Focus Question #1: VISION AND GOALS

- Develop technologies that reduce life cycle energy, water, materials and carbon intensity by an order of magnitude, that can lead to:
  - 1% or greater impact on US energy consumption
  - associated GHG emissions reductions
  - reduction of U.S. water consumption by 20%

- Develop technologies/processes to significantly increase material reuse and recoverability
Focus Question #2: CHALLENGES

• Lack of data analytic approaches for use of sensing/information

• Lack of expert systems to analyze and process data

• Disparity—across industry—in data and associated tools

• Lack of cost effective manufacturing processes to allow for optimized design to minimize material use

• Lack of adaptive, reactive technologies

• Lack of understanding the coupling among materials, energy, and water uses

• Balancing trade offs between lifecycle material and energy use

• Principal agent problem → manufacturer may not care about down-stream materials and energy use issues
Focus Question #3: R&D NEEDS

Process innovation
- Modular, feasible, distributed manufacturing approaches for sustainable manufacturing
- Innovative material synthesis technologies to reduce water, energy, and waste simultaneously

Product Innovation
- Recycle friendly alloys (and other materials like polymers, composites, etc.)
- Methods to better utilize/enable use of post consumer materials

Data & Analytics
- Develop metrics and functional relationships among water, energy and materials attributes
- “Big data” approaches for accessing/analyzing data across the life cycle – connecting each step of the supply chain

Sustainable manufacturing design tools
- Integrated life cycle design tools and databases with decision-support systems
- Design tools that consider sustainability parameters

Worksheet: R&D Focus Areas
- Design concepts and tools for sustainable manufacturing
- Innovative Processes and Products to support sustainable manufacturing (incl. appropriate data)