5
Interconnect Substrates-Ceramic	<ul style="list-style-type: none"> •Alternatives to Beryllia substrates 	2004-8
Displays	<ul style="list-style-type: none"> •Alternatives to Hg in Lamps •Improve Energy Efficiency 	ASAP Ongoing
Mass Data Storage	<ul style="list-style-type: none"> •Increase recycled content 	Ongoing
Optoelectronics	<ul style="list-style-type: none"> •High Temperature Soldering Compatibility 	2002-5
Digital Silicon Technology	<ul style="list-style-type: none"> •Reduce energy and water use, decrease emissions •Improve device power management 	Ongoing Ongoing
Energy Storage Systems	<ul style="list-style-type: none"> •Replace NiCd Technology •Improve Energy Efficiency 	2002-5 Ongoing
RF Components	<ul style="list-style-type: none"> •High Temperature Soldering Compatibility 	2002-5
Passive Components	<ul style="list-style-type: none"> •High Temperature Soldering Compatibility •Alternatives to Pb based frits 	2002-5 2002-4
Connectors	<ul style="list-style-type: none"> •High Temperature Soldering Compatibility •Alternative Flame Retardants 	2002-5 2002-5
Cables and Accessories Gap	<ul style="list-style-type: none"> •Reduce Pb, Cd, Hg<100 PPM 	2002

Connect with and Strengthen Your Supply Chain



Gap Analysis

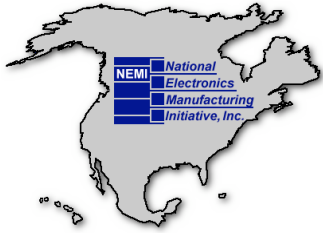
- **The most pressing implementation issue for Pb-free solder is the availability of components specified to meet higher soldering temperatures**
- **No standards exist for exchange of “Materials of Concern” Information.**
- **North American OEMs are generally not prepared to implement the Product Take Back requirements of WEEE**
- **There are no robust LCA/LCI tools**
- **The OEMs need to focus on eliminating hazardous materials in Cables and Accessories**



Recommendations

To remain competitive global electronics firms will need to:

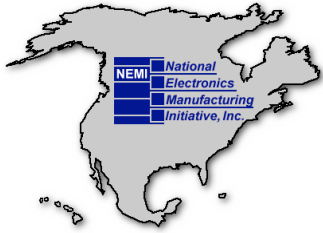
- Develop, qualify, and introduce new materials, components, and processes in 2002-6 to enhance recyclability, improve energy efficiency, and reduce ecological impact.
- Develop and implement efficient methods for data exchange of environmental attributes to meet the requirements of European and Japanese regulations on Electronics and Automotive products.
- Educate the supply chain to the new materials requirements and end-of-life responsibilities.
- Develop tools to address the complex decision and tradeoff process to develop products with minimal environmental burden.
- **Establishment of new NEMI TIGs should be considered to facilitate the previous four recommendations.**



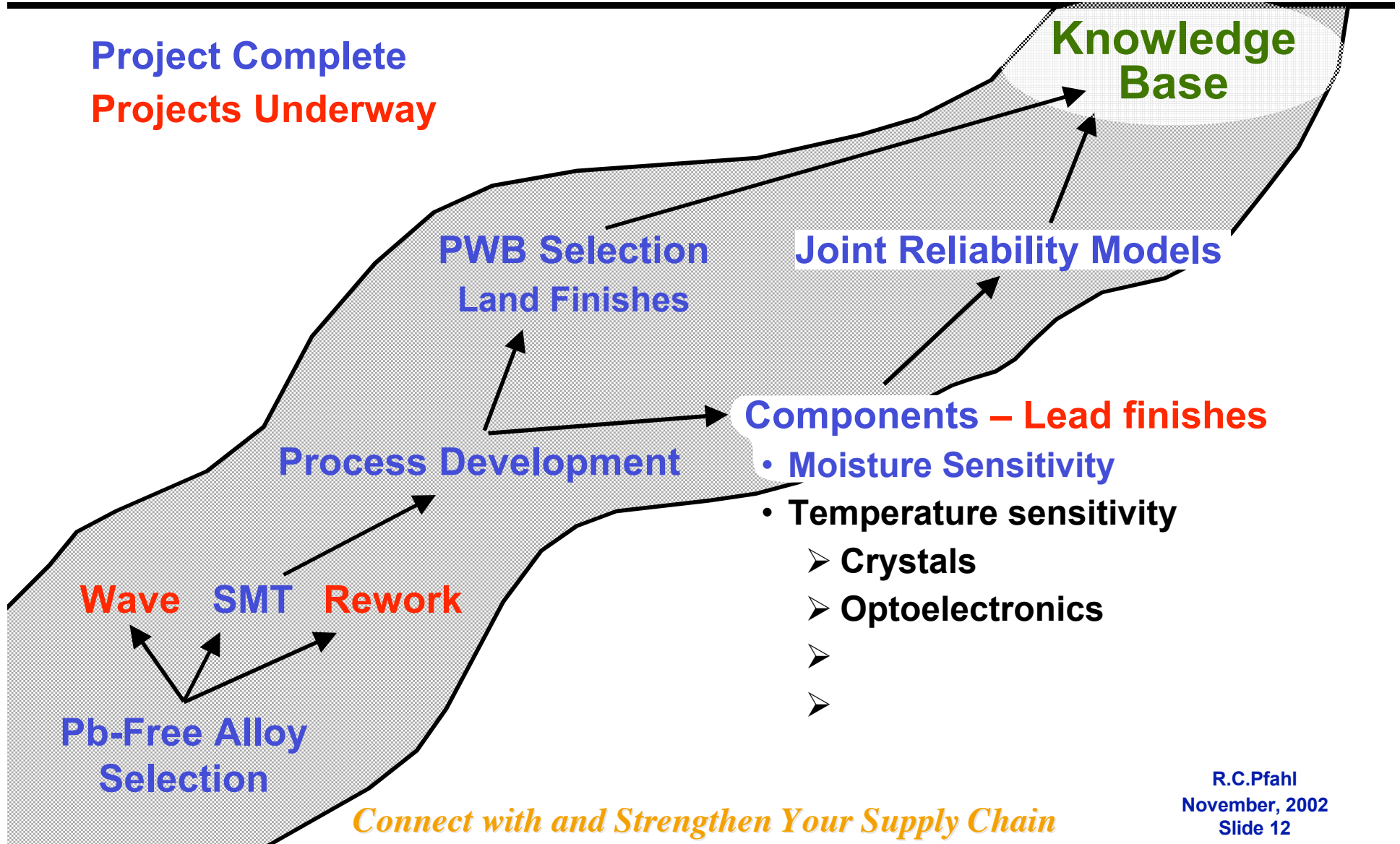
Addressing the RoHS Directive

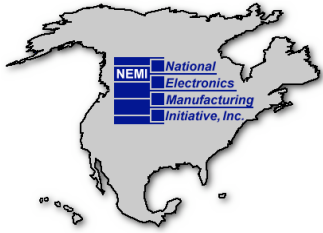
- **North American Pb-Free Activities (NEMI)**
 - Solder Alloy
 - Components/PWB
 - Process Development
 - Solder Reliability
 - Tin Whiskers
- **Materials of Concern (EIA)**
 - ✓ Materials Declaration Guide
 - ✓ Regulatory Tracking Tool

Connect with and Strengthen Your Supply Chain



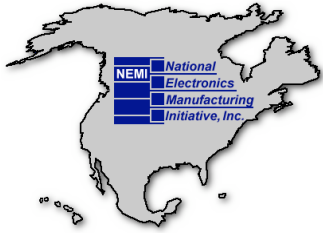
North American Pb-Free Activities (NEMI) Lead-Free Roadmap





Roadmap of Lead Free Assembly

- **Driving forces for Lead Free Assembly are many**
 - ✓ Market
 - ✓ Regulation
 - ✓ Reputation
- **Impact of these forces varies depending on**
 - ✓ Product segment (e.g. consumer, business, automotive)
 - ✓ Regional focus
 - ✓ Company strategy
- **NEMI Strategy is to ensure supply chain readiness for Lead Free Assembly**
- **Actual crossover is a business decision (based on above factors)**



NEMI Pb-Free Project Participants

OEMs/EMS

Agilent
Alcatel Canada
Celestica
Compaq(HP)
Delphi/Delco
IBM
Intel
Kodak
Lucent
Motorola
SCI
Solectron
StorageTek

Solder Suppliers

Alpha Metals
Heraeus
Indium
Kester

Components

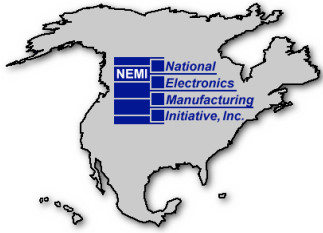
ChipPac
Intel
Motorola
Texas Instruments

FCI USA Electronics

Govt. & Other

NIST
SUNY-B/IEEC
ITRI (US)
IPC
BTU
Universal
Vitronics-Soltec

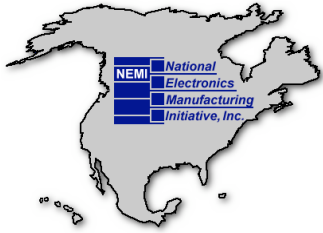
Connect with and Strengthen Your Supply Chain



Major Project Activities

- **Solder Alloy** – Carol Handwerker, NIST
 - ✓ Alloy Material Property development
 - ✓ Interface w/academia, government agencies
- **Components/PCBs** – Rich Parker, Delphi
 - ✓ Effect of High temperature reflow
 - ✓ Pb-free terminations
- **Process Development** – Jasbir Bath, Solectron
 - ✓ Generic process for Reliability test boards
 - ✓ Process characterization benchmark
- **Solder Reliability** – John Sohn, NEMI
 - ✓ Transparent test procedure
 - ✓ Common data to share with industry
- **Tin Whiskers** – Swami Prasad, ChipPAC

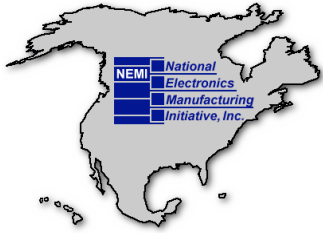
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NEMI Pb-Free Project Summary

- ✓ **Recommended specific Pb-Free SnAgCu alloy to industry**
- ✓ **Demonstrated manufacturability of Pb-free process with SnAgCu alloy – It is Doable! Motorola has product in production today with NEMI alloy.**
- ✓ **Demonstrated Reliability of Pb-free interconnection process with both SnPb and Pb-free component lead coatings – It is better than/equal to SnPb solder**
- ✓ **Industry can produce PWB's for Pb-free soldering**
- ✓ **Recommended modifications to JSTD 020 for Pb-free – Now released.**
- ✓ **Providing extensive data base to support conclusions**
- ✓ **Undertaking follow-on work to close knowledge gaps**
 - **Re-work, wave soldering (PIH interconnect)**
 - **Tin Whisker test methodology**
 - **Tin Whisker fundamental understanding**

Connect with and Strengthen Your Supply Chain



NEMI Pb-Free Project

- **The NEMI project has moved the industry forward in knowledge and understanding of Pb-free materials and processes.**
- **Continuing to work to fill in knowledge Gaps.**
- **Building the knowledge base equivalent to today's SnPb solder will not be done overnight.**
- **NEMI is open to working with other groups to insure that all major gaps are addressed in an effective & timely manner.**



Materials of Concern (EIA)

EIA Information and Supply Chain Management Tools

***EIA: Helping the Electronics Industry Achieve
Strategic Environmental Advantage***

R.C.Pfahl
November, 2002
Slide 18

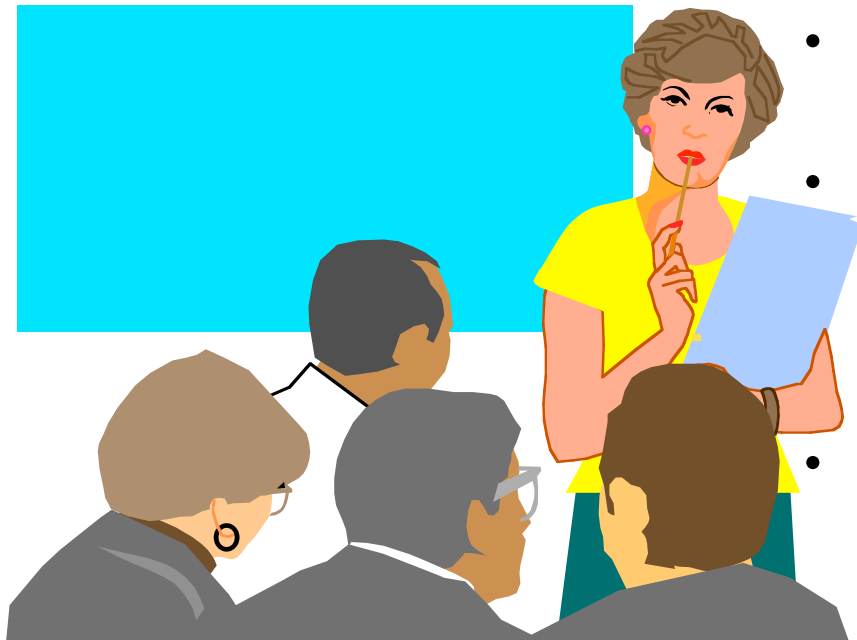


EIA's Material Declaration Guide

- **Companies use material declaration questionnaires to track material composition of components they purchase to ensure global sale**
- **Proliferation of questionnaires makes task inefficient and costly**
- **In 2000, EIA members asked EIA to take lead in development of industry guidance**

EIA: Helping the Electronics Industry Achieve Strategic Environmental Advantage

Material Declaration Status



- EIA Guide finalized February 2001
- Japanese and Europeans have similar efforts
- US-EU-Japanese Chemical lists, thresholds and formats differ
- Joint meetings have been held to harmonize
- Global standard expected in 2003.

Organizations Participating in Standardizing Material Declarations

- The European Information, Communications and Consumer Electronics Industry Technology Association (EICTA),
- The Japanese Green Procurement Supply Survey Initiative (JGPSSI) – a workgroup of the Japanese Electronics & Information Technology Industries Association (JEITA)
- The Electronic Industries Alliance (EIA)

EIA: Helping the Electronics Industry Achieve Strategic Environmental Advantage



Regulatory Tracking Tool

- **Regulatory Tracking Tool - internet based service that provides members with comprehensive legislation and regulatory information on international and domestic product requirements**

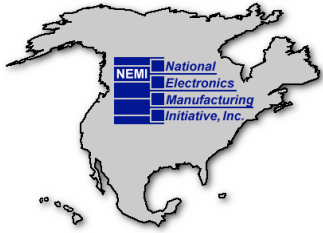
EIA: Helping the Electronics Industry Achieve Strategic Environmental Advantage



EIA Regulatory Tracking Tool

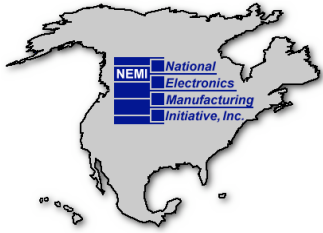
- **Why was it developed?**
- **Increased and often conflicting regulation at international, federal, and state levels may:**
 - ✓ Increase supply chain information requests.
 - ✓ Restrict free trade of electronics worldwide.
 - ✓ Result in inconsistent product requirements.
 - ✓ Increase manufacturing and marketing costs.
 - ✓ Reduce industry competitiveness.
 - ✓ Impact product reliability and effectiveness.
 - ✓ Increase environmental harm.
- **Companies need a tool to manage this information.**

EIA: Helping the Electronics Industry Achieve Strategic Environmental Advantage



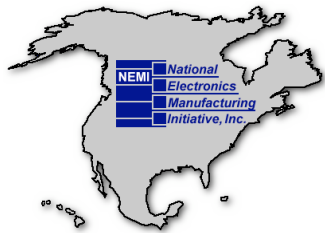
Addressing the WEEE Directive (AeA and NEMI) North American Status

- **North American OEMs are generally not prepared to implement the Product Take Back requirements of WEEE**
- **NEMI has taken the leadership by hosting a product take-back workshop in October 2002 to educate supply chain on new end-of-life requirements members**
 - ✓ **AEA Provided Support on Legislative Status**
 - ✓ **EIA Provided Support on Materials Declaration**



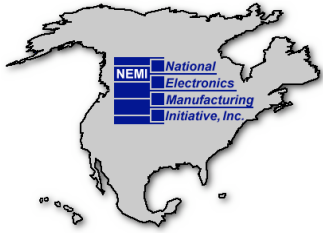
Identified Needs

- **No widely deployed standards exist for exchange of “Materials of Concern” Information**
- **Education of Supply Chain to new Requirements of WEEE and RoHS**
- **Web-based information on WEEE requirements**
- **Web-based exchange of WEEE required data to recyclers, treatment facilities, and member states.**
- **Development of Industry Standards for Measuring Hazardous Substance content in products**



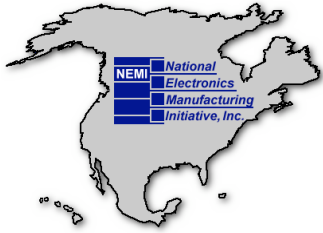
Next Steps

-
- **Follow Up NEMI Forum in first Quarter of 2003. Potential tasks include:**
 - ✓ **Address alternatives for meeting identified needs**
 - ✓ **Review alternative business models for recycling**
 - ✓ **Share best practices**
 - ✓ **Determine NEMI role in developing solutions**
 - ✓ **Establish Technology Integration Groups (TIGs) where needed.**



Needs and Direction of R&D

- **Develop and implement efficient methods for data exchange of environmental attributes to meet the requirements of European and Japanese regulations on Electronics and Automotive products.**
- **Develop tools to address the complex decision and tradeoff process to develop products with minimal environmental burden**
 - ✓ **Tools and data bases must be robust**
 - ✓ **Precise impact less critical than understanding relative burden of alternatives**



Regional Focus of R&D (CARE-1998)

Regional Drivers

Global Solutions

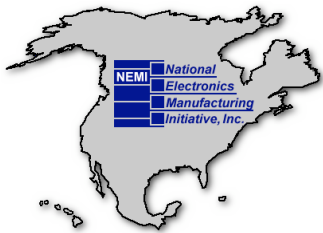
United States

- Regulation Driven
- Factory Focus
- Process Technology
 - ✓ CFC Elimination
 - ✓ VOC Reduction
 - ✓ Lead Elimination

Europe

- Customer & Regulation Driven
- Product Focus
- Information Technology
 - Design for Environment
 - Life Cycle Analysis

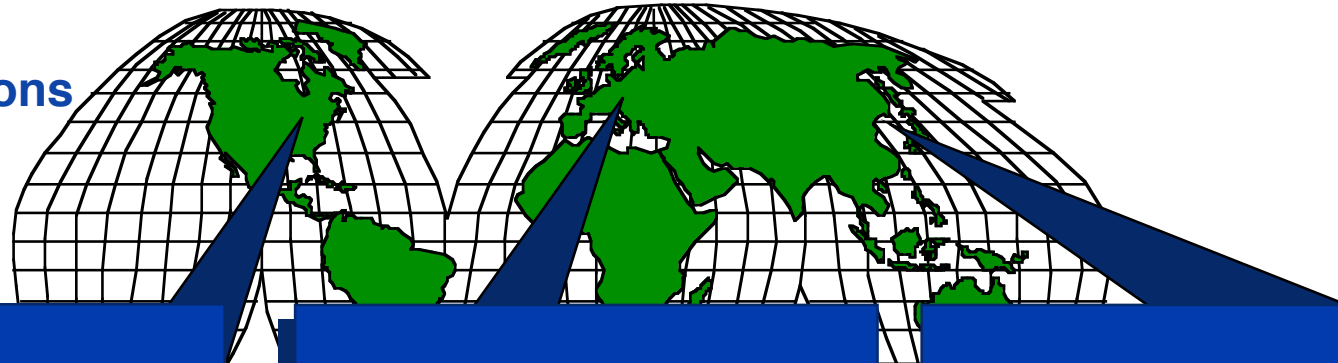
Connect with and Strengthen Your Supply Chain



Regional Focus of R&D (CARE-2002)

Regional Drivers

Global Solutions



United States

- Regulation Driven
- Application Focus
- R&D Linkages between industry, Gov., Academia
 - Viable analytical tools for Industry
 - Alternative Materials
 - Alternative Systems

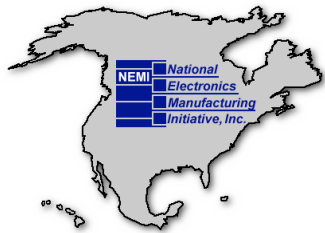
Europe

- Academic & Regulation Driven
- Academic Focus
- R&D: Model Focused
 - Life Cycle Analysis
 - Material Flow Analysis
 - Product Service Systems

Japan

- Government/Industry Driven
- Market Focus
- R&D: Product Focused
 - Hybrid Engines
 - Halogen Free Plastics
 - Pb-Free Products

Connect with and Strengthen Your Supply Chain



Conclusions

- **North America has a well defined roadmapping process for identifying Environmental needs in the Electronics Sector.**
- **The Process drives North American R&D institutes and research funding**
- **NEMI organizes Technology Integration Groups to develop and execute implementation strategies within the Supply Chain**
 - ✓ **Pb-Free Project**
 - ✓ **Product Take-Back Workshop**

Connect with and Strengthen Your Supply Chain