Overview:
Steel Casting Research Center
Missouri S&T

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Importance of Keeping Strong Metals Manufacturing/Casting Education in US

- The number of workers 55 and older rose to 31 million in April 2011 from 19.2 million in April 2001
- The labor force 20 to 24 years old grew less than 1 million to 15.2 million from 14.6 million in April 2001
- May 2011, 17.6% of manufacturing companies reported having increased difficulty recruiting positions of “most strategic importance,” up from 10.2% last year
- Top 3 concerns of manufacturing employers:
  - recruiting competent job applicants (45.1%)
  - low skill levels of new employees (30.3%)
  - knowledge transfer experienced to less experienced employees (28.8%)

Sources: *Bloomberg*, May 26, 2011; *Wall Street Journal*, June 6, 2011, *Sloan Center on Aging & Work*, May 19, 2011

US Metallurgical and Materials Engineering (ASEE)

- 78,347 Total Engineering Graduates
  - 18,391 in Mechanical Engineering
  - 1152 in Materials Related Engineering (65 MatE & 7 MetE)
    - ~100 graduated in Metallurgical Engineering or Materials with a Metals Emphasis
- 7 Universities with Metallurgical Engineering Programs
  - University of Alabama (MetE)
  - Colorado School of Mines (Met & MatE)
  - **Missouri University of Science & Technology (MetE)**
  - Montana Tech (Met & MatE)
  - South Dakota School of Mines (MetE)
  - University of Texas-El Paso (Met & MatE)
  - University of Utah (MetE)

ASEE 2011 College Profiles

Why are fewer schools offering metallurgy/casting and less students graduating in these fields?

- Most universities evolving away from traditional metallurgy
  - Few universities in the US provide metallurgy or metal casting degrees
  - Lack of industrial/government support for metallurgy/metal casting
  - Small undergraduate programs
  - Decreased public education funding (our state support went from 60% to 20%)
    - Enrollment OR research must make up difference in funding
  - Research funding is in materials science (not metals manufacturing)
- Recruiting problems
  - Students perceive metallurgy/manufacturing/casting as a negative
  - Materials science and engineering is more attractive
    - biomaterials, nanotechnology, etc. (non-manufacturing emphasis)

Why continue teaching metallurgy?

Because a BS in metallurgy is significantly different than a BS in materials science & engineering?

- MSE is typically solid state chemistry/physics
  - Not metal processing or manufacturing
- MSE is typically science based (theory)
  - Metallurgy is typically engineering based (practical)
- MSE typically eliminates metals manufacturing from curriculum
  - Eliminates courses required in S&T's metallurgy curriculum (such as metals processing, metal casting, steelmaking, metal microstructure, metals refining, welding, heat treating, etc.)

How has Missouri S&T stayed strong in metallurgy and casting?

- Comprehensive BS metallurgical engineering
  - Extractive, metal casting, steelmaking, physical metallurgy, etc.
  - Strongly sought by metal manufacturing industry
    - ~100 companies at Career Fairs/on campus seeking BS in MetE
    - Graduates receive multiple offers at salaries above average
- Aggressive recruitment
- Increased research through new programs
  - Steel Research / Metal Casting
    - Without research – metallurgy & casting will not survive
- Industrial / alumni support
  - Chaired professors (1 steel + 1 casting) / Equipment / Special funds
  - Scholarships

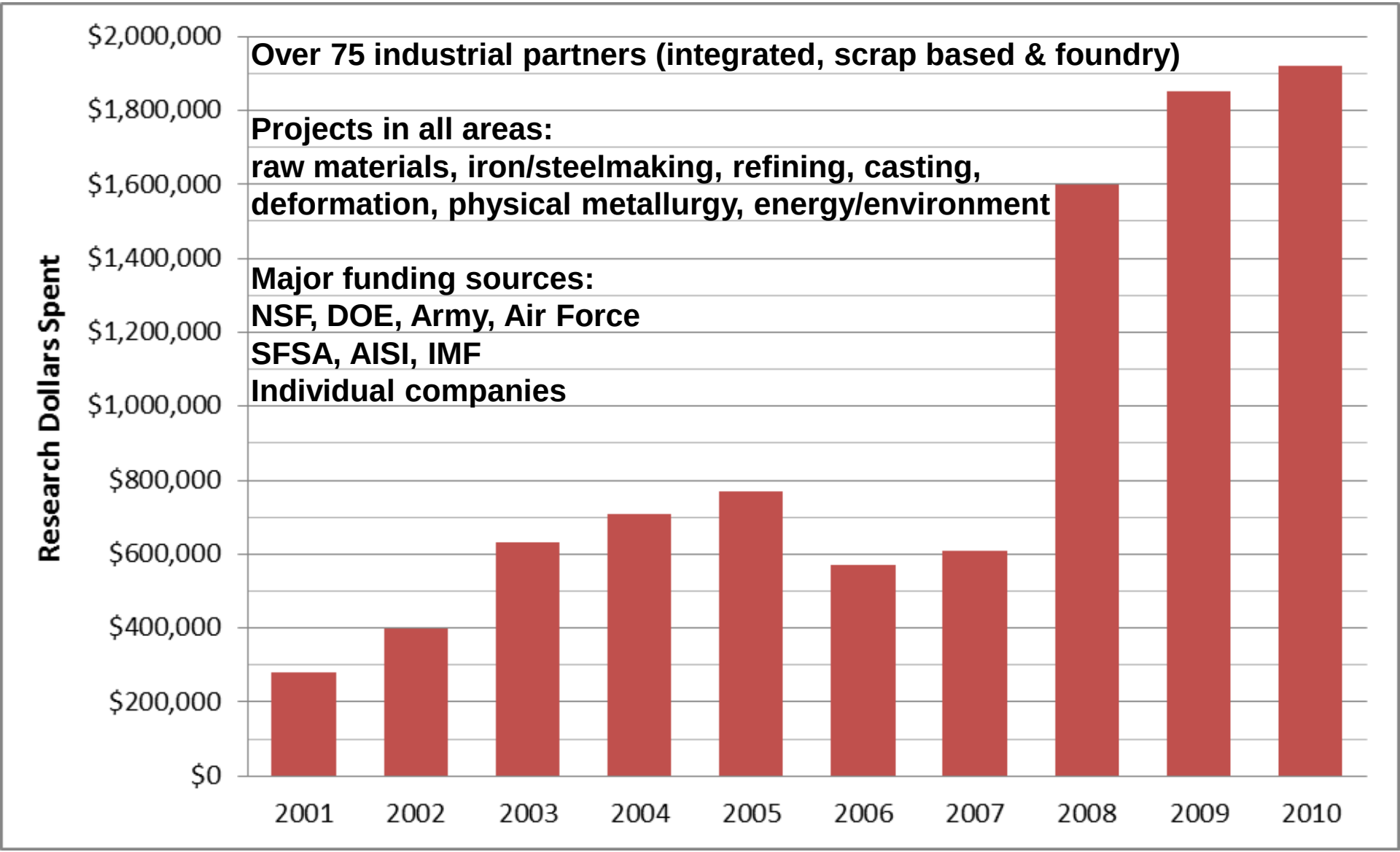
Metallurgical Engineering at Missouri S&T

- History of program
  - BS in Metallurgical Engineering (since 1870)
  - PhD in Metallurgical Engineering (since 1937)
- Largest US Metallurgical Engineering program
  - 228 BS Met E grads last 10 years (+210 BS Cer E grads)
    - 2/3 took positions in metals manufacturing
    - 100 took jobs in ferrous metallurgy
      - Integrated and mini-mill steel companies
      - Specialty steel and ferrous manufacturing
  - 17 Full-time Faculty – largest S&T research dept
    - $7 million in research

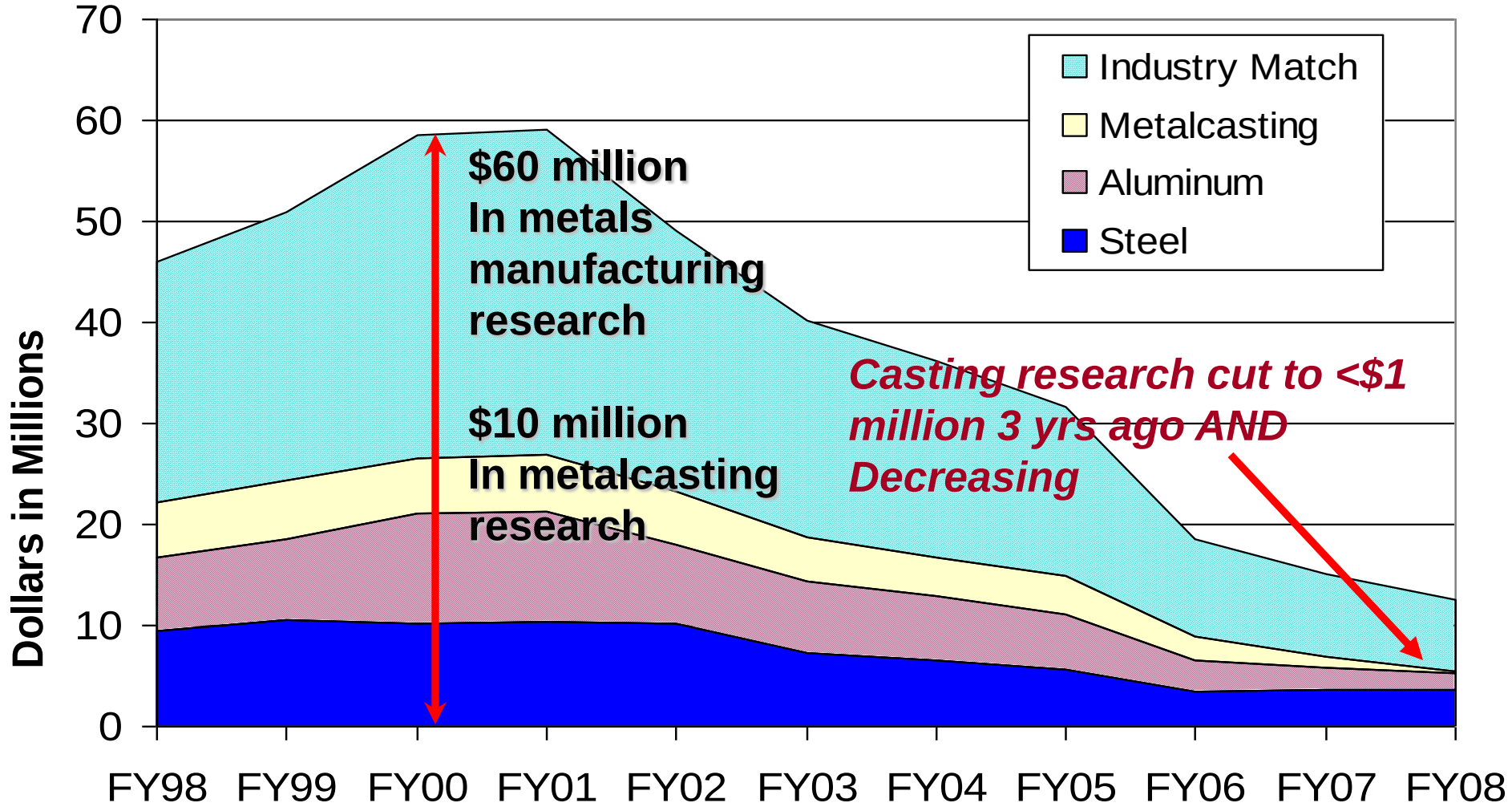
Employment Statistics (2006-12)

- BS Metallurgical Engineering Job Accepted – (2011-2012)
  - 19 BS Grads (4 Dec 2011 / 15 May 2012) – 100% jobs by graduation
    - ArcelorMittal (3), Carpenter, Caterpillar, Gerdau Steel, John Deere, KC Power & Light, Megamet, Metaltek, Nucor(2), Spartanburg Steel, St. Louis Cold Draw, Stollberg, Teck Cominco, Alaska, ThyssenKrupp Steel, Timken, US Steel
  - Salary range = $50,000 to $81,000/yr = ~$61,500 average
- Summary of jobs accepted (2006 - 11):
  - 67 (~75%) with iron & steel companies / metal casting / manufacturers:
    - Alleghany, Amsted Rail, ArcelorMittal(10), Bradken, Cameron, Carpenter(4), Caterpillar(4), Cleveland Cliffs, Durabar, Exitube, Gerdau(5), John Deere, Keokuk Casting, Metaltek(3), Neenah Foundry, Nooter, Nucor(10), Foundry Suppliers(2), Scot Forge(2), Severstal(2), Spartanburg, St. Louis Cold Draw, Steel Dynamics(3), ThyssenKrupp Steel, Timken(2), US Steel(6)
  - 8 (~8%) with non-ferrous metals manufacturing (mining/gold/copper)
  - 16 (~17%) with others (aerospace/petroleum/corrosion/power plants)
  - In addition - MS/PhD Students working on metal casting projects:
    - PhD’s - 5 FEF Key Professors graduated (Bartlett, Teague, Tuttle, Trueba, Webber)
    - MS grads at Metaltek, Pacific Steel, Harrison Steel, Columbiana

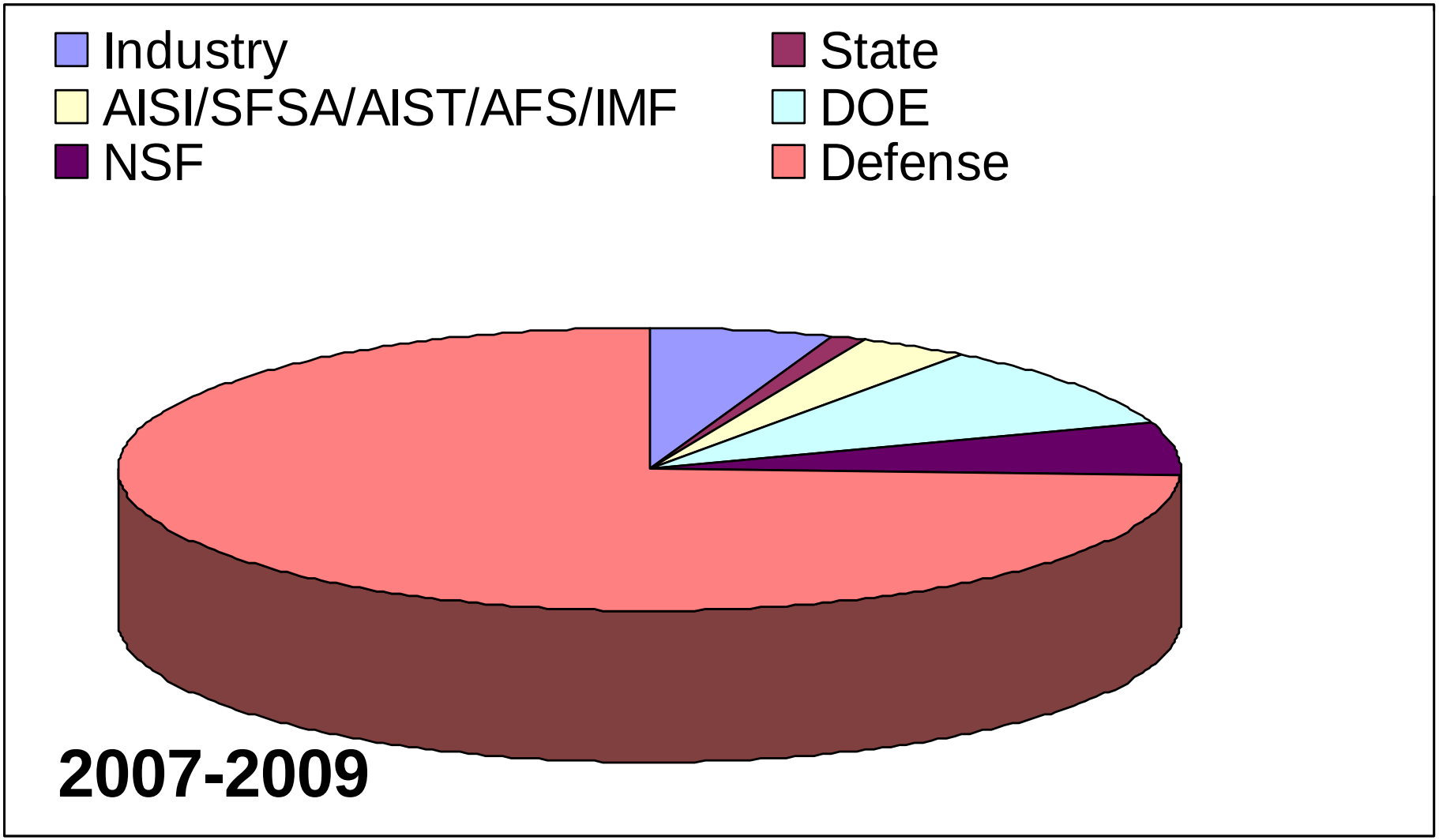
Growth of Steel Casting Research at Missouri S&T



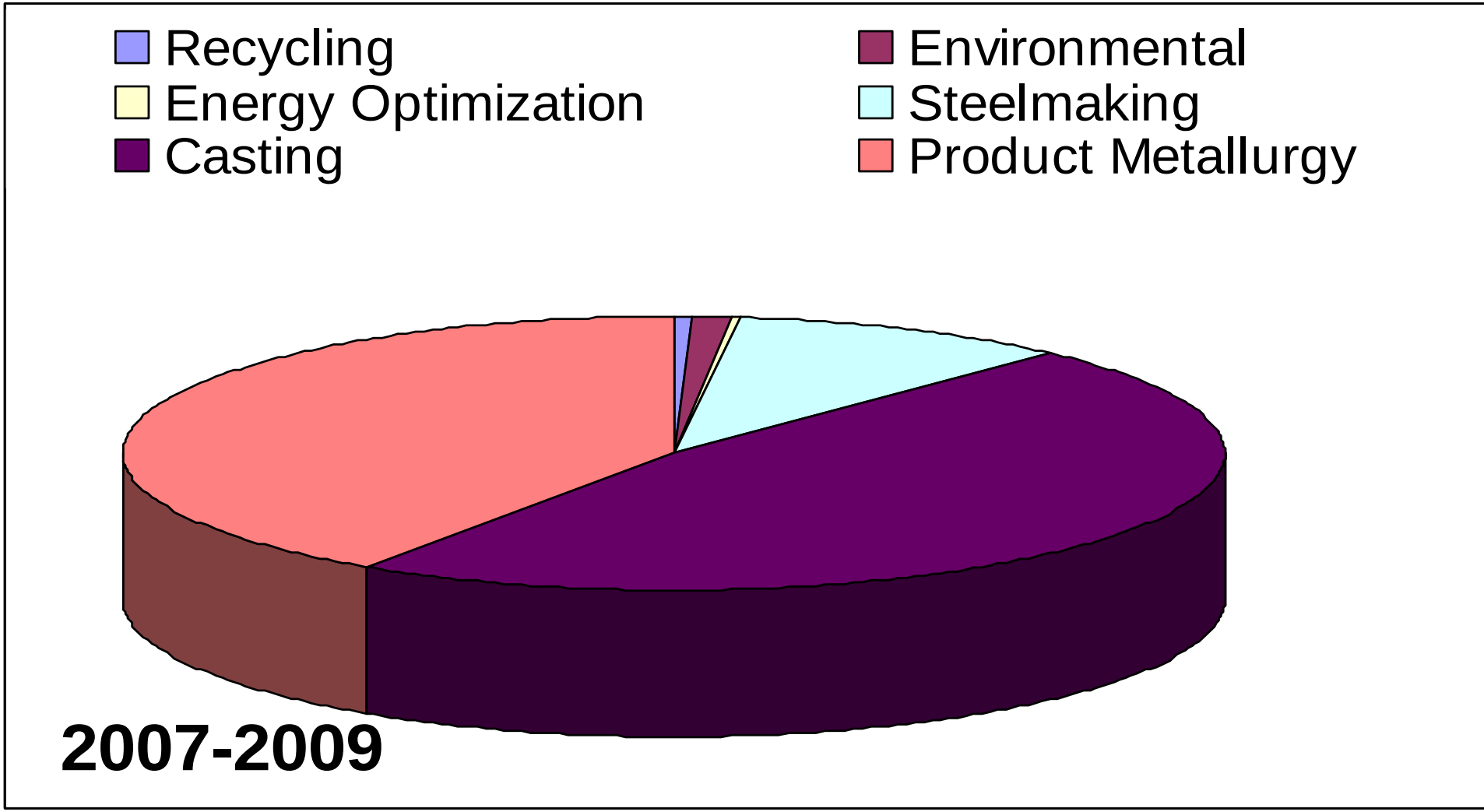
US DOE Funding – Industries of the Future



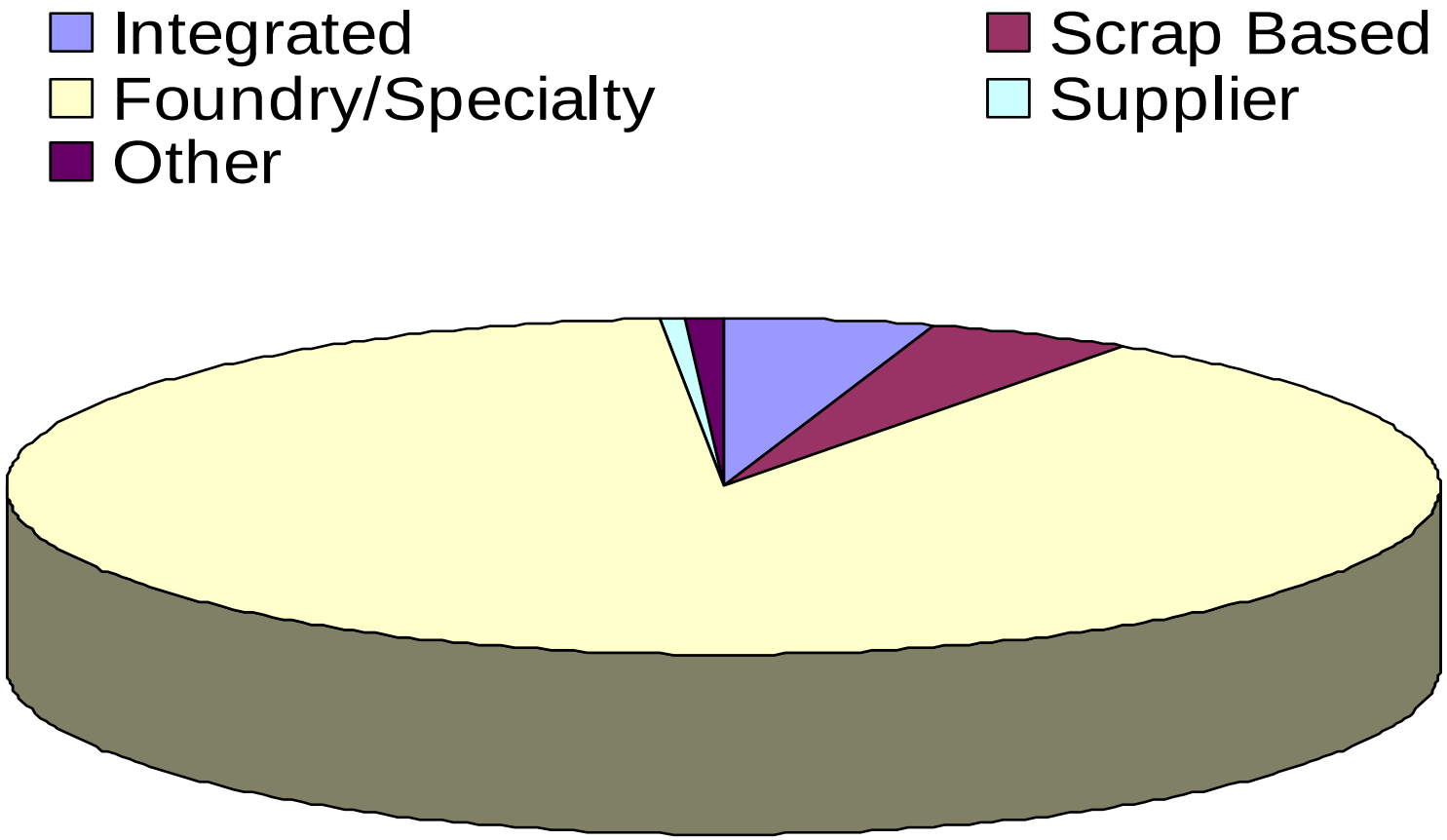
Funding Sources



Research Areas



Industries Support



2007-2009

Missouri S&T Steel Casting Research Group

- Kent Peaslee, Ken Iverson Steelmaking Chair
- David Van Aken, Physical Metallurgy
- Von Richards, Wolf Professor of Metal Casting
- Julia Medvedeva, Computational Physics
- Nadezda Medvedeva, Physics
- Simon Lekakh, Steel Processing
- KC Chandrashekhara, Modeling of Solid Structures
- Jeff Smith, Refractories

Steel Manufacturing Research Consortium

The Steel Manufacturing Research Consortium will be comprised of steel manufacturing companies and suppliers that fund metallurgical research at the Missouri University of Science and Technology.

Major benefits of the consortium structure for industry partners:

- pooled resources
- reduced indirect costs (0% versus 51.5%)
- a common legal agreement
- protection of company proprietary information
- timely research and reporting
- students (undergrad/grad) interested and trained in casting

Steel Manufacturing Research Consortium

Funding is pooled to address fundamental steel casting/manufacturing issues:

- steelmaking, casting, product development, environmental and safety issues or any area partners select for collaborative research

Research results of consortium are shared:

- Value beyond sponsorship of a single university project
- No university indirect costs for funding through the industry consortium
- All funding devoted to accomplishing research objectives

Legal agreement common for all industry partners:

- Non-exclusive royalty-free license to use IP developed by Consortium
- Company proprietary information strictly protected
  - students sign agreement to protect company proprietary information
  - non-disclosure agreements signed by university with each company

Research reported quarterly / Two annual Consortium meetings

- Research focus/direction determined by industry partners at meetings

Steel Manufacturing Research Consortium

Other important benefits:

- Early access to undergrad and grad students - potential job candidates
- Industry engineers work closely with students to provide guidance and direction on projects and have opportunity to assess student's skill level
- 2/3 of graduates entering metal casting/steel industry during last 5 years worked on steel-related research projects – Consortium sustains trend
- Immediate access to faculty and facilities at Missouri S&T
- Continuing education through Center workshops/short courses

Expected Fee Structure:

- Full Voting Membership - $60,000 per year (100 voting points)
- Gold Membership - $200,000 per year (500 voting points)
- Associate Membership - $15,000 per year (no voting points)