Advanced Manufacturing, & Solid State Lighting Opportunities

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Status Quo: Products invented here, and made elsewhere
Significance of U.S. Manufacturing

11% of U.S. GDP, 12 million U.S. jobs, 60% of U.S. Exports

U.S. Trade Balance of Advanced Technology

Swung to historic deficit, lost 1/3\textsuperscript{rd} of workforce
Clean Energy: Nexus of Opportunities

- **Security**
  - Energy self-reliance
  - Stable, diverse energy supply

- **Economy**
  - Competitiveness in clean energy
  - Domestic jobs

- **Environment**
  - Clean air
  - Climate change
  - Health

Clean Energy Solutions
Climate Action Plan: Efficiency and Sustainability
National Economic Council: Manufacturing Competitiveness
Quadrennial Energy Plan: End-Use Sector Focus
Quadrennial Technology Plan: DOE Technology Area Focus
Clean Energy Manufacturing Tech-Team: Cross-Cutting Impact

Efficiency in Manufacturing Processes (Energy, CO$_2$)
Enabling Materials and Technologies for Clean Energy

Modalities: Technology Assistance and Technology Development
National Manufacturing Policy & DOE’s Role

- DOE is active across the pillars of Advanced Manufacturing
- DOE is a leader in advanced manufacturing innovation and implementing the National Network for Manufacturing Innovation (NNMI)

NNMI:
Processes for Clean Energy Materials & Technologies

**Solar PV Cell**

**Carbon Fibers**

**Light Emitting Diodes**

**Electro-Chromic Coatings**

**Membranes**

**EV Batteries**

**Multi-Material Joining**
Clean Energy Manufacturing Initiative – Across DOE

Collaboration toward:
- Common goal to collectively *increase U.S. manufacturing competitiveness*

Coordination for:
- Comprehensive Strategy
- Collaborative Ideas
AMO’s Purpose is to Increase U.S. Manufacturing Competitiveness and Energy Efficiency through:

- **Broadly Applicable Efficiency Technologies for Energy Intensive and Energy Dependent**
  - examples: combined heat and power (CHP), efficient manufacturing process intensification, energy management and process controls

- **Manufacturing**
  - Platform Manufacturing Innovations for Advanced Energy Technologies
    - examples: carbon fiber composites; critical materials; advanced materials manufacturing; high performance simulation, visualization and modelling, wide band gap semiconductors/power electronics
Manufacturing Sector Whitespace

Traditional Manufacturing Industry Sector Focus Areas

- Metals
- Glass & Ceramics
- Forest & Biomass
- Petrochemicals
- Extraction
- Concrete

Energy Use-Impactful Manufacturing

- Transportation
- Efficient Systems
- Power Generation
- Energy Delivery

Cross-Cutting Impact Opportunities
Broad Topical Areas

- **Platform Materials and Technologies for Energy Applications**
  - Advanced Materials Manufacturing (Mat’l Genome, Nanomaterials, etc.)
  - Critical Materials
  - Advanced Composites & Lightweight Materials
  - 3D Printing / Additive Manufacturing
  - 2D Manufacturing / Roll-to-Roll Processes
  - Wide Bandgap Power Electronics
  - Next Generation Electric Machines

- **Efficiency in Manufacturing Processes (Energy, CO₂)**
  - Advanced Sensors, Controls, Modeling and Platforms (ie. Smart Manf.)
  - Advanced Chemical Process Intensification
  - Grid Integration of Manufacturing (CHP and DR)
  - Sustainable Manufacturing (Water, New Fuels & Energy)

- **Emergent Topics in Manufacturing**
1. Technical Assistance

2. R & D Projects

3. Manufacturing R & D Facilities
AMO-supported R&D Facilities

1. **Manufacturing Demonstration Facility**: at Oak Ridge National Lab

2. **America Makes**: The National Additive Manufacturing Innovation Institute

3. **Critical Materials Institute**: A DOE Energy Innovation Hub at Ames National Lab

4. **Next Generation Power Electronics Manufacturing Innovation Institute**: *Power America* at NC State University

5. **Composites Materials and Structures Manufacturing Innovation Institute**: *Institute for Advanced Composite Materials Innovation* at Knoxville, TN

- Encompass machine-to-plant-to-enterprise-to-supply-chain aspects of sensing, instrumentation, monitoring, control, and optimization

- Enable hardware, protocols and models for advanced industrial automation: requires a holistic view of data, information and models in manufacturing

- Leverage High Performance Computing for High Fidelity Process Models

- Significantly reduce energy consumption and GHG emissions & improve operating efficiency – 20% to 30% potential

- Increase productivity and competitiveness across all manufacturing sectors: Special Focus on Energy Intensive Manufacturing Processes

Smart factories will be interconnected with supply chain, distribution, and business systems.

Leverages AMP 2.0
Advanced Materials Manufacturing

**Core Effort for Advanced Materials**

- **Advanced Modeling, Computing, and Simulation Capabilities**
  - leveraging and expanding on the current MGI multi-physics, multi-scale computational base

- **High Throughput Synthesis, Characterization & Analysis Capabilities**
  - high productivity combinatorial discovery & development tailored to specific energy end uses

*unique set of in-house capabilities in accelerated energy-materials development*

**linkages in methods / data / intellectual property**

Combines multi-physics, multi-scale computation with high-throughput synthesis and characterization for intelligent, focused RD&D in numerous energy technology thrusts, managed, e.g., in cross-cutting Materials Manufacturing Centers of Excellence (MMCOEs)

Leverages AMP 2.0

**U.S. DEPARTMENT OF ENERGY**

Energy Efficiency & Renewable Energy
2D Fabrication / Advanced Roll-to-Roll Manufacturing

- Technology development for the electronic manufacturing service (EMS) sectors to move from plate-to-plate standard lithography to continuous R2R processing.
- Miniaturization of critical feature sizes to the nanoscale
- Advancing tools and methods for process control, defect sensing, and real-time feedback
- **Potential Energy Applications:**
  - Solar, Batteries, Fuel Cell MEAs, Separation Membranes, Solid State Lighting, Building Envelopes, etc.
What does Success Look Like?

Energy Products Invented Here...

...And Competitively Made Here!
Thank You

Questions?