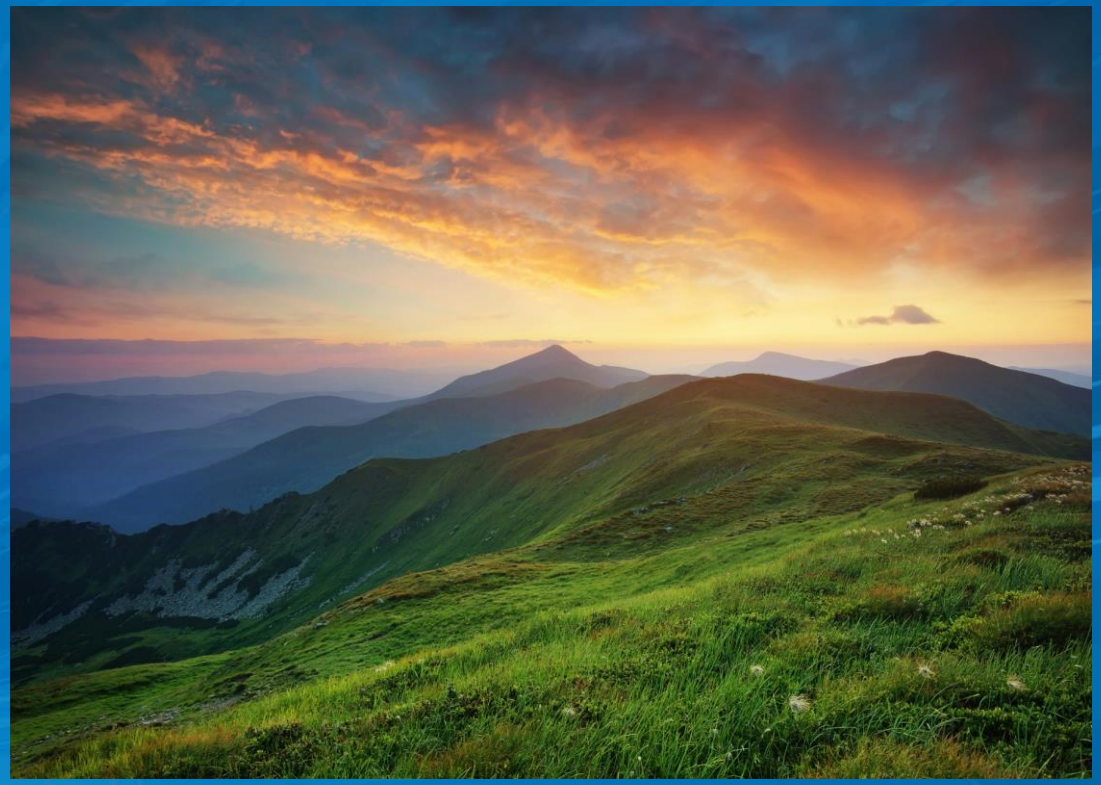
Roadmapping for Advanced Packaging & Heterogenous Integration: iNEMI's Perspective



Francis Mullany, Director of Roadmapping

ASME InterPACK 2022
25 October 2022

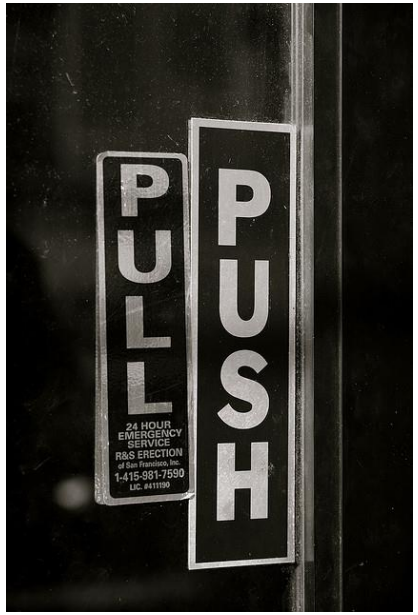
iNEMI®
Advancing manufacturing technology

“Mind the Gap!”

Technology roadmapping navigates the gap between today’s technology capability & tomorrow’s needs

Will McC, Wikipedia

Why Technology Roadmapping? It's Not About the Technology…



- Create a consensus view of gaps and challenges.
- Guide ecosystem collaboration to unblock competitive markets
- Ensure that technology push addresses real societal pull.

Why Technology Roadmapping? A Historical View

Early 1990s saw the emergence of major technology roadmaps to guide US industry:

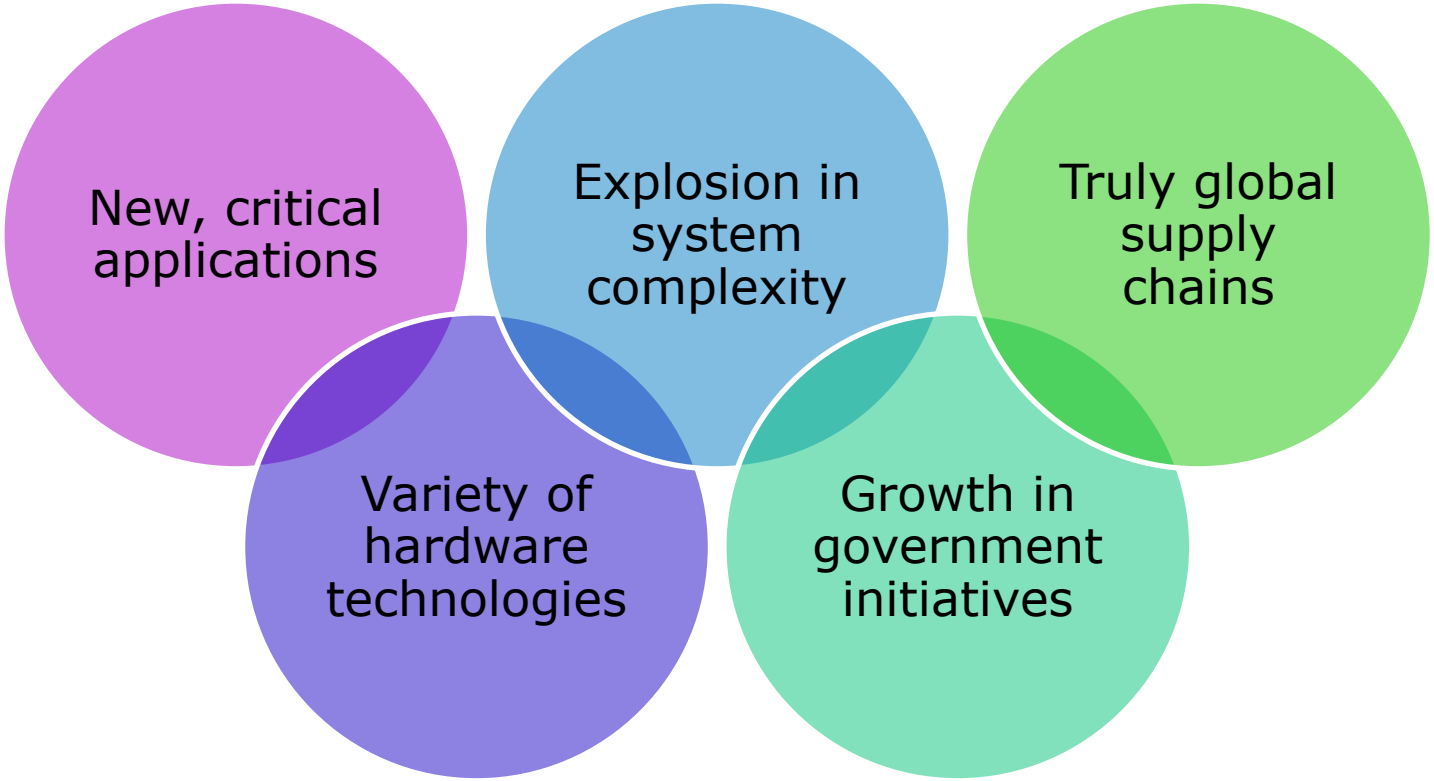
- NTRS – National Technology Roadmap for Semiconductors
- NEMI – National Electronics Manufacturing Initiative's roadmap

1994 NTRS Roadmap prediction

Year of First DRAM Shipment / *Minimum Feature Size (μm)*	*1995* / *0.35*	*1998* / *0.25*	*2001* / *0.18*	*2004* / *0.13*	*2007* / *0.10*	*2010* / *0.07*
Memory						
Bits/Chip (DRAM/Flash)	64M	256M	1G	4G	16G	64G
Cost/Bit @ volume (millicents)	0.017	0.007	0.003	0.001	0.0005	0.0002
Logic (High-Volume: Microprocessor)						
Logic Transistors/cm^2 (packed)	4M	7M	13M	25M	50M	90M
Bits/cm^2 (cache SRAM)	2M	6M	20M	50M	100M	300M
Cost/Transistor @ volume (millicents)	1	0.5	0.2	0.1	0.05	0.02
Logic (Low-Volume: ASIC)						
Transistors/cm^2 (auto layout)	2M	4M	7M	12M	25M	40M
Non-recurring engineering cost/transistor (millicents)	0.3	0.1	0.05	0.03	0.02	0.01

Figure 7. Overall Roadmap Technology Characteristics, Major Markets

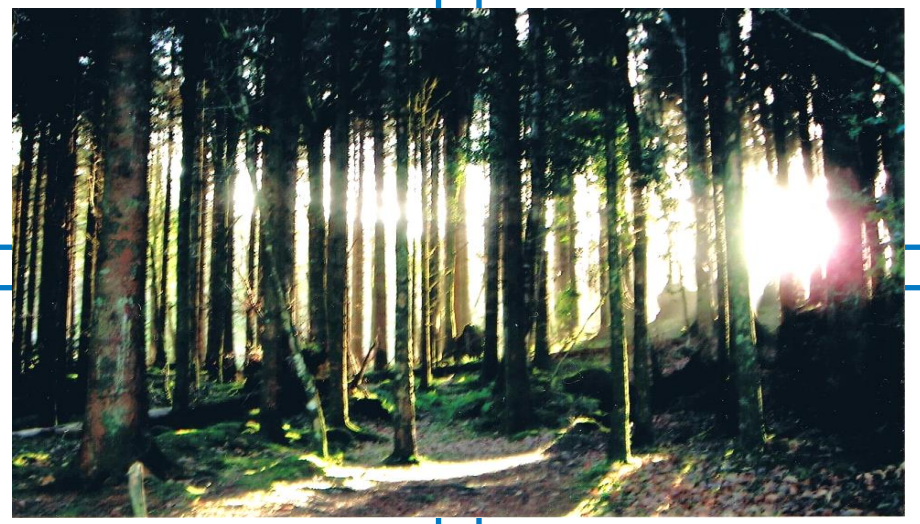
Increasing Relevancy of Technology Roadmaps for Packaging



The iNEMI Roadmap: Seeing Both the Wood and the Trees

Vision for a shared future in electronics manufacturing

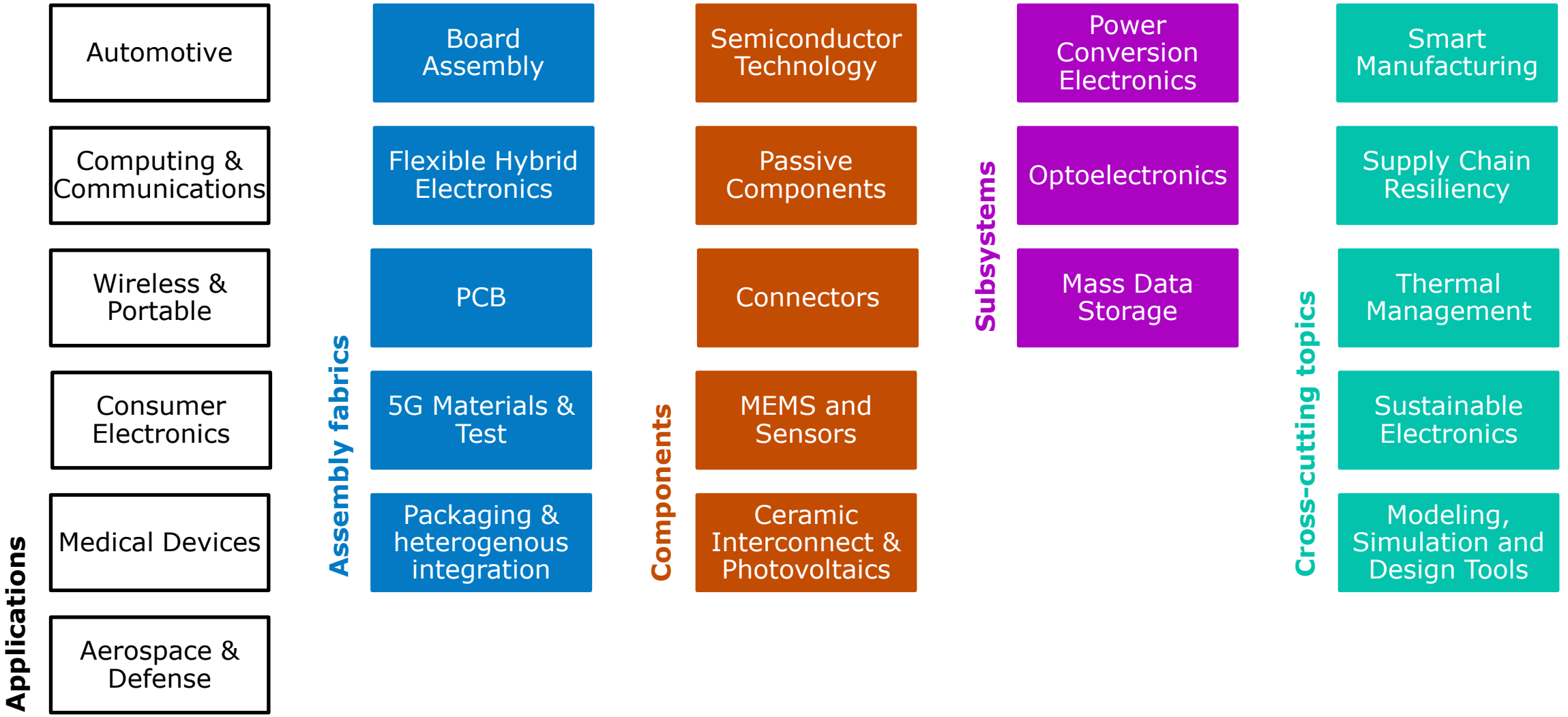
10-year time horizon



Full supply chain & lifecycle perspective

Focus on technical barriers to meeting real-world needs

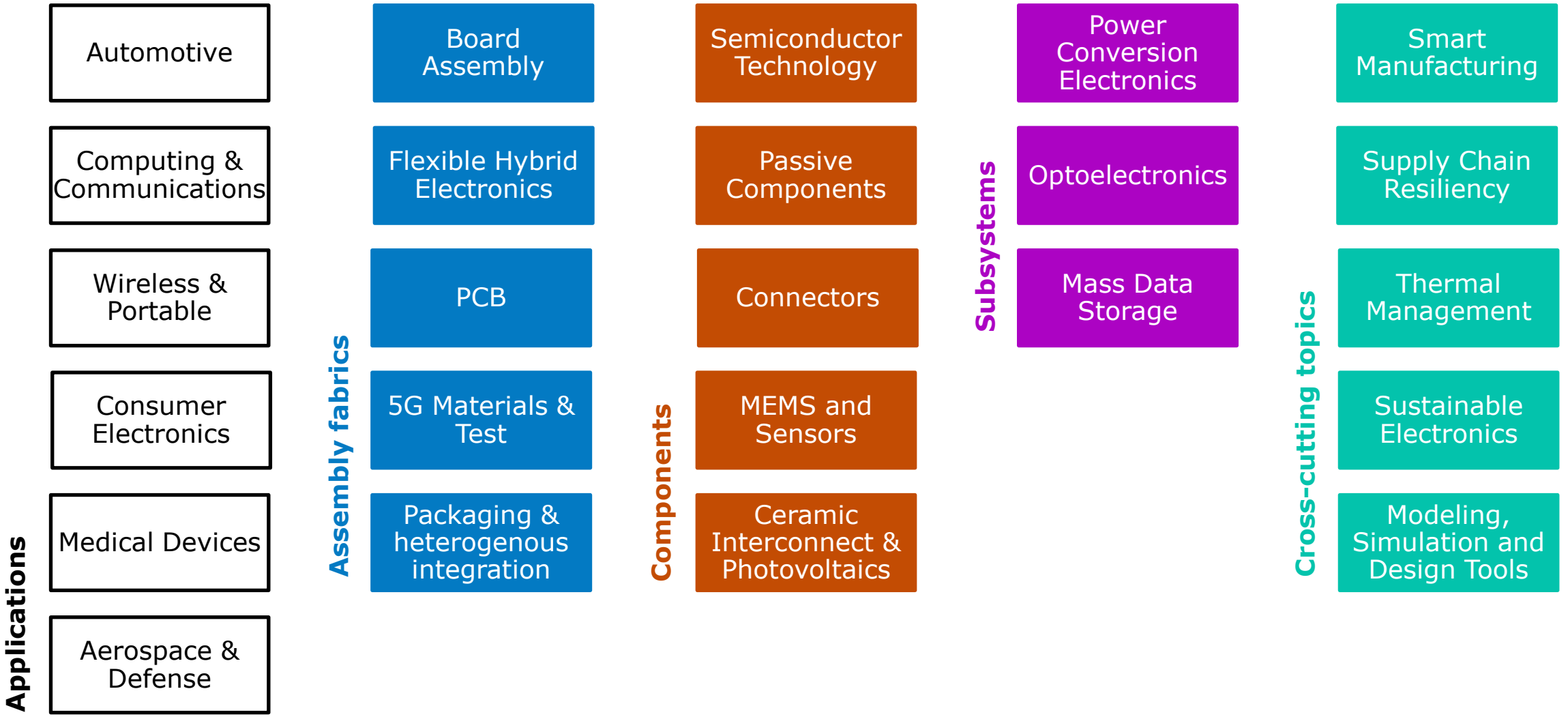
iNEMI Roadmap: Technical Scope



2022 iNEMI Roadmap Refresh: A New Approach to Roadmapping

Vision: Influence technology investment decisions by moving to shorter, on-line documentation, updated in real time by a diverse community of experts

iNEMI Roadmap: Technical Scope



iNEMI Roadmap: Schedule

Priority topics – available 1Q23

Applications

- Automotive
- Computing & Communications
- Wireless & Portable
- Consumer Electronics
- Medical Devices
- Aerospace & Defense

Assembly fabrics

- Board Assembly
- Flexible Hybrid Electronics
- PCB
- 5G Materials & Test
- Packaging & heterogenous integration

Components

- Semiconductor Technology
- Passive Components
- Connectors
- MEMS and Sensors
- Ceramic Interconnect & Photovoltaics

Subsystems

- Power Conversion Electronics
- Optoelectronics
- Mass Data Storage

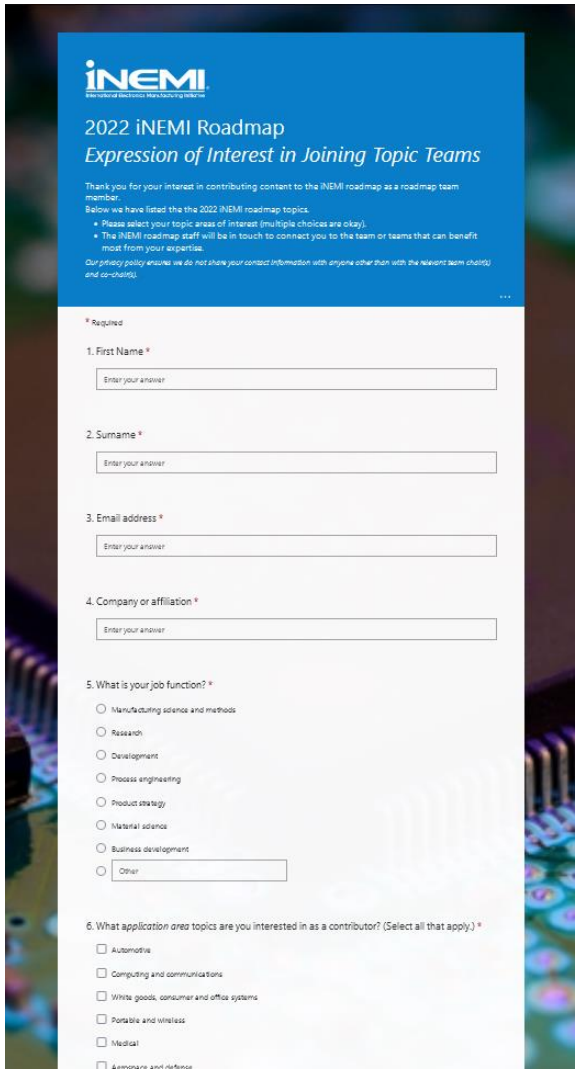
Cross-cutting topics

- Smart Manufacturing
- Supply Chain Resiliency
- Thermal Management
- Sustainable Electronics
- Modeling, Simulation and Design Tools

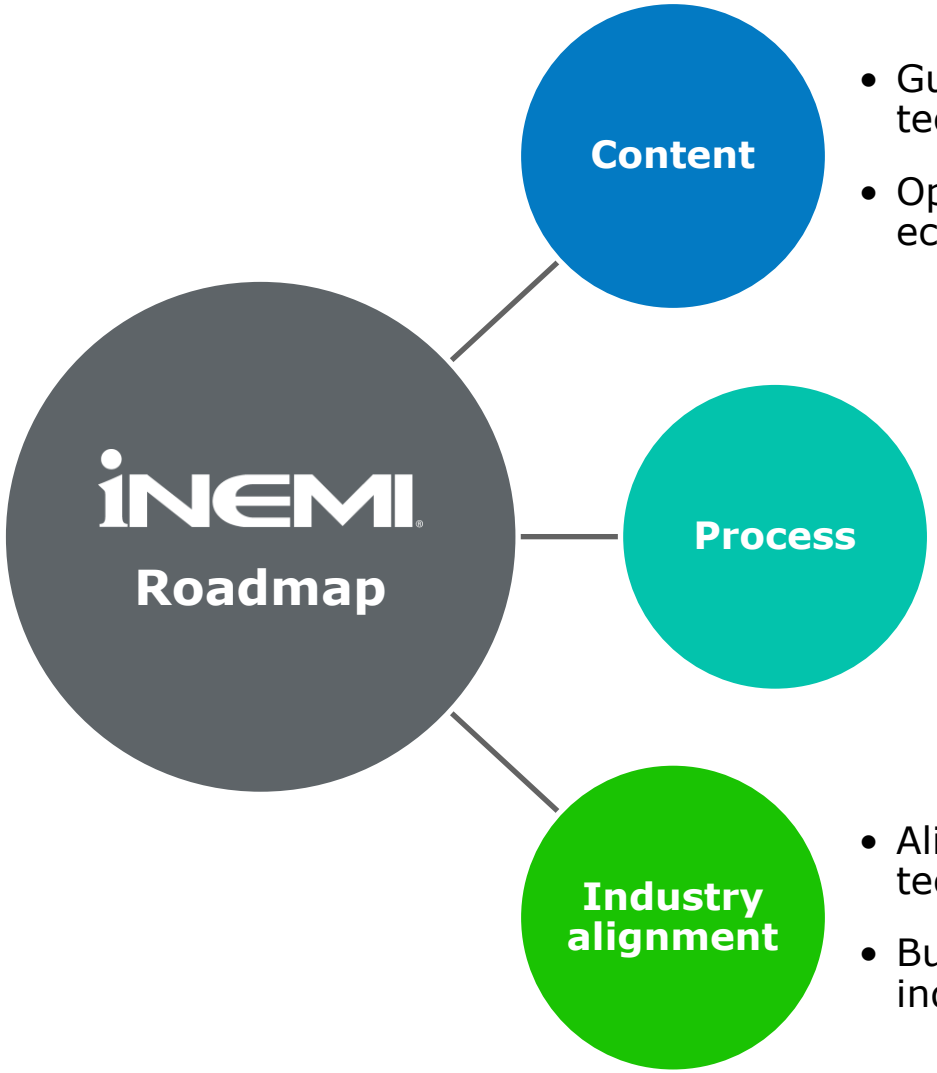
How To Get Involved In The iNEMI Roadmap

Please fill out a short expression-of-interest form at

https://forms.office.com/r/4mt747vhUD



Value of the iNEMI Roadmap



Value

- Guide R&D investment decisions for when technology is needed by the market
- Open new markets by triggering the closure of key ecosystem technology gaps

- Platform/forum for shared learning between subject matter experts
- Provide deeper insights from other parts of the value chain and other disciplines

- Align company strategy with the ecosystem's technology evolution
- Build future technology alignment along the industry value chains