South Carolina Centers of Economic Excellence

2007-2008 Annual Report to the S.C. General Assembly and the S.C. Budget & Control Board

[CoEE Program information for FY 2009 is indicated in brackets.
The FY 2009 report will be issued on October 1, 2009.]

[COVER PHOTOGRAPH: Dr. Travis Knight, Director of the University of South Carolina Nuclear Engineering Graduate Program, works on a fluidized bed chemical vapor deposition coater to produce coated particle fuels for high temperature gas-cooled reactor applications. Dr. Knight's research on this project focuses on advanced coated particle fuels for very high temperature operation to improve efficiency and performance. These reactors have the potential to be used in the future for hydrogen production as well as electricity. Similar types of reactors exist in Japan and China and are being built in South Africa. A demonstration reactor is planned for Idaho National Laboratory by year 2019. Any future production of hydrogen for transportation must come from nuclear power if it is to reduce carbon emissions and other pollutants associated with burning fossil fuels.]

MESSAGE FROM THE COEE REVIEW BOARD CHAIR

Shortly after the South Carolina Centers of Economic Excellence (CoEE) Review Board was formed in October 2002, it wrote into its guidelines an accountability measure to South Carolina's taxpayers: an objective, comprehensive evaluation of the CoEE Program after its first six years.

In June 2008, the CoEE Review Board contracted with the prestigious Washington DC-based Washington Advisory Group to conduct this external evaluation. The evaluation team was led by Dr. Karen Holbrook, former president of The Ohio State University and the current Vice President for Research & Innovation at the University of South Florida. The two other evaluation team members included Dr. Jack Breese, former Research Director at Microsoft and member of the Washington State Economic Development Commission, and Dr. Hunt Williams, former president of Merit Network, Inc. (a Michigan-based economic development organization that developed America's first national high-speed Internet backbone for research and education). All three individuals are inarguably leading experts on academic research and economic development.

As members of the CoEE Review Board signed the evaluation contract, they were all well aware of possible worst-case scenarios for such intense external scrutiny—especially given the program's critical legislative mandate: "the creation of well-paying jobs and enhanced economic opportunities in knowledge-based industries for all South Carolinians." A few Review Board members—myself included—may even have lost a few nights of sleep between June and December of last year.

In January 2009, the *2003-2008 CoEE Program Comprehensive Evaluation* was released during a televised press conference. Never have I been so proud as when I stood at the podium and announced that the Washington Advisory Group had concluded the CoEE Program was the best research program of its kind in the nation and should be the envy of all other states. Through fiscal year 2008, the CoEE Program has generated nearly **one quarter-billion dollars** in non-state investment into the state economy and is already responsible for the creation of more than 2,000 high-paying, knowledge-based economy jobs.

News about the CoEE Program only continues to improve: At the end of the 2008 calendar year, South Carolina's three senior research institutions reached the $100 million mark in non-state matching pledges for advanced scientific research in such critical industry areas as automotive engineering, biomedicine, future fuels, and cancer research. To date, 42 Centers of Economic Excellence have been created, with 21 world-class researchers recruited from the world's most prestigious academic institutions to lead them.

The CoEE Program is not just profoundly impacting our state's major metropolitan areas. For example, leading titanium manufacturer American Titanium Works (ATW) recently announced the building of a $422 million manufacturing plant in Laurens County, which is expected to employ more than 300 people. ATW's CEO cited the Clemson University International Center for Automotive Research (part of the CoEE Program with four CoEE endowed professorships) as one of the main reasons for its location decision.

Also, research conducted at the Stroke CoEE, a collaborative program between USC and MUSC, has critically reshaped rural stroke care in South Carolina. In May 2008, the REACH network was activated. Doctors at MUSC are now able to treat stroke victims at community hospitals through remote telemedicine. In just a few months at McLeod Health, twice the number of stroke patients were treated with a life-changing stroke therapy than had been treated in the full previous year.

I am also pleased to report that in 2008, SC LightRail went online. SC LightRail is a dedicated, high-speed communication network which links the state's senior research universities to the National LambdaRail. (Think Super Internet: complex data feeds that once required considerable time to send now blaze across the state in mere seconds.) Funded by the General Assembly in 2008, SC LightRail offers multiple economic development benefits. It provides support for the development of new or expanding business segments that rely heavily on imaging (biomedicine, bioengineering, etc.). It reduces costs by enabling the universities to pool resources instead of purchasing duplicate systems. And it takes South Carolina's research universities to the next level in terms of computing power—which makes our state more competitive for major research grants and serves as an essential recruitment tool to attract top CoEE Program faculty.

The CoEE Program is South Carolina's proactive effort to reinvent its economy and improve quality of life. Thus far, more than 100 major companies—including BMW, 3M, Toyota, BlueCross BlueShield, Fluor, Exxon Mobile—have invested in the program. The CoEE Program is now also attracting the most creative students in the country. Despite the fact that the current economic crisis has forced our state leaders to reevaluate many of its budgetary priorities, there is little doubt that investing in science, research, and technology is a certain way to secure the South Carolina's economic future.

The recent words of S.C. Speaker of the House Bobby Harrell perhaps sum up best the first six years of this one-of-a-kind academic research program: "Since the CoEE Program began, South Carolina has successfully built Centers in cutting-edge fields that diversify our state's economy and position us competitively in the national and global economy. This is particularly important given today's economic uncertainty. The CoEE Program will have continued long-term positive impact on South Carolina's economy."

What a wonderful way to conclude the first chapter in the history of the CoEE Program. We can only begin to imagine the triumphs in store over the next six years!

SOUTH CAROLINA
CoEE
CENTERS of ECONOMIC EXCELLENCE
RESEARCH • INNOVATION • INVESTMENT

Paula Harper Bethea
Chair, SC Centers of Economic Excellence Review Board
April 2009

South Carolina Centers of Economic Excellence
2007-2008 Annual Report to the S.C. General Assembly
and the S.C. Budget & Control Board

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MUSC College of Nursing Dean, Dr. Gail Stuart (left) and CoEE chair holder, Dr. John Schaefer (right), demonstrate resuscitation techniques on a simulator mannequin caring for patients with acute stroke symptoms.

Executive Summary

PROGRAM SUMMARY

In 2002, the South Carolina General Assembly enacted the South Carolina Research Centers of Economic Excellence Act (RCEE Act). The legislation originally designated $200 million through 2010 from the South Carolina Education Lottery to establish Centers of Economic Excellence by creating unique endowed professorships at South Carolina's three senior research institutions: Clemson University, the University of South Carolina, and the Medical University of South Carolina. (In 2008, the S.C. General Assembly revised the RCEE Act to provide for $30 million in guaranteed funding each year provided all lottery scholarships have been funded, and provided at least 80% of all appropriations have been awarded through the most recent previous fiscal year.) Each Center of Economic Excellence (CoEE) specializes in knowledge-economy research in fields such as engineering, nanotechnology, biomedicine, energy science, environmental science, and information and management science. The world-class scientists hired to become CoEE chairs will secure major private sector funding and federal grants for the state and over time will increase the state's knowledge base and stimulate the state's economy.

An 11-member Review Board appointed by the Governor (3 appointees), the President Pro Tempore of the Senate (3 appointees), the Speaker of the House of Representatives (3 appointees), the Chair of the Senate Finance Committee (1 appointee), and the Chair of the House Ways & Means Committee (1 appointee) approves new CoEEs and provides program oversight. The three research university presidents serve as ex-officio, non-voting members of the Review Board. Staff and operational support for the CoEE program are provided by the Commission on Higher Education, which also approves the program annual operating budget.

Once a CoEE is approved by the Review Board, the fiscal lead institution, along with any collaborating institutions, has 18 months during which to solicit dollar-for-dollar, non-state pledges to match the state award total (between $2 million and $5 million). In February 2007, the CoEE Review Board approved a policy whereby an institution may apply for as many as two, six-month extensions beyond the 18-month pledge verification deadline. All non-state matching pledges must be realized within 78 months of the CoEE award date. State funds may only be drawn against in-hand (realized) non-state pledges. The entire portion of the state award, plus no

less than 40% of the non-state match, must be placed into endowment for each CoEE; no more than 60% of the non-state match may be used to fund start-up operating costs for a CoEE.

On June 25, 2008, the South Carolina General Assembly enacted significant amendments to the RCEE Act. These amendments included: (a) increasing the number of Review Board members from nine to 11; (b) establishing an October 1 annual deadline for the program annual report and audit, and requiring that both documents be submitted to the members of the legislature in addition to the Budget & Control Board; (c) providing permanent funding for the program in the amount of $30 million annually; (d) allowing the CoEE Review Board to use accrued program interest to fund additional CoEEs; (e) encoding the three-tier review process for CoEE proposals; (f) encouraging the senior research institutions to partner with other South Carolina institutions of higher education; (g) permitting the senior research institutions to use a percentage of non-state matching funds for CoEE start-up costs; and (h) permitting cash equivalent donations for non-state matching funds.

In December 2002, the CoEE Review Board determined that an external evaluation of the CoEE Program should be performed in the program's sixth year. The Review Board believed it was critical to create an accountability measure that ensures state tax dollars are being used efficiently and wisely to achieve the program's statutory mandate "to create well-paying jobs and enhanced economic opportunities for the people of South Carolina" (S.C. 2-75-5(B)(1)). On January 12, 2009, the CoEE Review Board released the Washington Advisory Group's *2003-2008 CoEE Program Comprehensive Evaluation.* (The Washington Advisory Group is a Washington DC-based consulting firm which specializes in strategic counsel and analysis of higher education institutions with institutional mission focus in R&D and economic development.)

The *2003-2008 CoEE Program Comprehensive Evaluation* places the CoEE Program in rarefied academic research territory:

> Our conclusion is that the CoEE program is an extraordinary effort by the state of South Carolina to invest in its Knowledge Economy and is a best-in-kind program that is, or should be, the envy of other states. The state and its senior research universities are to be applauded for nurturing the CoEE program and for deploying it as a powerful tool for the creation of high-wage jobs and improvement in the quality of life of South Carolina's citizens.

The WAG evaluation team also reported that in the CoEE Program's first six years, not only has it been responsible for creating 2,000 high-paying, knowledge-based jobs (a remarkable statistic for any economic development program in its first few years), but the program has put ***one quarter billion dollars*** in non-state investment into the South Carolina economy.

By the end of fiscal year (FY) 2008, the CoEE Review Board had approved 41 research centers and 70 endowed chair positions,[1] 15 of which were appointed by the end of FY 2008. [In FY 2009, an additional seven chairs were appointed, and one chair resigned.] As intended, the program is brightening the economic landscape in South Carolina: At the end of FY 2008, of the $169 million awarded by the Review Board, $119.7 million in non-state matches had been pledged, with more than $72.7 million in pledges paid and $66.5 million in state lottery funds drawn down by the three senior research institutions.[2]

Over time, each institution has developed concentrated CoEE focus areas. Clemson University's core strengths are in automotive and transportation technology, as well as in advanced materials, sustainable environment, and biotechnology/biomedical sciences. From 2003 to 2008, the CoEE Review Board awarded $42 million and 16 endowed professorships to Clemson University:

- The Clemson University International Center for Automotive Research (CU-ICAR), a worldwide automotive/motor sports research and development campus, has four CoEE endowed chairs in the fields of **Automotive Design and Development**, **Automotive Manufacturing**, **Automotive Systems Integration**, and **Electronic Systems Integration**.
- Research at the **Photonic Materials CoEE** concentrates on organic and inorganic materials for optical fiber and related photonic technologies.
- The **Advanced Fiber-Based Materials CoEE** researches novel fiber materials, fabrics, and integrated components which possess unique functionality and performance over traditional textile materials.
- The **Supply Chain Optimization & Logistics CoEE** focuses on supply chain modeling, material handling, logistics, planning systems, and distribution.

[1] In FY 2009, the CoEE Review Board awarded two additional Centers (four endowed chair positions) with FY 2008 funds: the Medication Safety & Efficacy CoEE (MUSC/USC) and the Cancer Disparities CoEE (MUSC/USC/SCSU). Also, during FY 2009, the Molecular Nutrition CoEE at Clemson University was withdrawn (1 chair). At the time of publication, the total number of Centers and endowed chairs is 42 and 74, respectively.

[2] At the time of publication, these total figures are $172.6 million, $142.1 million, $99.6 million, and $91.4 million, respectively.

- The **Urban Ecology & Restoration CoEE** supports the growth of the state's environmental industry through the integration of basic ecological science with engineering and urban design.
- The **Health Facilities Design and Testing CoEE**, a collaboration between Clemson and MUSC (Clemson as lead institution), researches the relationships between the design of health care settings, human health and health care delivery.
- The **Optoelectronics CoEE** will focus on improving the devices, systems and protocols used in high-speed optical communication networks.
- The research focus of the **Cyberinfrastructure CoEE** (or **Cyber-Institute**) is on the development, testing, and evaluation of prototype cyberinfrastructure equipment and programs, leading to stronger collaborative environments for research, education and technology transfer throughout South Carolina.
- Clemson also has an endowed chair as a collaborating institution in each of the following CoEEs: **Clinical Effectiveness and Patient Safety**, **Regenerative Medicine**, **SeniorSMART™ Center**, and **Advanced Tissue Biofabrication**.
- The awards for the **Restoration CoEE** ($3 million, two chairs) and **Electron Imaging CoEE** ($5 million, one chair) were withdrawn by Clemson during FY 2008. [The award for the **Molecular Nutrition CoEE** ($2 million, one chair) was withdrawn by Clemson during FY 2009.]

MUSC's focus areas are neuroscience, cancer research, cardiovascular disease, health care, and novel technologies. From 2003 to 2008, the CoEE Review Board awarded $60.5 million to MUSC to establish 15 CoEEs. All told, 29 CoEE endowed chairs were created to serve at MUSC:

- The **Proteomics CoEE** pursues research in new and improved technologies for studying and gathering information encoded in the genomes of proteins.
- The **Marine Genomics CoEE**, a collaboration between MUSC and the College of Charleston (with MUSC as the lead institution), researches marine functional genomics and bioinformatics, including the analysis of physiological adjustments in animal and plant genetics that result from environmental changes.
- The **Regenerative Medicine CoEE**, a collaboration between all three research institutions (with MUSC as the lead institution), expands statewide expertise in developmental biology, adult stem cell technology, and tissue engineering.
- The **Neuroscience CoEE** researches age-related neurodegenerative problems including dementia, Alzheimer's disease, Parkinson's disease, and stroke.
- The **Translational Cancer Therapeutics CoEE**, a collaboration between MUSC and USC (with MUSC as the lead institution), expands opportunities for increased interdisciplinary research to enhance research in the biology common to cancer.

- The **Cancer Drug Discovery CoEE**, a collaboration between MUSC and USC (with MUSC as the lead institution), provides mechanisms for target identification and generation of lead compounds in the drug discovery process.
- The **Gastrointestinal Cancer Diagnostics CoEE** researches state-of-the-art translational medicine for gastrointestinal cancer patients, with the eventual goal of decreasing the overall impact of cancer mortality and morbidity.
- The **Vision Science CoEE**, a collaboration between MUSC and USC (with MUSC as the lead institution), focuses on the development of new therapies for macular degeneration, glaucoma, retinitis pigmentosa, and other eye diseases.
- The **Molecular Proteomics in Cardiovascular Disease and Prevention CoEE** works to translate advances in basic bench science into clinical bedside care in an effort to improve cardiovascular prevention and treatment.
- The **Clinical Effectiveness & Patient Safety CoEE**, a collaboration between all three research institutions (with MUSC as the lead institution), improves clinical education and patient safety through the use of simulation technology.
- The **Tobacco-Related Malignancy CoEE** works to discover biomarkers of tobacco-related malignancies, with an initial focus on lung cancer.
- The **Stroke CoEE,** collaboration between MUSC and USC, strengthens the clinical and basic stroke research in South Carolina by stimulating the development of new therapeutics, emphasizing drug discovery and biotechnology.
- The **Advanced Tissue Biofabrication CoEE**, a collaboration between MUSC, Clemson and USC (with MUSC as the lead institution), envisions industrial-scale production of complex tissues and organs for the repair, replacement or restoration of diseased cells, tissues and organs.
- The **Cancer Stem Cell Biology CoEE**, a collaboration between MUSC and Clemson (with MUSC as the lead institution), will generate further understanding of cancer stem cells and ways to eradicate them without harming healthy cells.
- The **Renal Disease Biomarker CoEE** addresses the need for reliable and prognostic biological indicators for kidney disease; these indicators are essential for early detection and therefore treatment of renal diseases.
- MUSC also has endowed chairs as a collaborating institution in the following four CoEEs: **Health Facilities Design & Testing** (one chair), **Brain Imaging** (two chairs), and **Childhood Neurotherapeutics** (one chair), and **Health Care Quality** (one chair).

USC has developed three major CoEE clusters: future fuels (including hydrogen and solid oxide fuel cell research), biomedical science, and nanotechnology. In the first four years of the program, USC received $56.5 million for the creation of 25 CoEE chairs:

- The **Nanostructures CoEE** concentrates on research in experimental nanoscale physics and is positioning the state to compete in the global electronic market.

- The **Brain Imaging CoEE**, a collaboration between USC and MUSC (with USC as the lead institution), is a world-class brain imaging center which researches detection deception and minimally invasive brain stimulation technologies.
- The **Polymer Nanocomposites CoEE** conducts research on the development of new materials with improved properties for the polymers market.
- The **Tourism & Economic Development Technology CoEE**, a collaboration between USC and Coastal Carolina University (with USC as the lead institution), creates innovation in the tourism industry with new technological standards that will allow major tourism businesses to operate more efficiently.
- The Future Fuels Initiative, which is expanding USC's expertise in fuel cells and alternative energy, incorporates CoEE endowed chairs in **Hydrogen and Fuel Cell Economy**, **Renewable Fuel Cells** and **Solid Oxide Fuel Cells**.
- The **Childhood Neurotherapeutics CoEE**, a collaboration between USC and MUSC (USC as lead institution), uses advances in metabolic disorders, pharma-cogenetics, and neuroinflammatory diseases to study child neurological disorders.
- The **Health Care Quality CoEE**, a collaboration between USC, MUSC and Clemson (USC as the lead institution), researches the national health care crisis and seeks to improve the quality and economics of S.C's health care systems.
- The **Rehabilitation and Reconstruction Sciences CoEE** is focused on medical and public health needs in the areas of orthopedic disorders, exercise and sports-related injury prevention, treatment and rehabilitation.
- The **Strategic Approaches to Electricity Production from Coal CoEE** focuses on the synthesis, characterization and testing of novel catalysts and adsorbents with applications in the power generation industry.
- The **SeniorSMART™ CoEE**, a collaboration between USC and Clemson (with USC as the lead agent), fosters multidisciplinary research that contributes to development of new jobs, products, and cutting-edge technologies to foster independence for seniors.
- The **Nanoenvironmental Research & Risk Assessment CoEE** focuses on the scientific, technological, health, economic, and societal effects of nanotechnology on the environment.
- The **Nuclear Science and Energy CoEE** concentrates its research on the design, development and analysis of advanced materials required to extend the life of existing nuclear power reactors and to develop a new generation of more efficient reactors.
- USC also has at least one endowed chair as a collaborating institution in the following six CoEEs: **Clinical Effectiveness and Patient Safety**, **Regenerative Medicine**, **Translational Cancer Therapeutics**, **Cancer Drug Discovery**, **Vision Science**, **Stroke** (two chairs), and **Advanced Tissue Biofabrication**.

ECONOMIC IMPACT SUMMARY

After six years, the state's research institutions are fulfilling the Research Centers of Economic Excellence Act mandate to enhance the state's economy, recruit non-state dollars, and create well-paying jobs. In its *2003-2008 CoEE Program Comprehensive Evaluation* (WAG report), the Washington Advisory Group reported that the CoEE Program has resulted in one-quarter billion dollars in non-state investment in the South Carolina economy. Also, more than 2,000 high-paying jobs have been created as the result of the program. No fewer than 1,100 of these jobs are the result of $122 million "in new research funding from competitively awarded research grants" (More than $58 million of the $122 million is directly tied to 14 CoEE endowed chair-holders.) These extramural research grants, which derive from federal and private organizations, represent investment that is above and beyond the dollar-for-dollar, non-state matching requirement for the CoEE Program. The WAG report indicated that these awards and jobs "would not have come to South Carolina without the CoEE Program."

In FY 2008, faculty associated with the **Solid Oxide Fuel Cells CoEE** generated over $26 million in proposed research funding, including a $22 million DOE proposal. In FY 2008, the **three CoEE chairs at CU-ICAR** and their research teams were awarded 33 grants totaling more than $5 million from federal and corporate sources. The **CoEE in Nanostructures** has received funding in the amount of $1.6 million from the U.S. Army Research Office, NSF, Seagate Technology and Aerotech Corporation. During 2008, the **CoEE in Cancer Drug Discovery** had over $3.7 million in sponsored federal funding. Current federal funding for the **Brain Imaging CoEE** is in excess of $10 million. The **CoEE in Polymer Nanocomposites** has received two grants of $901,000 and $500,000 from the U.S. Air Force Research Laboratory; in FY 2008, the CoEE also received a $865,000 research grant from NSF, MeadWestvaco and Montan Polysaccharides. In FY 2008, the **Vision Science CoEE** obtained research contracts totaling over $1.5 million from a number of companies including Bausch & Lomb, and Pfizer. In FY 2008, the **SeniorSMART™ CoEE** received $3.9 million in research funding from NIH, the Fullerton Foundation and S.C. Health and Human Services. The **Health Facilities Design and Testing CoEE** has been awarded a subcontract with the U.S. Department of Defense entitled Patient Room of the Future; the first two phases provided the CoEE with over $850,000 in research funding. The **Renal Disease Biomarker CoEE** had $4.4 million in federal research

funding in FY 2008. **Health Care Quality CoEE endowed chair-holder Dr. Sanderson** received a $7 million grant from the FCC to enhance rural healthcare through telecommunications and information services. [See pages 96-97 for a complete list of CoEE Program extramural research funding.]

The WAG report also indicated that new corporate facilities accounted for 895 new high-paying, knowledge-based jobs, most of which are the result of corporate partnerships with the Clemson University International Center for Automotive Research (CU-ICAR) in Greenville. Timken and BMW have located corporate research & development offices on the CU-ICAR campus; together, they have created 500 high-paying jobs in the Upstate region.

The WAG report noted that the 13 CoEE-related spin-off companies are responsible for the creation of at least 40 high-paying, knowledge-based positions. The WAG report further explained that job creation at spin-off companies is characteristically limited in the early stage of programs such as the CoEE Program, but that the results thus far are impressive. Work associated with the **CoEE in Hydrogen and Fuel Cell Economy** and the **CoEE in Renewable Fuels for the Fuel Cell Economy** at USC has led to six spin-off companies. The **CoEE in Childhood Neurotherapeutics** has led to the creation of ImmunoMod, a spin-off company which develops drugs for treatment of diabetes. The **CoEE in Regenerative Medicine** has fostered a spin-off company, FirstString, which markets new wound repair technology. [See related article on page 65.] The **CoEE in Brain Imaging** launched a spin-off company, Cephos Corporation, which uses brain imaging technology to detect deception (lie detection).

Once a CoEE endowed chair is appointed and his or her research team is fully assembled, the process of technology transfer begins: Technology transfer takes groundbreaking science—*intangible* intellectual property—and converts it into *tangible* products and services. Technology transfer spurs the knowledge-based economy and leads to the development of companies and the creation of new jobs. When a CoEE researcher makes a laboratory discovery, it is registered via a form called a "disclosure." Once a disclosure has been registered, the technology transfer office at each research institution studies it to consider its commercial possibilities. Patents are

then sought for the most commercial/marketable discoveries. Once a patent is obtained, the institution seeks to license the discovery with industry, often toward product development.

To date, 110 invention disclosures have been registered as the result of the CoEE Program. This has led to 52 provisional U.S. patent applications, 49 U.S. patent applications, and the issuance of seven U.S. patents; also, 27 international patent applications toward the issuance of one international patent. Presently eight active licenses have resulted from CoEE Program research.

Through FY 2008, the **Photonic Materials CoEE** has filed 26 invention disclosures, six provisional U.S. patent applications, 16 U.S. patent applications with three U.S. patents being issued; the CoEE has four active executed licenses. The **Marine Genomics CoEE** has generated intellectual property based on a major discovery that RNA injected into shrimp could protect them against viral infections; this discovery has major implications on shrimp aqua-culture, which is periodically devastated by viral infections. The **Childhood Neurotherapeutics CoEE** has been granted two U.S. patents and has submitted a total of four U.S. provisional and six non-provisional U.S. patent applications along with 13 international patent applications. Researchers for the **CoEE in Molecular Proteomics in Cardiovascular Disease and Prevention** have identified a set of blood enzymes that can be used to indicate high probabilities of heart failure; this has led to a license agreement with Ortho-Clinical Diagnostics, a subsidiary of Johnson & Johnson, which hopefully will result in the development of tests for the early detection and treatment of heart failure. Research at the **CoEE in Cancer Drug Discovery** has led to the filing of a disclosure for several new compounds that inhibit PIM kinase, an enzyme that is over-expressed in cancer cells; based on this discovery, a new biotech company has been formed to develop PIM kinase inhibitors to treat cancer.

CONCLUSION

Through the CoEE Program, South Carolina's research institutions (Clemson, USC and MUSC) have realized the great potential of consortia research centers, resulting in unprecedented scientific collaboration. More than one-third of the CoEEs are scientific partnerships between and among S.C. public institutions. Recruiting the world's finest researchers is no easy task, but by planning strategically for focused research clusters and committing to a unique spirit of institutional collaboration, CoEE Program stakeholders have made South Carolina an attractive working environment in the new "flat world," where knowledge is the principal currency. In the coming years, the reputation of the Palmetto State as a major landmark on the knowledge-based economy map will continue to grow, attracting businesses and entrepreneurs which will vitally enhance the state's economy and reposition the state for success in the new century. As one South Carolina business leader commented to the Washington Advisory Group during the preparation of its comprehensive evaluation: "The CoEE Program is the life blood of the future of this state."

MUSC MEDICAL UNIVERSITY of SOUTH CAROLINA

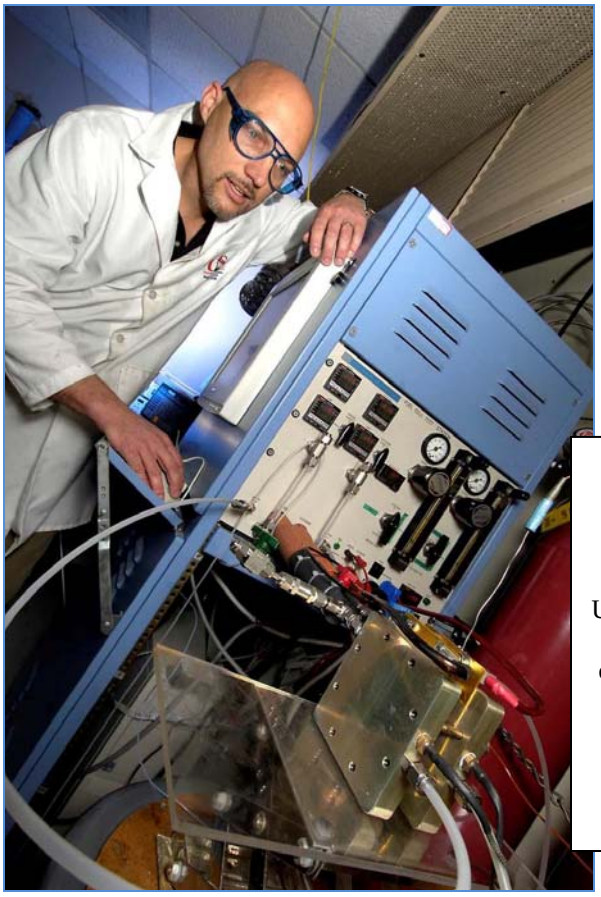
SOUTH CAROLINA CoEE CENTERS of ECONOMIC EXCELLENCE RESEARCH • INNOVATION • INVESTMENT

CoEE proteomics research has led to a license agreement with Ortho-Clinical Diagnostics, a subsidiary of Johnson & Johnson.

Dr. Michael Zile (standing), Director of the **Molecular Proteomics in Cardiovascular Disease & Prevention CoEE**, and Dr. Daniel Knapp, Director of the **Proteomics CoEE**, discuss applications of proteomic methods to unraveling the mechanisms of heart failure.

CoEE in Advanced Fiber-based Materials

Clemson University and donors celebrated completion of funding for the $4 million **CoEE in Advanced Fiber-based Materials** in September 2008. Left to right: Kathleen Richardson, director, Clemson School of Materials Science and Engineering; Alfred W. Thomas III, president, Frankl & Thomas Inc.; Brian Morin, CEO, Innegrity, LLC; Mark Kent, CEO, KENTWOOL; Esin Gulari, Dean, Clemson College of Engineering and Science; Robert W. Moser, J.E. Sirrine Foundation; John D. Hall, Glen Raven; Clemson President James F. Barker.



Dr. John Weidner, USC Professor and Associate Chair of Chemical Engineering, tests a fuel cell in the Swearingen Engineering Center.

USC has been awarded three CoEEs that work in concert to study fuel cells: the **Hydrogen and Fuel Cell Economy CoEE**, the **Renewable Fuel Cells for the Fuel Cell Economy CoEE**, and the **Solid Oxide Fuel Cells CoEE**.

I. Program Introduction and History

In 2002, the South Carolina General Assembly passed the South Carolina Research Centers of Economic Excellence Act (RCEE Act). The legislation designated $200 million through 2010[3] from the South Carolina Education Lottery to establish unique Centers of Economic Excellence (CoEE) at South Carolina's three senior research institutions: Clemson University, the University of South Carolina, and the Medical University of South Carolina. (In 2008, the S.C. General Assembly revised the RCEE Act to provide for $30 million in annual funding provided (a) all lottery scholarships have been funded, and (b) at least 80% of all appropriations have been awarded through the most recent previous fiscal year.) Each CoEE specializes in knowledge-economy research in fields such as engineering, nanotechnology, biomedicine, energy science, environmental science, and information and management science. The world-class scientists hired to become CoEE chairs will secure major private sector funding and federal grants for the state and over time will increase the state's knowledge base and stimulate the state's economy.

The RCEE Act also created the CoEE Review Board, which provides program oversight. The Board is composed of 11 members: three appointed by the Governor, three by the President Pro Tempore of the Senate, three by the Speaker of the House of Representatives, one by the Chair of the Senate Finance Committee, and one by the Chair of the House Ways & Means Committee. Membership terms are three years, and individuals may serve three total terms. The three research university presidents serve as ex-officio, non-voting members of the Review Board. Staff and operational support for the Endowed Chairs Program are provided by the Commission on Higher Education (CHE), which also approves the operational budget for the program.

The CoEE Review Board held its first meeting on October 17, 2002, at which time it approved formal bylaws. At the December 5, 2002, meeting, the Review Board approved Program *Guidelines* and *Request for Proposals 2002-2003*, which established a competitive, annual process whereby Centers of Economic Excellence and supporting endowed chairs are proposed by the research institutions and approved by the Review Board. The three-tier review process includes two rigorous scientific evaluations (a technical review and an onsite panel review), followed by the Review Board's analysis of the review findings and a formal vote on individual proposals. In 2008, the legislature incorporated the three-tier review process into the RCEE Act.

[3] The General Assembly appropriated $30 million per year in the state budget for fiscal years 2003 through 2008.

"Since the CoEE Program began, South Carolina has successfully built Centers in cutting-edge fields that diversify our state's economy and position us competitively in the national and global economy. This is particularly important given today's economic uncertainty. The CoEE Program will have continued long-term positive impact on South Carolina's economy."

S.C. Speaker of the House Bobby Harrell
speaking to reporters at a January 2009 press conference

Once a research center is approved by the Review Board, an institution has 18 months in which to solicit dollar-for-dollar, non-state[4] pledges to match the state award total (between $2 million-$5 million). These non-state matching pledges must be realized within 78 months of the award date. In February 2007, the CoEE Review Board approved a policy whereby an institution may apply for as many as two, six-month extensions beyond the 18-month pledge verification deadline. State funds may only be drawn against in-hand (realized) non-state pledges. The entire state award, plus no less than 40% of the non-state match, must be placed into endowment for each CoEE; no more than 60% of the non-state match may be used to fund operating costs for a CoEE.[5] The endowment pays the salaries or salary supplements of the world-class scientists (endowed chairs) recruited to lead each CoEE and also funds the purchase of equipment, laboratory construction, other faculty and research assistants.

Since the inception of the CoEE program, the CoEE Review Board has worked diligently to balance its oversight responsibilities with the mandate to enhance the state's knowledge-based economy. On August 30, 2004, the Review Board voted to limit the number of non-collaborative proposals to three per year, while continuing to allow an unlimited number of collaborative proposals. On June 29, 2005, the Review Board approved a marketing plan in order to disseminate program successes and enhance program visibility; one year later, on June 13, 2006, the Review Board secured the marketing services of the Clare Morris Agency.

[4] Non-state matches may derive from private and federal sources.
[5] At the October 20, 2006, CoEE Review Board meeting, the Review Board voted to change this minimum figure from $2 million to 40% of the non-state match total.

On June 13, 2006, the Review Board approved an RFP to audit the program for fiscal years 2003 to 2010. On August 28, 2006, the Review Board contracted the services of Derrick, Stubbs and Stith, LLC, to conduct program audits. The 2003-2006 South Carolina Centers of Economic Excellence Program Audit was released on November 5, 2007. The Review Board was pleased to announce that the first four years of program activity received an unqualified audit with no major material findings. The 2007 CoEE Program Audit was released on September 8, 2008, and also received an unqualified audit with no major material findings. [The 2008 CoEE Program Audit, simultaneously released with this report, received an unqualified audit with no findings.]

On December 12, 2006, the CoEE Review Board convened a Cost Share Work Group. Financial representatives from all three research institutions, the Office of the State Treasurer, and Commission on Higher Education staff gathered to discuss accounting standards related to the South Carolina Research Centers of Economic Excellence Act. On February 26, 2007, the Review Board approved a Cost Share Accounting Policy, which contains specific guidelines for claiming and valuing in-kind matches.[6]

On November 5, 2007, the CoEE Review Board approved the protocol for a summative evaluation of the program's first six years (2003-2008), as required by the Program *Guidelines*. In June 2008, the CoEE Review Board acted unanimously to contract with the Washington Advisory Group to conduct the *2003-2008 CoEE Program Comprehensive Evaluation* (WAG Report). The WAG Report was published in January 2009 to much acclaim. [See Section IV below.]

> [T]he CoEE program has had a profound and positive impact on the prospects for economic growth and diversification in the State of South Carolina. It has raised the quality and relevancy of university research, improved the stature of the research universities, and increased collaboration among the universities and between the universities and the private sector.
>
> from the Washington Advisory Group
> *2003-2008 CoEE Program Comprehensive Evaluation*

On November 5, 2007, the CoEE Review Board unanimously adopted a program mission statement:

[6] The Cost Share Accounting Policy also applies to Research University Infrastructure Act projects, which is a separate statutory mandate of the CoEE Review Board.

> The South Carolina Centers of Economic Excellence program serves the public interest by creating incentives for the state's research universities, in cooperation with other institutions of higher education in the state, to raise capital from non-state sources to fund endowments for specialized research professorships. These professorships in turn serve as the nucleus for unique, university-based research centers which cultivate critical, public-private industrial partnerships, expand the state's knowledge base, create well-paying jobs, and enhance economic opportunities and improve the quality of life for the people of South Carolina.

On June 25, 2008, the General Assembly enacted significant amendments to the RCEE Act, which encoded many policies the CoEE Review Board had adopted since the CoEE Program's inception. These amendments included: (a) increasing the number of Review Board members from nine to 11 (see above); (b) establishing an October 1 annual deadline for the program annual report and audit, and requiring that both documents be submitted to the members of the legislature in addition to the Budget & Control Board; (c) providing permanent funding for the program in the amount of $30 million annually (see above); (d) allowing the CoEE Review Board to use accrued program interest to fund additional CoEEs; (e) encoding the three-tier review process for CoEE proposals (see above); (f) encouraging the senior research institutions to partner with other South Carolina institutions of higher education; (g) permitting the senior research institutions to use a percentage of non-state matching funds for CoEE start-up costs; and (h) permitting cash equivalent donations for non-state matching funds.

During the program's first six years, the Review Board approved 41 CoEEs and 70 endowed chair positions;[7] 15 chairs were appointed by the end of FY 2008. [Thus far in FY 2009, an additional seven chairs have been appointed, with one resigning.] As intended, the program is brightening the state economy: Through FY 2008, of the $169 million awarded by the Review Board, $119.7 million in non-state matches been pledged, with more than $72.8 million in pledges realized and $66.5 million in state funds drawn by the three senior research institutions.[8]

[7] In FY 2009, the CoEE Review Board awarded two additional Centers (four endowed chair positions) with FY 2008 funds: the Medication Safety & Efficacy CoEE (MUSC/USC) and the Cancer Disparities CoEE (MUSC/USC/SCSU). Also, during FY 2009, the Molecular Nutrition CoEE at Clemson University was withdrawn (1 chair). At the time of publication, the total number of Centers and endowed chairs is 42 and 74, respectively.

[8] At the time of publication, these total figures are $172.6 million, $142.1 million, $99.6 million, and $91.4 million, respectively.

II. Strategic Planning and Collaboration

In its 2008 report, the CoEE Onsite Review Panel[9] noted great improvement in strategic planning over the course of the CoEE Program's history: "The Site Review Panel is very impressed with the increasing quality of proposals that are being submitted. … [I]ndividuals who have been on the Onsite Review Panel for several years have noted that most of the proposals are now of very high quality. … This year it was clear that the Universities have developed a strategy to focus on areas of major strengths. … [I]t is evident that new proposed Chairs will focus on enhancing areas of interest in which the funded CoEEs have already established strength and expertise."

Clemson University's core strengths are in the area of automotive and transportation technology (with four CoEE endowed chairs at the **Clemson University International Center for Automotive Research** [CU-ICAR]), as well advanced materials and biotechnology/biomedical sciences. USC has developed three major CoEE clusters: future fuels, biomedical science, and nano-technology. MUSC's strengths lie in the areas of neuroscience, cancer research, cardiovascular disease, healthcare, and novel technologies. The following graphic illustrations highlight the focus clusters at each of the three research institutions:

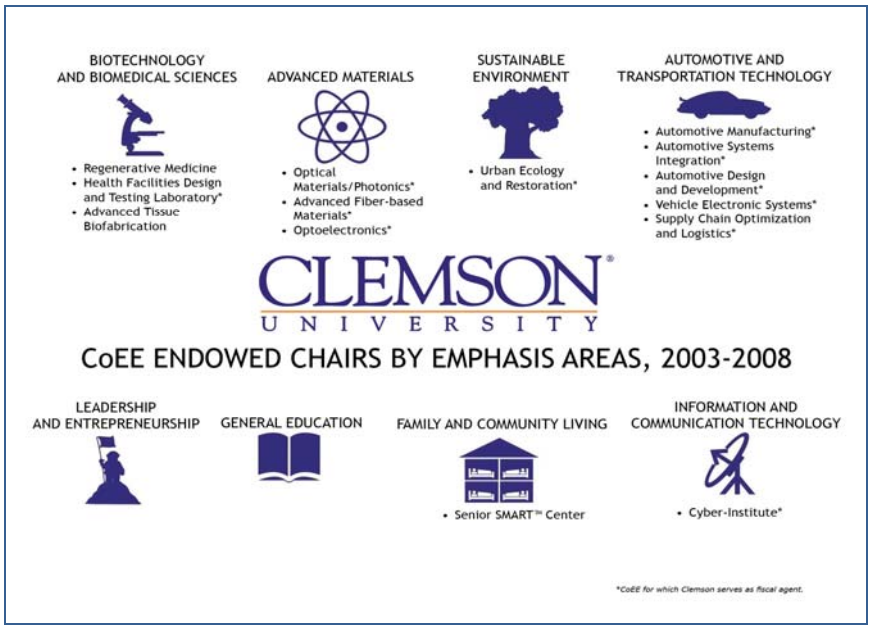


Figure 1. Clemson CoEE Endowed Chairs by Emphasis Areas.

[9] The CoEE Onsite Review Panel is composed mainly of research vice presidents from premier American Association of University institutions. The Panel conducts the second tier of the three-tier review process for CoEE proposals. The Panel visits each senior research institution and hears presentations from principal investigators and institutional administrators about each proposal, then presents funding recommendations to the Review Board.

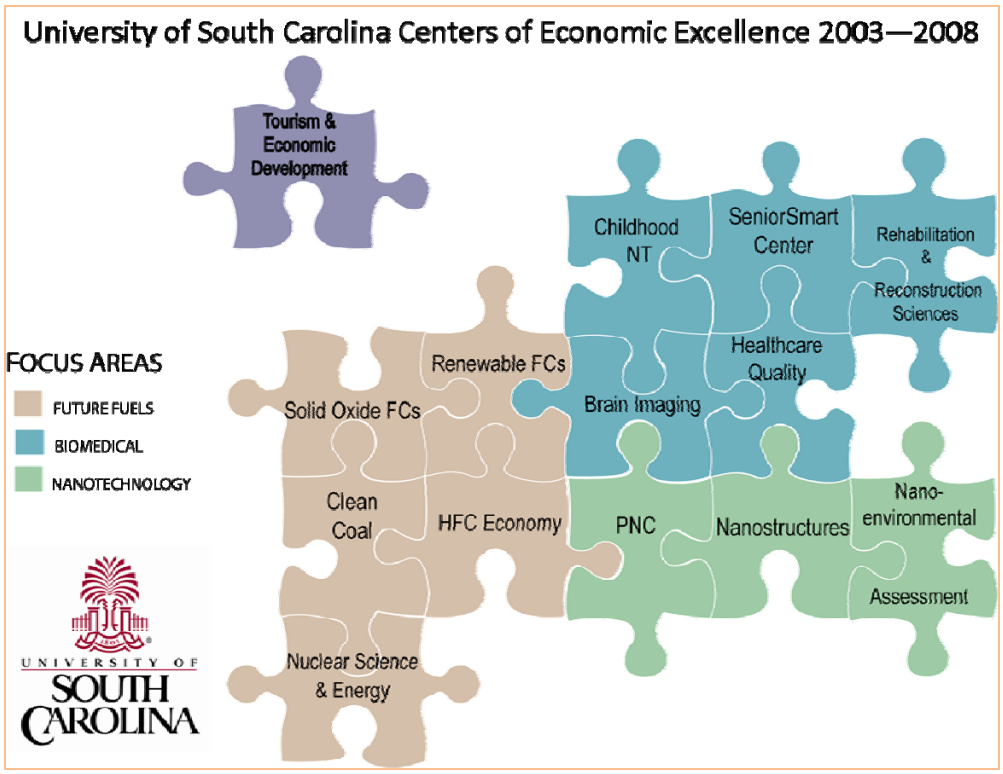


Figure 2. USC CoEE Endowed Chairs by Emphasis Areas.

Abbreviations: NT = Neurotherapeutics; FC = Fuel Cells; HFC = Hydrogen Fuel Cell; PNC = Polymer Nanocomposites.

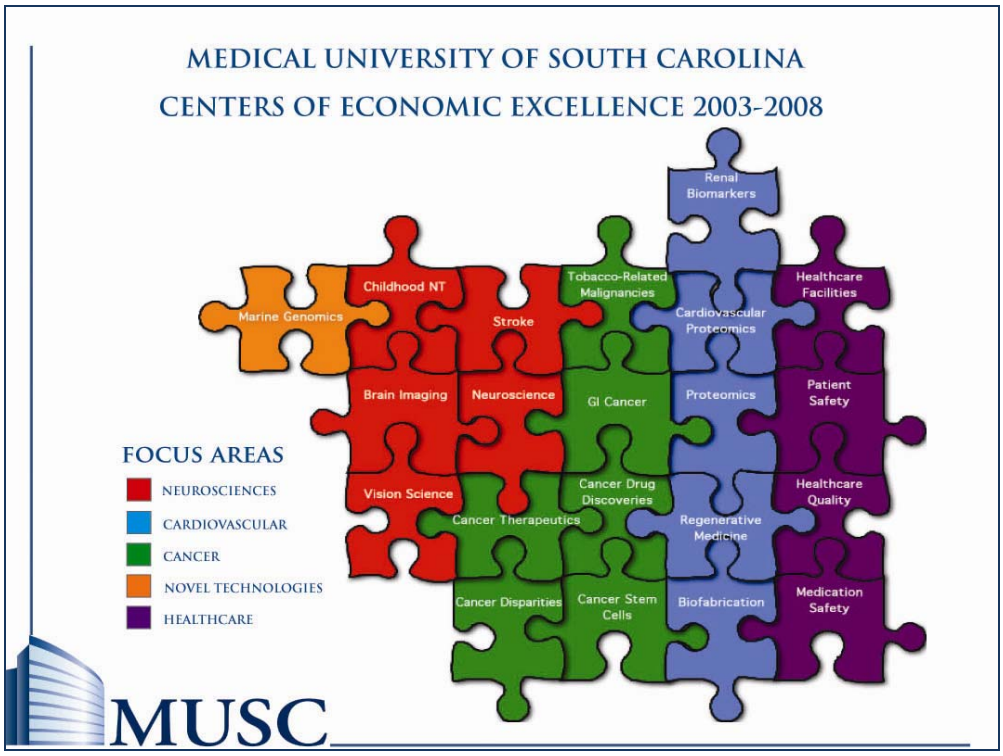


Figure 3. MUSC CoEE Endowed Chairs by Emphasis Areas.
Abbreviations: NT = Neurotherapeutics; GI = Gastrointestinal.

The scientific discoveries and breakthroughs made by each CoEE will serve as a nucleus for industry and further research within the state, leading to a better and stronger knowledge base and economy. This cycle of economic development is shown in the following illustration:

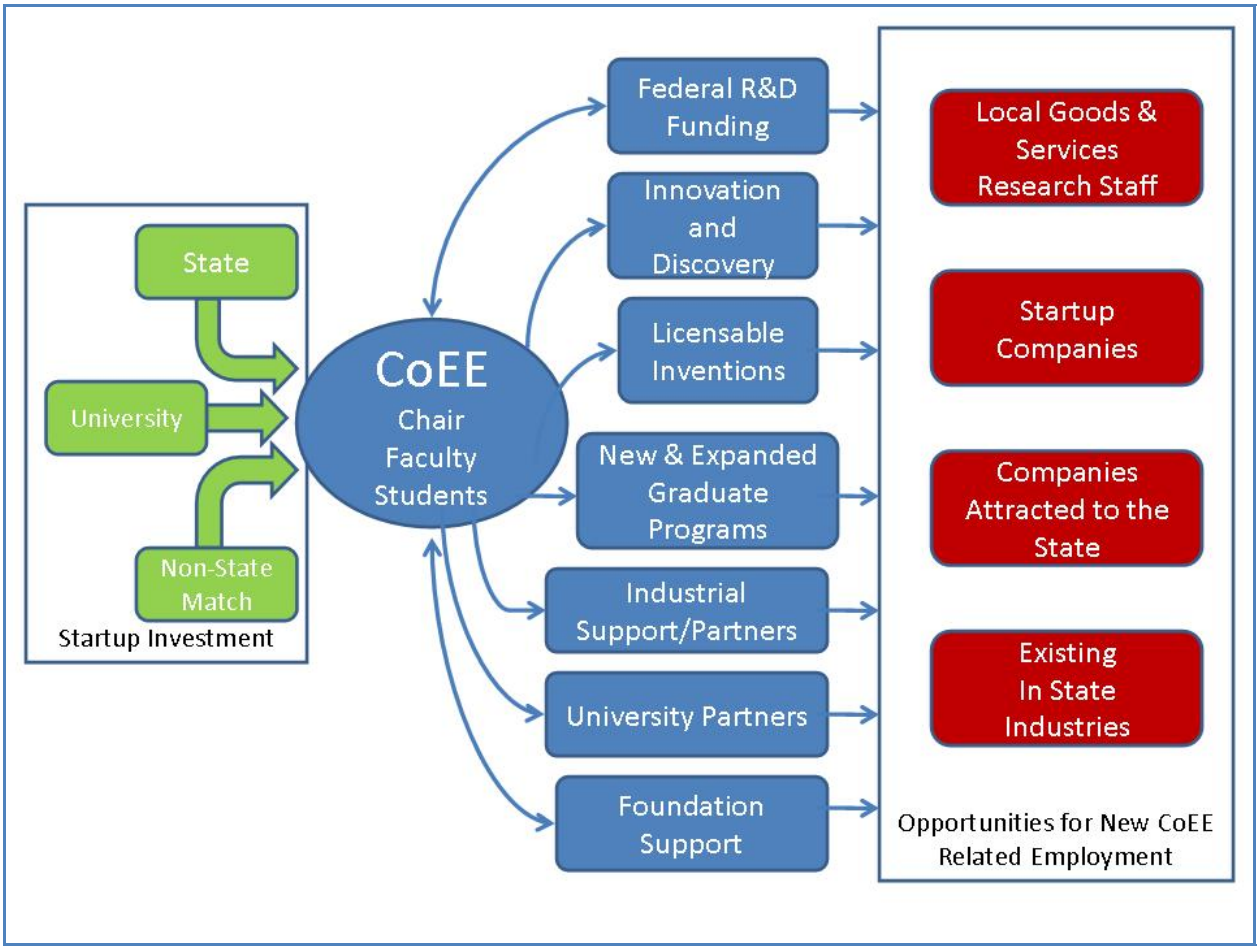


Figure 4. CoEE Investment and Jobs Flow.
[Reprinted with permission by the Washington Advisory Group.]

A prime example of the symbiotic strength of the CoEE Program is CU-ICAR, which potentially can support USC as a test facility for its Future Fuels Initiative CoEEs, as well as the SMARTWheels™ component of the **SeniorSMART™ Center**, a USC/Clemson CoEE collaboration which promotes independent mobility and living for seniors. Research at Clemson and USC is thus likely to lead to economic development as automotive and energy companies are attracted to locate in South Carolina or to invest in research and development (R&D) being conducted in the state.

> "Because CoEE research is performed at universities, it is tempting to view the program as 'just another' university program. ... [B]usiness support has been critical to the General Assembly's commitment to the program. ... The CoEE program is 'the life blood of the future of this state,' one business leader said during our interviews. ... [W]e wouldn't have made any progress as a state without it.'"
>
> from the *2003-2008 CoEE Program Comprehensive Evaluation*

In December 2005, BMW opened its Information Technology Research Center, the first BMW R&D facility outside of the Munich area, on the CU-ICAR campus. The center houses approximately 300 personnel. In September 2006, Timken Corporation opened its Greenville Technology Center on the CU-ICAR campus; this facility employs 200 Timken workers and houses all of its product development activities for automotive applications, as well as the worldwide corporate center of excellence for dimensional and surface metrology and manufacturing process development. In FY 2008, Clemson also announced CU-ICAR corporate partnerships with Mazda North American Operations, Okuma America Corporation, and Morris South. Also, Ozen Engineering (California) and associates CADFEM GMbH (Germany) and EnginSoft, SpA (Italy) made the decision to locate their North American headquarters at CU-ICAR, as did INTEC, U.S., Inc., a technology leader in software for the automotive industry. [In November 2008, American Titanium Works announced plans to build a $420 million manufacturing facility in Laurens County which will employ more than 300 people in Laurens County. ATW also announced plans to locate its tech center at CU-ICAR; this will employ 40 more people. The potential research synergies between ATW and CU-ICAR were a critical part of ATW's decision process.]

Since the program's beginning, the research institutions have realized the great potential of collaboration and have pursued the creation of consortia research centers. More than one-third of the CoEEs are scientific partnerships between and among South Carolina public institutions, including three, four-year comprehensive teaching universities.[10] Dr. John Schaefer, endowed chair-holder at MUSC's **CoEE in Clinical Effectiveness and Patient Safety**, has noted that such academic collaboration rarely exists anywhere in the nation—not even at Harvard or Yale.

Nowhere is the program's collaborative spirit more evident than in health sciences research. In April 2004, Health Sciences South Carolina (HSSC) was established. HSSC is a statewide, public-private consortium of university and regional health systems with a shared vision of using

[10] College of Charleston (CoEE in Marine Genomics), Coastal Carolina University (CoEE in Tourism & Economic Development) and South Carolina State University (CoEE in Cancer Disparities).

health sciences research to improve the health and economic well-being of South Carolina. HSSC is a major non-state partner in 11 health-related CoEEs. In August 2006, HSSC was the recipient of a $21 million grant from the Duke Endowment, the largest such grant by the Charlotte-based private foundation's health care division. A major portion of this grant is being used to match CoEE state awards.

HSSC president Dr. Jay Moskowitz is himself a CoEE endowed chair for the **Health Care Quality CoEE**. Dr. Moskowitz's vision for the Health Care Quality CoEE is for doctors anywhere in the state to be able to access a patient's electronic medical records: "The Health Care Quality CoEE will examine safety, quality, cost efficiency, and bring healthcare teams together including doctors, nurses, scientists, and technicians. The next phase will be to bring in fiduciaries and the private sector into the mix of universities and hospital systems. And if this state achieves the highest quality and efficient healthcare system, it will, in the long run, lower healthcare costs in the state and at the same time bring in new industry and products from our healthcare systems. Then it will be a true success."

HSSC President and CoEE chair Jay Moskowitz (right) welcomes Dr. Martin Morad (left) to the Palmetto State. Dr. Morad, a FY2009 CoEE chair appointment in the Regenerative Medicine CoEE, will lead research on the creation of the world's first biological pacemaker. Dr. Morad is an emblem of CoEE collaboration, holding faculty appointments at all three South Carolina senior research institutions.

Other health-related CoEE collaborations include the **Stroke CoEE** (MUSC/USC), led by renowned neurologist and CoEE chair-holder Dr. Robert Adams. Dr. Adams and his team use telemedicine to link rural hospitals with stroke experts at MUSC. In May 2008, the REACH network was activated to provide stroke victims at community hospitals through telemedicine. In just a few months at McLeod Health, twice the number of stroke patients were treated with a life-changing stroke therapy than had been treated in the entire previous year.

Stroke experts and CoEE chair holders, Drs. Marc Chimowitz (L) and Robert Adams (R), examine brain scans using telemedicine methods.

The **Clinical Effectiveness and Patient Safety CoEE** (MUSC/USC) is training healthcare personnel around the state so that medical errors are reduced. The first of three patient simulation training labs is operating on the campus of the Greenville Hospital System, with a second training lab now operating at MUSC. Each lab is equipped with computerized mannequins that simulate human reactions. More than 2,800 students have participated in simulation activities in areas including emergency team training, difficult airway management, and labor delivery skills.

The **Health Facilities Design and Testing CoEE** (Clemson/MUSC) is an interdisciplinary and multi-institutional platform for collaborative educational, research and public service initiatives to study relationships between the design of healthcare settings, human health and healthcare delivery. The primary purpose of the CoEE is to expand and disseminate knowledge on how health facility design impacts healthcare delivery and how to create architectural settings that better support patient health.

Health Facilities Design and Testing faculty at Clemson confer in a patient simulator laboratory that features patient- and staff-friendly design elements.

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The appeal of bonded research partnerships serves as an enticing recruiting tool to the renowned scientists required to lead each Center. Dr. Richard Swaja, CoEE Chair in Regenerative Medicine at MUSC and a former senior advisor with the National Institutes of Health, has stated that he moved to South Carolina in part because of the state's recognition of the importance of collaboration and sharing resources. Dr. Sanderson, the MUSC chair of the Health Care Quality CoEE and the former CIO for Duke University Health System, expressed to the CoEE Review Board, "The collaboration fostered by the program, plus the state-supported endowment, were precisely why I allowed myself to be recruited."

The Washington Advisory Group *2003-2008 CoEE Program Comprehensive Evaluation* cited the uniqueness of the coordinated efforts between the state's research institutions:

> "The CoEE program has transformed the culture of South Carolina's research universities. Collaboration and entrepreneurship are now the norms. … This change in mindset will have a long-term impact as junior faculty are hired and promoted. … At all levels, the CoEE Program has been a catalyst for the universities to aspire to become 'flagship' research institutions working for the benefit of South Carolina."

As Rich Karlgaard, publisher of *Forbes* has stated, "The most valuable natural resource in the 21st century is brains." In the new "flat world," where knowledge is the principal currently, strategically planning focused research clusters and committing to a spirit of institutional collaboration—both at the heart of the CoEE Program mission—is the best way to mark South Carolina on the global economic map.

Discovery I is part of USC's new Innovista research campus. This wet lab research building and vivarium lab is in the construction phase and is scheduled for completion in 2009. Discover I will house a number of world-class biomedical and CoEE research programs, including the Brain Imaging CoEE.

III. Approved Centers of Economic Excellence: 2003-2008

Funding Year 2002-2003			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Automotive Systems Integration	1	$5 million
Clemson	Automotive Manufacturing	1	$5 million
USC	Nanostructures	1	$4 million
USC/MUSC	Brain Imaging	2*	$5 million
MUSC	Proteomics	1	$4 million
MUSC	Neuroscience	3	$3 million
MUSC/College of Charleston	Marine Genomics	2	$4 million
Total Awarded in 2002-2003		**11**	**$30 million**

Funding Year 2003-2004			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Automotive Design & Development	1	$5 million
Clemson	Electronic Systems Integration	1	$3 million
Clemson	Photonic Materials	1	$5 million
USC	Polymer Nanocomposites	1	$3.5 million
USC	Hydrogen & Fuel Cell Economy I **	2	$2.5 million
MUSC/Clemson/USC	Regenerative Medicine	3	$5 million
MUSC/USC	Translational Cancer Therapeutics	2	$5 million
Total Awarded in 2003-2004		**11**	**$29 million**

Funding Year 2004-2005			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Restoration [WITHDRAWN]	—	[$3 million]
Clemson	Electron Imaging [WITHDRAWN]	—	[$5 million]
USC	Renewable Fuel Cells	1	$3 million
USC	Hydrogen & Fuel Cell Econ. II **	[See 03-04.]	$2.5 million
USC/Coastal Carolina	Tourism & Economic Development	1	$2 million
MUSC	Gastrointestinal Cancer Diagnostics	1	$5 million
MUSC/USC	Cancer Drug Discovery	4	$5 million
MUSC/USC	Vision Science	3	$4.5 million
Total Awarded in 2004-2005		**10**	**$22 million**

* Reduced from four to two by act of the CoEE Review Board on June 9, 2008.
** The Hydrogen & Fuel Cell Economy CoEE was approved during 2003-2004. Funding for one half of this CoEE was provided in 2003-04, the other half in 2004-2005.

Funding Year 2005-2006			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Supply Chain Optimization & Logistics	1	$2 million
Clemson	Urban Ecology and Restoration	1	$2 million
Clemson	Advanced Fiber-based Materials	1	$4 million
Clemson	Molecular Nutrition ***	1	$2 million
USC	Solid Oxide Fuel Cells	1	$3 million
USC/MUSC	Childhood Neurotherapeutics	3	$5 million
MUSC	Molecular Proteomics in Cardiovascular Disease & Prevention	2	$5 million
MUSC/USC/Clemson	Clinical Effectiveness & Patient Safety	3	$5 million
Total Awarded in 2005-2006		**13**	**$28 million**

Funding Year 2006-2007			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson/MUSC	Health Facilities Design & Testing	2	$5 million
USC	Rehabilitation and Reconstruction Science	1	$5 million
USC	Strategic Approaches to Electricity Production from Coal	1	$5 million
USC/MUSC/Clemson	Healthcare Quality	2	$5 million
USC/Clemson	Senior SMART™ Center †	3	$5 million
MUSC	Tobacco-Related Malignancy	2	$5 million
MUSC/USC	Stroke	3	$5 million
Total Awarded in 2006-2007		**14**	**$35 million**

Funding Year 2007-2008			
Institution (fiscal institution first)	**Proposal Title**	**Endowed Chairs**	**Proposal Amount**
Clemson	Optoelectronics	1	$2 million
Clemson	Cyber-Institute	1	$2 million
USC	Nanoenvironmental Research & Risk Assessment	1	$3 million
USC	Nuclear Science and Energy	1	$3 million
MUSC	Renal Disease Biomarker	2	$5 million
MUSC/Clemson	Cancer Stem Cell Biology	2	$5 million
MUSC/USC/Clemson	Advanced Tissue Biofabrication	3	$5 million
MUSC/USC/SCSU	Cancer Disparities ††	3	$3.6 million
MUSC/USC	Medication Safety & Efficacy ††	1	$2 million
Total Awarded in 2007-2008		**15**	**$30.6 million**

*** The Molecular Nutrition CoEE was withdrawn in FY 2009 but is included in the *2008 CoEE Program Audit*.
† The SeniorSMART CoEE was approved in FY 2008. Funding was provided from FY 2007 dollars.
†† Approved in FY 2009 with FY 2008 funding. These are not included in the *2008 CoEE Program Audit*.

Program Totals	
Total Funds Awarded (2003-2008)	**$169 million**
[Proposals Funded in FY 2009 with FY 2008 Funding]	**[$3.6 million]**
TOTAL LOTTERY APPROPRIATIONS (2003-2008)	**$180 million**

USC President Harris Pastides (left), CoEE Chair Paula Harper Bethea (center)
and BlueCross BlueShield of SC CEO Ed Sellers (right), discuss CoEE Program collaboration.
In March 2008, the BlueCross BlueShield of South Carolina Foundation announced a $5 million pledge
to support the Regenerative Medicine CoEE, which supports research in developmental biology,
adult stem cell technology and tissue engineering at all three South Carolina senior research institutions.

IV. The *2003-2008 CoEE Program Comprehensive Evaluation*

When the CoEE Review Board issued its first guidelines in December 2002, it determined that an external evaluation of the CoEE Program should be performed in the program's sixth year. The Review Board believed it was critical to create an accountability measure that ensures state tax dollars are being used efficiently and wisely to achieve the program's statutory mandate "to create well-paying jobs and enhanced economic opportunities for the people of South Carolina" (S.C. 2-75-5(B)(1)). At a January 12, 2009, press conference, the CoEE Review Board released the Washington Advisory Group's *2003-2008 CoEE Program Comprehensive Evaluation*.

The Washington Advisory Group (WAG) is a Washington DC-based consulting firm which specializes in strategic counsel and analysis of higher education institutions with institutional mission focus in R&D and economic development. Many WAG consultants have doctorates and terminal degrees in research-related fields and/or have worked as higher education administrators with extensive technology transfer experience or as R&D directors/leaders in major private corporations or laboratories. WAG has contracted to perform major R&D and Innovation & Competitiveness analysis with a number of Association of American University members as well as with the U.S. House of Representatives. The WAG consultant list contains some of the most distinguished scientists, research businesspeople and university administrators in the nation.

The CoEE Program evaluation was led by Dr. Karen Holbrook, immediate past president of The Ohio State University and the current Vice President for Research & Innovation at the University of South Florida. The two other evaluation team members included Dr. Jack Breese, former Research Director at Microsoft and member of the Washington State Economic Development Commission, and Dr. Hunt Williams, former president of Merit Network, Inc. (a Michigan-based economic development organization that developed America's first national high-speed Internet backbone for research and education). All three individuals are inarguably leading experts on academic research and economic development.

Between July and October 2008, the WAG evaluation team completed detailed analysis of all CoEE Program data (more than 5,000 pages of materials) and conducted three separate, comprehensive site visits to each senior research institution campus. More than 150 program stakeholders were personally interviewed, including members past and present of the CoEE

Review Board, legislative leaders (all Review Board appointing legislators), state business leaders, CoEE non-state matching fund donors, and CoEE chairs and principal investigators.

The three S.C. senior research university presidents (left to right, Clemson's James Barker, USC's Harris Pastides, and MUSC's Ray Greenberg) and CoEE Chair Paula Harper Bethea at the January 12, 2009, press conference to release the Washington Advisory Group *2003-2008 CoEE Comprehensive Evaluation*.

The results of WAG's analysis places the CoEE Program and the state of South Carolina in rarefied academic research territory:

> Our conclusion is that the CoEE program is an extraordinary effort by the state of South Carolina to invest in its Knowledge Economy and is a best-in-kind program that is, or should be, the envy of other states. The state and its senior research universities are to be applauded for nurturing the CoEE program and for deploying it as a powerful tool for the creation of high-wage jobs and improvement in the quality of life of South Carolina's citizens.

The WAG evaluation team reported that the CoEE Program "has had a profound and positive impact on the prospects for economic growth and diversification in the State of South Carolina" and has significantly increased the reputations of the senior research institutions and the quality of academic research throughout the state. In its first six years, not only is the CoEE Program responsible for creating 2,000 high-paying, knowledge-based jobs (a remarkable statistic for any

economic development program in its first few years), but the program has also put ***one quarter billion dollars*** in non-state investment into the South Carolina economy.

Despite its tremendous success, the *2003-2008 CoEE Program Comprehensive Evaluation* cautions readers to understand that the CoEE Program is still in a "gestational period." Recruiting the best scientists and engineers in the world requires patience and concentrated effort. And the fruits of technology transfer (patents, licensing and product development) require collaborative organization: "We recommend that South Carolina consider the formation of a technology transfer function specifically to help the CoEEs spin off companies, perhaps taking advantage of an existing organization such as SCRA and the SCLaunch program."

The WAG report also reminds readers that major academic research/economic development project successes, such as what has been accomplished at the North Carolina Research Triangle, can require decades of strategic planning and investment. But the payoff is more than worthwhile: "North Carolina's economy in the 1950s was poor. The state's per capita income ranked 49th in the nation, the economy was concentrated in low-wage industries of tobacco, textiles and furniture, and the state suffered from 'brain drain.' … [The Research Triangle Park] changed the culture and the economy of North Carolina. Over 1,000 technology-based startups and spin-offs are located in the Triangle area ... with [an annual] total payroll over $2.7 billion."

The WAG evaluation team was also very impressed by the administrative discretion shown by the CoEE Review Board. While administrative costs for most foundations and similar grant programs is as much as 10%, overhead for the CoEE Program has amounted to a mere 1.3%.

Key findings from the report include:

1. The CoEE Program has brought cutting-edge research programs and equipment, matching funds and competitive research awards, and Knowledge Economy jobs to the state.
2. The CoEEs and Endowed Chairs are of high quality in terms of scholarship, research and economic impact.
3. The CoEE program has transformed the culture of South Carolina's research universities. Collaboration and entrepreneurship are now the norms.
4. The CoEE program has raised the national and international reputations of the universities and made South Carolina more competitive in the global economy.
5. The CoEE program benefits from strong business support, and the industry partners are pleased with the outcomes to date.

6. The CoEE program has solidified relationships among the universities, hospitals, national laboratories & industry, and has created a statewide network for innovation.
7. A single, integrated statewide economic development plan does not yet exist in South Carolina, but the CoEE program has coalesced around clusters that could be components of such a plan.
8. Graduate education is an industry attractor and a workforce and economic benefit.
9. The universities have made significant investments in the CoEEs, but they may not be able to continue investing at the same rate in the future.
10. In certain instances, the universities lack the institutional capacity to adequately manage functions and infrastructure associated with the CoEE program.
11. Public awareness of the program is limited and its image and audiences are not yet well-defined.
12. The CoEE Review Board has performed effective oversight with support from the Commission on Higher Education.

Key recommendations for improvement of the CoEE Program include:

1. The CoEE program is fulfilling the goals for which it was created, and **funding for the program should be continued as a high priority for South Carolina.**
2. The program could be more effective if a portfolio approach to CoEE investment were adopted in coordination with other state programs and incentives.
3. Front-loaded funding would accelerate new Center start-ups and the state's return on investment. The General Assembly and the CoEE Review Board should adopt policies to facilitate expedited outcomes.
4. The universities should identify potential funding match partners before a CoEE award is made.
5. The universities could develop creative approaches to fundraising that also enhance program outreach and visibility.
6. The program should increase the focus and emphasis on graduate education as a stimulus for creating a high-tech workforce in South Carolina.
7. A new statewide approach to technology transfer could help the CoEEs commercialize their research results.
8. Regulatory relief is needed to address issues of university services and infrastructure.
9. The program should establish a Council of Chairs and an annual CoEE conference.
10. The program should establish future performance metrics and streamline reporting.

Addressing members of the media at the January 12, 2009, press release of the *2003-2008 CoEE Program Comprehensive Report*, S.C. Speaker of the House Bobby Harrell congratulated the CoEE Review Board and the three South Carolina senior research institutions for its numerous successes: "We're thrilled with the results of the program, thrilled with the results of the study. The report shows us we have a powerful tool for helping South Carolina's economy, and it was the right thing to do years ago when we pushed this through the General Assembly."

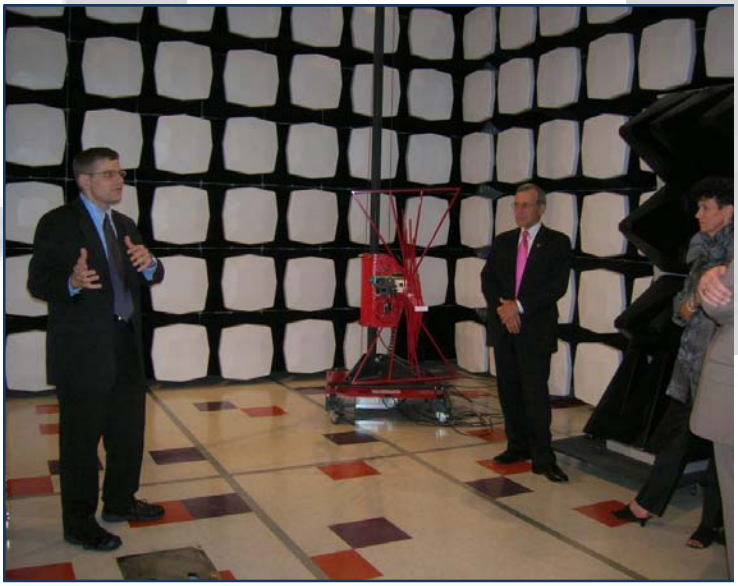
The *2003-2008 CoEE Program Comprehensive Evaluation*
is available to download at www.sccoee.org .

V. Summary Descriptions of the Centers of Economic Excellence

Dr. Paul Simon Morgan, CoEE chair for the Brain Imaging CoEE, assists a patient in a Siemens 3T MRI. Dr. Morgan has a research relationship with Dr. Peter Mansfield, a Nobel laureate famed for his work in Magnetic Resonance Imaging.

Vincent Lee, a Ph.D. student in Clemson University's graduate program in automotive engineering.

Dr. Cathy Murphy of the Nanoenvironmental CoEE removes solutions of purified gold nanorods from a centrifuge. These nanorods can be used as therapeutics to eliminate bacteria in the human body with the use of lasers.



Dr. Tom Kurfess, BMW Chair in Automotive Manufacturing, presents a guided tour of the CU-ICAR anechoic chamber to members of the CoEE Review Board.

CLEMSON UNIVERSITY: FUELING THE KNOWLEDGE-BASED ECONOMIC ENGINE
DR. CHRISTIAN E.G. PRZIREMBEL

Since its beginning, Clemson University has made economic development a critical component of its mission. In the 21st century, the evolution of South Carolina's economy to a so-called "knowledge economy" is taking center stage, and Clemson is playing a leadership role in advancing this new economic paradigm.

Clemson is intentional in developing a strategy that matches the University's strengths with the state's existing or potential business strengths to grow its economy.

Participation in the CoEE Program is enabling Clemson to attract world-class faculty and students into critical disciplines in five areas of research: Advanced Materials, Automotive and Transportation Technology, Biotechnology and Biomedical Sciences, Information and Communication Technology, and Sustainable Environment. To date we have established 11 CoEEs grounded in these research areas. There are encouraging indicators of the program's value, such as recent collaboration by a number of fiber-related industry partners to fund the Advanced Fiber-based Materials CoEE to refuel that industry. Clemson's computing program, ranked 60 among the world's Top 500 computing sites, is teaming with campus and statewide partners to advance research in many areas, including health care and homeland security.

The Clemson University International Center for Automotive Research (CU-ICAR) is perhaps our greatest CoEE success story to date. Created just six years ago, CU-ICAR today is a thriving reality with four CoEE endowed chairs leading a unique master's and doctoral program in automotive engineering, hundreds of new jobs and a high-tech campus that is attracting automotive-related companies from around the world. The presence of CU-ICAR, we are told, was critical to American Titanium Works' recent decision to locate in South Carolina. The company will employ 320 people at its Laurens County manufacturing plant; its research and development program, to be located at CU-ICAR, will employ an additional 40 individuals.

Dr. Christian E.G. Przirembel
Clemson University Vice President
of Research & Economic Development

Knowledge acquired in the laboratories of research universities is intended to be shared and used for the common good. The CoEE Program jumpstarts the ability of South Carolina's research universities to deliver new knowledge through its graduates and technology transfer that will spawn new business and provide high-paying, high-quality jobs at every level, from administrative support and technicians to engineers and executives. Everybody wins.

2003-2008 Clemson University Centers of Economic Excellence[11]

CoEE Name: **PHOTONIC MATERIALS**
Award Date: **4/27/04** Award Amount: **$5 million**

ADVANCED MATERIALS

The Photonic Materials CoEE is closely affiliated with Clemson's Center for Optical Materials Science and Engineering Technologies (COMSET). (Since 2000, COMSET's sponsored research has exceeded $38 million.) This CoEE focuses on the design, fabrication and testing of optical fibers for use in (a) directed energy systems critical to federal defense efforts; (b) communication systems for automobiles and information technologies; and (c) light-based biomedical therapies. The Photonics CoEE chair will lead COMSET's research activities in organic and inorganic materials for optical fiber and related photonic technologies.

CoEE FACT: The science of light-based technologies is a $400 billion global market with projected growth to $1 trillion by 2015.

3M Corporation donated a chemical deposition vapor system worth nearly $900,000 to this CoEE; Clemson is now one of only three universities in the world with industry-level optical fiber production capability. In 2005, the High Energy Laser Joint Technology Office awarded Clemson a $2.7 million research grant for light-based technology research. This CoEE has also received major funding from the J.E. Sirrine Textile Foundation. The Carolina MicroOptics Triangle (CMOT) is a regional optics cluster among Clemson, UNC-Charlotte and Western Carolina University. CMOT added industrial affiliates in 2007 and is recognized as one of only four university photonics clusters in the U.S. Additionally, COMSET will formalize the Carolinas Photonics Consortium this year, adding Duke and NCSU. These consortia advance the joint development of new optical materials, devices and components in support of the existing photonics industry in the Carolinas as well as the creation of new ventures. This CoEE has launched two spin-off companies: Advanced Pho-tonic Crystals and Tetramer Technologies. Recent ac-complishments include a nationally acclaimed patent for carbon nanotube-based trans-parent electrodes and the initial formation of the nation's second Photonics doctorate program.

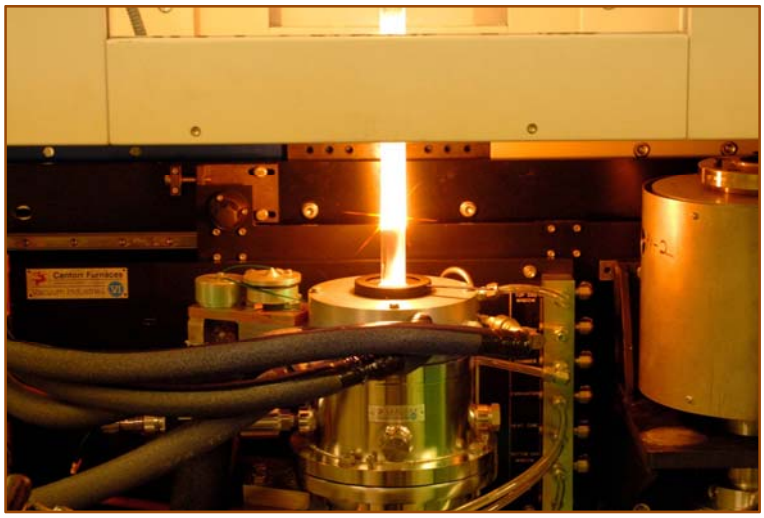
Clemson is recruiting the J. E. SIRRINE FOUNDATION ENDOWED CHAIR OF OPTICAL MATERIALS.

Nobel laureate Charles Townes (left) with Clemson's Vice President for Research and Economic Development, Chris Przirembel (right), at the dedication of the Charles H. Townes optical science laboratories, affiliated with Clemson's Photonic Materials CoEE.

[11] Included here are Clemson's independent Centers. A summary of all collaborative Centers, including ones for which Clemson is the lead institution, follows on pages 62-75.

CoEE Name: **ADVANCED FIBER-BASED MATERIALS**
Award Date: **6/13/06** Award Amount: **$4 million**

The Advanced Fiber-Based Materials CoEE intends to be a catalyst in repositioning existing manu-facturing resources to support new industry opportunities in this field. Research at this CoEE concentrates on the composition of novel fiber materials, fabrics and integrated components which possess unique functionality and value-added performance over traditional textile materials. This CoEE is developing a niche industry in high-tech fibers and materials including fiber-reinforced composite materials based on metals, ceramics and polymers. A multimillion-dollar non-state match was donated by the J.E. Sirrine Textile Foundation. Clemson is in continued conversation with other corporations to receive ad-ditional research support.



Industry quality glass being drawn into optical fiber at 4000 degree F at Clemson's COMSET.

CoEE FACT: The 2002 Palmetto Institute Report identified advanced materials as a seed cluster industry in the state.

Clemson is actively recruiting the COEE CHAIR IN ADVANCED FIBER-BASED MATERIALS.

CoEE Name: **OPTOELECTRONICS**
Award Date: **6/09/08**
Award Amount: **$2 million**

2008 CoEE

The Optoelectronics CoEE will focus on improving devices, systems and protocols used in high-speed optical communication networks. The field of optoelectronics encompasses electronic devices that emit, transform, transmit or sense light. Common applications for this technology include communications, data storage and sensors. For South Carolina industries to remain competitive, they must have access to the latest advances in high speed communications and have access to skilled graduates who have a state-of-the-art education in optoelectronics. As part of Clemson's COMSET, the Optoelectronics CoEE will advance research in optoelectronics and optical communications theory and practice. The chair and research team will analyze the limitations of optoelectronic communication devices and networks that have significant economic impact and will seek to meet the industry need for higher data rates and lower latency for switching and routing in optical networks. This CoEE has received a non-state matching donation of $1 million from The Comporium Group (formerly Rock Hill Telephone & affiliates), a communication services provider to upstate counties in South Carolina.

Clemson is actively recruiting the COEE CHAIR IN OPTOELECTRONICS.

AUTOMOTIVE AND TRANSPORTATION TECHNOLOGY

Clemson University International Center for Automotive Engineering (CU-ICAR)

CU-ICAR, a worldwide automotive/motor sports research and development campus, has four CoEE Endowed Chairs associated with it and more than $220 million in public and private investment to date. The Carroll A. Campbell, Jr. Graduate Engineering Center on the CU-ICAR campus, which was completed in June 2008, houses all four Clemson CoEE automotive endowed chairs and their research teams. In 2008, the CoEE chairs and their teams were awarded 33 grants from federal and corporate sources totaling more than $5 million, with six pending proposals for $2.5 million. CU-ICAR faculty completed the final design of the Automotive Engineering graduate school curriculum in 2006-07 and held its first classes in August 2007. Currently, there are presently 33 graduate and 20 doctoral students in the Automotive Engineering program.

CoEE FACT: CU-ICAR offers the nation's only Ph.D. in Automotive Engineering.

FY 2008 marked a significant year of new partnerships for CU-ICAR. An investment of $1.5 million ($1.1 million in equipment plus $400,000 in training and support) from the Okuma America Corporation and Morris South, Machine Tool Systems was provided. BMW Automotive Manufacturing CoEE chair Dr. Kurfess commented on this unique investment: "Okuma is committed to making sure our students and faculty have access to the latest technology. They have allowed us to avoid obsolescence, one of the biggest problems we face in terms of equipment. We do not have to dispose of or replace equipment; they will update as new generations of this machinery become available."

The CU-ICAR CoEEs feature state-of-the-art research equipment. BMW Automotive Manufacturing Chair Tom Kurfess is shown here using the Zeiss Pro T Compact Dual Column Full Vehicle CMM, a drive-on research tool to allow full vehicle and other large-item coordinate measurements.

Also in FY 2008, Mazda North American Operations partnered with CU-ICAR by providing graduate fellowships, drive trains and a Mazda CR 7 Crossover vehicle for testing. In June, the Ozen Engineering (California) with its associates CADFEM GMbH (Germany) and EnginSoft, SpA (Italy) decided to locate their North American headquarters at CU-ICAR. This partnership will provide CU-ICAR with significant software, training and support services for Automotive Engineering. INTEC, U.S., Inc. has also chosen CU-ICAR as the site for its U.S. presence; INTEC is a automotive industry software leader and will provide approximately $1.1 million in training and support services to the Automotive Engineering program.

This past year, CU-ICAR formed a unique partnership with Spartanburg Community College (SCC) to promote and support the formation of new companies. SCC will offer incubator space to CU-ICAR researchers in its Accelerated Business Center located twenty minutes from CU-ICAR at its Tyger River Campus. This offering will allow innovators to move intellectual property from the lab to the manufacturing phase and then on to market.

CoEE Endowed Chair Name: **Automotive Manufacturing**
Award Date: **6/24/03** Award Amount: **$5 million**

The BMW endowed chair in Automotive Manufacturing is developing novel micro-electromechanical systems technologies for manufacturing as well as improving the efficiency of manufacturing large, complex objects. This CoEE has contacted and/or is in discussion to develop private sector partnerships with such major companies as General Motors, IBM, Toyota, Honda, Daimler-Chrysler, Hewlett-Packard, Nissan, and Robert Bosch Corporation. Faculty-conducted workshops have been held with BMW, Michelin, Timken, and Siemens since 2004 to promote industry involvement in CU-ICAR's research initiatives. Two junior faculty members with expertise in production systems and quality assurance support this chair's research.

Dr. Thomas Kurfess, BMW COEE ENDOWED CHAIR IN AUTOMOTIVE MANUFACTURING [appointed 8-15-05]. Kurfess' research focuses on precision systems, controls, automation, and robotics. His work is being used in a variety of manufacturing environments, helping U.S. companies to compete in the global market. In addition to automotive research, he is preparing the next generation of engineers to work in the complex global automotive industry as director of the Carroll A. Campbell Jr. Graduate Engineering Center. Kurfess served as a special U.N. consultant to the Malaysian government in the areas of applied mechatronics and manufacturing. He has received numerous honors and awards, including the National Science Foundation Young Investigator Award and a NSF Presidential Faculty Fellowship Award. He is a member of the National Academies Panel on Manufacturing Engineering, president of the Society of Manufacturing Engineers at the North American Manufacturing Research Institute, and associate editor for the *International Journal of Engineering Education*. In 2007, Kurfess delivered 40-plus presentations to corporations and civic groups. In 2008, Kurfess authored 13 academic publications and presented at nine industry conferences.

Dr. Thomas Kurfess,
BMW CoEE Endowed Chair
in Automotive Manufacturing.

CoEE Endowed Chair Name: **Automotive Systems Integration**
Award Date: **6/24/03** Award Amount: **$5 million**

The BMW Automotive Systems Integration chair is considered the linchpin of the CU-ICAR faculty positions. This researcher will advance the field of integrated platform design, development, and manufacturing. Systems integration is the testing of vehicle systems and their components to ensure efficient and safe operation. Leaders at BMW and other major automotive companies have noted a lack of cultivation and education of systems integration engineers. This endowed chair-holder will have a proven track record of research in integrated platform design and manufacturing and a clear vision of the importance of this approach to future product design, development, and manufacturing. This chair will likely become a global leader, both as a researcher and instructor, in a field that is crucial to the global automotive market. BMW has committed itself as the major non-state partner of this endowed chair.

[Clemson University hired Dr. Paul Venhovens as the BMW CHAIR IN AUTOMOTIVE SYSTEMS INTEGRATION on August 15, 2008.]

CoEE FACT:

Increasing percentage of electronics with respect to vehicle value:

Electronics share:	**2004: 20%**	**2015: 40%**
Software share	**2004: 4.5%**	**2010: 13%**

CoEE Endowed Chair Name: **Automotive Design & Development**
Award Date: **8/25/03** Award Amount: **$5 million**

The Timken endowed chair in Automotive Design & Development researches and advances the fields of vehicular design and development, methodologies, and design tools. Non-state funding has been secured with the Timken Company (Fortune 500), which provides automotive industry products and solutions based on friction management and power transmission. Timken opened its new Greenville Technology Center (GTC) in September 2006 on the CU-ICAR campus. GTC houses Timken's product development activities for automotive applications and its worldwide corporate center of excellence for dimensional and surface metrology and manufacturing process development. Approximately 200 Timken employees work in this facility. Timken furthered its partnership with the donation of approximately $800,000 worth of equipment for the Campbell Graduate Engineering Center, which opened in June 2008. In 2008, the Precision Metrology Lab was also completed in the Timken Design Laboratory; this space will enable high precision measurements of component dimensions and surface finish.


John Ziegert, Timken Chair of Automotive Design and Development.

Dr. John Ziegert, TIMKEN COEE ENDOWED CHAIR IN AUTOMOTIVE DESIGN AND DEVELOPMENT [appointed 8-15-06]. Ziegert's research is focused on designing automotive instruments and machines used in high-precision measurement and manufacturing. At CU-ICAR, Ziegert and his team are developing friction management and power transmission solutions that show promise for improving the manufacturing processes for a variety of industry sectors. He has held academic appointments at the University of Florida and the California

Institute of Technology. He serves as president of Tetra Precision Inc., a Florida-based metrology company. Ziegert holds three patents with three more pending. Ziegert is editor-in-chief for *Precision Engineering* and is the organizing committee co-chair for the 2009 North American Manufacturing Research Conference. Ziegert authored 10 scientific publications in FY 2008.

CoEE Endowed Chair Name: **Vehicle Electronic Systems Integration**
Award Date: **4/27/04** Award Amount: **$3 million**

The Michelin endowed chair in Vehicle Electronic Systems Integration at CU-ICAR researches vehicle electronics, a complex field where components such as software, telematics, information and communication systems, electronics, mechatronics, and sensors must be integrated in a well-balanced way to create attractive, stable, economic products. In automotive technology, electronics is the area with the greatest promise for growth, and South Carolina has the potential to become a major R&D center in vehicular electronics through the research conducted by this chair. The Clemson Vehicular Electronics Consortium has been created, which provides companies access to the automotive research at CU-ICAR. In 2008, an ETS-Lindgren FACT-3 RF semi-anechoic test chamber was installed; this instrumentation will save companies time and resources and attract new industry to the state. Michelin has made a full non-state match donation for this chair.

Dr. Todd H. Hubing, MICHELIN COEE ENDOWED CHAIR IN VEHICLE ELECTRONIC SYSTEMS INTEGRATION [appointed 7-1-06]. Hubing's research focus is the electronic automotive systems industry, with particular emphasis on systems compatibility. His research has applications for the development of a more practical electric-powered car. Previously, Hubing was a professor at the University of Missouri-Rolla. In 2008, he authored nine academic publications and made ten presentations, including to the IEEE International Symposium on Electromagnetic Compatibility, the 2008 Asia-Pacific Symposium on EMC and the Freescale Technology Forum.

Clemson University's Michelin Endowed Chair in Vehicular Electronic Systems Integration
Todd Hubing (right) instructs a graduate student in the 7-post-shaker chamber
at CU-ICAR's Carroll A. Campbell Jr. Graduate Engineering Center.

The Carroll A. Campbell Jr. Graduate Engineering Center at CU-ICAR.

The Carroll A. Campbell, Jr. Graduate Engineering Center on the CU-ICAR campus, which houses all four Clemson CoEE automotive endowed chairs and their research teams, opened in June 2008. CU-ICAR is home to the nation's only Ph.D. in Automotive Engineering. In addition to current major CoEE partnerships with Michelin, BMW and Timken, CU-ICAR announced several other FY2008 partnerships with Mazda, Okuma America Corporation and Morris South, and Machine Tool Systems. In 2008, the CoEE chairs and their teams were awarded 33 grants from federal and corporate sources totaling more than $5 million, with six pending proposals for $2.5 million.

CoEE Chairs at CU-ICAR (left to right): Dr. Thomas Kurfess, Dr. John Ziegert and Dr. Todd Hubing.
[The fourth and final CU-ICAR CoEE chair, Dr. Paul Venhofens, was appointed in FY2009.]

CoEE Name: **Supply Chain Optimization & Logistics**
Award Date: **9/16/05** Award Amount: **$2 million**

The Supply Chain Optimization and Logistics CoEE is a component of a larger initiative, the Clemson Institute for Supply Chain Optimization and Logistics (CISCOL). Research at this CoEE centers on supply chain modeling, material handling, logistics, planning systems and distribution. The primary goals include: (a) conducting interdisciplinary research of multi-faceted problems associated with supply chain; (b) assisting in economic development by providing industries with access to Clemson's resources and expertise in supply chain activities; (c) delivering tangible products and services in the area of supply chain optimization and logistics through theoretical and applied research; and (d) conducting educational activities supporting technology transfer. Fluor Corp. is a full non-state partner for this CoEE. This CoEE has received sponsored research funding from Southern Company, Michelin and Lockheed Martin. Discussions for research funding are underway with Aerospace Engineering, IntelliTrans Solution, Alabama Power and Electric, AGS Resources and SPAWAR. The CoEE reported that in FY 2008, five students graduated with doctoral degrees and ten students graduated with master's degrees from the Industrial Engineering Department in the supply chain area. In 2008, ten additional doctoral students and fifteen master's students were recruited into the field. In order to further Clemson's success in this scientific field, the university requested and received approval in November 2008 from the S.C. Commission on Higher Education for a master's in Industrial Engineering with a concentration in Supply Chain and Logistics.

Clemson is recruiting the FLUOR ENDOWED CHAIR IN SUPPLY CHAIN OPTIMIZATION & LOGISTICS.

"Our partnership with Fluor Corporation and the state match for the endowment reinforce and strengthen our established supply chain programs at Clemson. The quality of research to come will increase significantly and include models for business and industry everywhere."

Clemson President James Barker
September 4, 2007, Clemson news release

"As the globe continues to shrink and economies become more integrated, procurement, supply chain and logistics skills have become the lifeblood of the engineering and construction industry's ability to execute projects at home and abroad. By supporting this endowed chair…we are ensuring that the next generation of engineers and procurement specialists are equipped with the knowledge to excel in our industry."

Fluor Chairman & CEO Alan Boeckmann
September 4, 2007, Clemson news release

CoEE Name: **Urban Ecology & Restoration**
Award Date: **9/16/05** Award Amount: **$2 million**

Through research, this CoEE supports the growth of the state's environmental industry. This CoEE will attract world-renowned faculty in restoration development who will create a knowledge-based industry cluster. This CoEE is unique for its interdisciplinary, integrative approach to the restoration of historic, ecological and urban infrastructure resources through the integration of basic ecological science, engineering, and urban design and planning. This CoEE is likely to fuel the creation of high-wage, knowledge-based professional opportunities that will bring evidence-based research and applied, sustainable solutions to the restoration industry. Research outcomes of this CoEE will include the creation of engineering systems for integrated wastewater management and treatment; bio-filters and bio-remediation materials and techniques for toxic soils; materials and installation techniques for re-vegetated aquatic buffer and filtration zones; erosion and sedimentation control techniques and materials; recycled and advanced building materials; pervious pavement systems for roads and parking lots; and materials and techniques for propagation, installation, and maintenance of native plant species in urban settings. Collaborations are planned with the College of Charleston and the American College of the Building Arts in Charleston.

Clemson is actively recruiting the COEE CHAIR IN URBAN ECOLOGY AND RESTORATION.

CoEE Name: **Cyber-Institute**
Award Date: **6/09/08**
Award Amount: **$2 million**

Cyberinfrastructure (CI) is the term for hardware, software and networking tools that make it easier to store, process and transmit large amounts of data. CI helps researchers organize and coordinate data, enhancing their ability to manage projects and collaborate with colleagues in multiple locations. The Cyber-Institute CoEE will concentrate its research on developing, testing, and evaluating prototype CI equipment and programs, leading to stronger collaborative environments for research, education and technology transfer at Clemson and throughout South Carolina. Objectives for this CoEE include increasing the level of research funding to build integrated cyberinfrastructure in the state; connecting research and scholarship in the field of CI to the commercial sector through corporate partnerships; expanding the creation and utilization of cyberinfrastructure resources in S.C.; and developing an education and workforce development program.

Clemson is actively recruiting the CYBER-INSTITUTE COEE CHAIR.

Clemson C-Light closes cyber gap in South Carolina

by Tim Bowen & Teresa C. Hopkins

Clemson University has closed the cyber gap in South Carolina by joining the national high-speed research community through direct fiber connections between Clemson, Greenville, Atlanta and Charlotte, providing direct access to the National LambdaRail, Internet2 and other national and international research networks.

The network, known as C-Light, was developed using private donations and gifted fiber with no burden to the taxpayers of South Carolina. This cooperative effort now provides Clemson researchers and faculty with leading-edge capabilities using direct fiber connectivity to high-capacity networks and resources that will enable research, academic and economic advancements and opportunities that were previously out of reach for Clemson and the Upstate. C-Light specifically provides faculty with the infrastructure they need to collaborate with colleagues and access resources nationally and internationally and ensures the capability to apply for major research grants from funding agencies like the National Science Foundation.

“Clemson’s capacity for data transmission has increased from the equivalent of a footpath in the forest to a 16-lane superhighway,” said Jim Bottum, chief information officer at Clemson. “In the past, Clemson was limited to “commodity” connectivity which prohibited us from participating in national initiatives like the TeraGrid and the National LambdaRail. In essence, we lacked the 'toll' to get onto the national research superhighway; so, for Clemson to advance toward its goals, C-Light had to happen.”

The fiber network that now connects Clemson, Greenville and Charlotte to the Atlanta regional hub also includes the Clemson University International Center for Automotive Research in Greenville.

James Leylek, director of the Clemson University Center for Computational Mobility Systems, said that in the past he was forced to ship data from CU-ICAR to research partners by regular "snail mail" because of network limitations. “The world of high-performance computing offers unlimited opportunities for researchers needing to get data and information quickly,” said Leylek. “C-Light is a tremendous boost to productivity.”

Because C-Light is a strategic alliance between Clemson University and Charter Business, the benefits of high-speed connectivity are not limited to the university. Industry and businesses that need this kind of connectivity will be attracted to Upstate South Carolina because through research collaborations with Clemson they will be able to gain access to the network, bringing significant economic growth potential to the Upstate.

C-Light also will provide an important building block for the South Carolina Light Rail, for which the state legislature recently appropriated one-time funding to acquire fiber to connect the three South Carolina research universities. Clemson also is building a Network Operations Center (NOC) as part of an $8 million campus network upgrade that could be utilized as a foundational piece of the South Carolina Light Rail.

“The research and educational capabilities afforded by this initiative position Clemson University as the intellectual anchor of the Upstate,” said Dori Helms, Clemson’s vice president for academic affairs and provost.

Chris Przirembel, vice president for research and economic development at Clemson, notes the research support for faculty and students provided by the connection.

“C-Light will enable our faculty to develop highly skilled and innovative graduates, who in turn will produce scientific achievements and technological advancements that will fuel economic development and investments in quality of life for all South Carolina residents,” he said.

One of the most innovative features of C-Light is the fact that Clemson connected to the national infrastructure without burdening the state budget. The fiber and equipment were donated and the entire venture is a cooperative effort between Clemson and Charter Business.

“Charter Business is proud to partner with Clemson University on deploying a Dense Wave Division Multiplexing system connecting Greenville to a significant point of presence in Atlanta,” said Jim McGann, vice president of Charter Business. “Through this strategic alliance, Charter Business will be able to enhance its robust network, streamline operations and better deliver content to customers throughout the southeast.

“This partnership shows what can be achieved when public companies and higher education work together with common goals to promote area research and economic development,” McGann said.

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MEDICAL UNIVERSITY OF SOUTH CAROLINA: UNPRECEDENTED PARTNERSHIPS & RESEARCH EMPOWERMENT

Dr. John Raymond

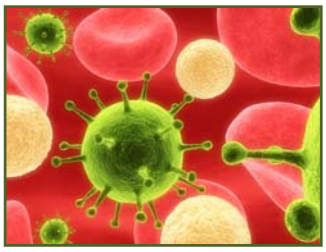
Founded in 1824, MUSC is the only freestanding academic health science center in South Carolina. Our missions focus on health care, prevention and wellness in educational, research and clinical care settings. The CoEE Program has empowered MUSC to fulfill those missions and to play important roles in the emerging knowledge-based economy South Carolina. This is particularly critical to MUSC, as health care costs constitute about 17% of national expenditures. The CoEE Program has catalyzed the creation of key partnerships with Clemson University, the University of South Carolina, the College of Charleston, Health Sciences South Carolina and various hospital partners including Palmetto Health in Columbia, the Greenville Hospital System and Spartanburg Regional Healthcare System. MUSC participates in 19 CoEEs, 13 of which are in collaboration with other academic institutions. MUSC has recruited 10 endowed chairs in areas such as drug discovery, medical simulation, informatics, patient safety, stroke and neuroscience, GI cancer, brain imaging, bioengineering, regenerative medicine, and molecular and cellular microscopy. The endowed chairs have joined MUSC from outstanding institutions such as Cornell, M.D. Anderson, the University of Pennsylvania, the University of Nottingham, Duke, Emory and Penn State. Cutting edge CoEE initiatives have attracted significant private sector and federal investment in matching funds for the CoEE Program in excess of $30 million, with pledges for further commitments of over $30 million.

The CoEE Program has stimulated unprecedented collaborations that have resulted in the formation of statewide networks that are transforming health care education, delivery and research in South Carolina. The CoEE Program has stimulated the recruitment of endowed chairs jointly with Clemson and with USC. Indeed, two CoEE endowed chairs, which hold primary appointments at Clemson and USC, are in residence at MUSC. As a direct result of the CoEE Program, MUSC and its partners have created a statewide medical simulation network, a statewide patient safety initiative, and statewide networks for stroke care, congestive heart failure research, brain imaging, and tissue engineering. These networks have attracted competitive grant support of nearly $70 million from NIH and the Duke Endowment, placing MUSC and its partners in a position of national leadership.

The CoEEs have created new start-up companies based on MUSC discoveries; led to the development of promising medical diagnostic tools, new drug therapies and medical devices; and resulted in unprecedented opportunities for our faculty to contribute to the economic health of South Carolina. Ultimately, these developments will create new high wage jobs for our citizenry, and an influx of talented people and promising industries. MUSC is grateful that the S.C. Legislature created the CoEE Program, and that they continue to support it. The CoEE Program has given us the remarkable opportunity and responsibility to partner with Clemson, USC and other collaborators to enrich the knowledge-based economy in South Carolina, and to give the citizens of our state a substantial and long-lasting return on their investment.

Dr. John Raymond
MUSC Provost & Vice President
for Academic Affairs

2003-2008 Medical University of South Carolina Centers of Economic Excellence[12]



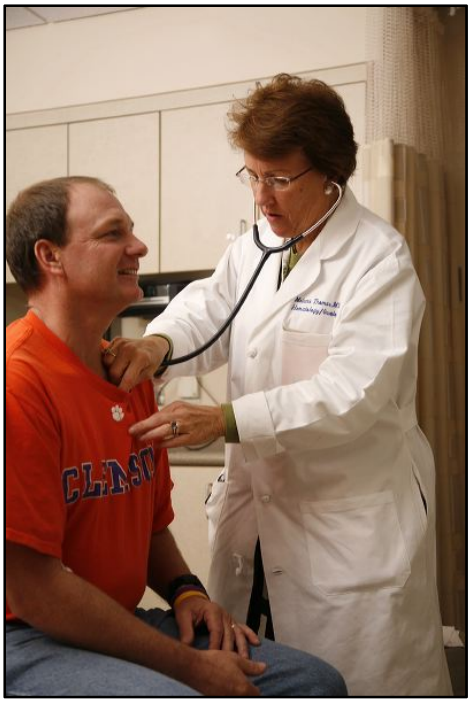
CANCER RESEARCH

CoEE Name: **Gastrointestinal Cancer Diagnostics**
Award Date: **6/29/05** Award Amount: **$5 million**

The Gastrointestinal Cancer Diagnostics CoEE researches state-of-the-art translational medicine for gastrointestinal cancer patients, with hopes of decreasing the overall impact of cancer mortality and morbidity and closing disparity gaps throughout the state. Areas of research include molecular profiling, therapeutic targets, screening technologies, therapy, environmental interactions and population studies, with particular emphasis on esophageal cancer, which is highly prevalent in South Carolina. This CoEE anticipates receiving major research grants and the creation of spin-off companies as the result of its research. Major non-state partners include the Spartanburg Regional Healthcare System (along with six other hospital systems), the U.S. Department of Veteran Affairs, DHEC, the South Carolina Cancer Alliance, Roche Carolina and Bank of America. A MUSC faculty member is conducting research on the beneficial effects of native West African plant extracts on the progression of cancerous tumors in a laboratory in the Republic of Guinea. CoEE faculty, along with other MUSC cancer researchers, have submitted a proposal for a National Institutes of Health Clinical and Translational Science Award and a proposal for a National Cancer Institute Cancer Center designation.

MUSC is actively recruiting a CoEE CHAIR IN GI MALIGNANCY DIAGNOSTIC & THERAPEUTIC TRIALS.

[MUSC hired Dr. Melanie B. Thomas as the GRACE E. DEWOLFF ENDOWED CHAIR IN MEDICAL ONCOLOGY on August 1, 2008.]



CoEE FACT: Colorectal cancer is one of the leading causes of cancer death in the U.S. In 2006, the American Cancer Society estimated that colorectal cancer would result in 2,370 new cases and 880 deaths in South Carolina alone.

Dr. Melanie B. Thomas, CoEE chair for the GI Cancer Diagnostics CoEE, examines a patient. She is working to obtain NCI Cancer Center designation status for MUSC's cancer research centers.

[12] Included here are MUSC's independent Centers. A summary of all collaborative Centers, including ones for which MUSC is the lead institution, follows on pages 62-75.

CoEE Name: **Tobacco-Related Malignancy**
Award Date: **6/18/07** Award Amount: **$5 million**

The CoEE in Tobacco-Related Malignancy is devoted to discovering biomarkers of tobacco-related malignancies. The initial focus is on lung cancer, but Center leaders also hope to make advances in other tobacco-related malignancies including head and neck, bladder and esophageal cancers. The CoEE's goals include: (a) identifying biomarkers of tobacco-related malignancies using genomics, proteomics and lipidomics; (b) employing techniques to validate biomarkers; (c) integrating bioinformatics to evaluate discovery efforts and to mine cancer databases; (d) developing a networked tissue repository; and (e) developing and implementing clinical trials to evaluate new biomarker uses. The CoEE, in conjunction with the Hollings Cancer Center (HCC), will partner with the U.S. Department of Veteran Affairs, DHEC, the S.C. Cancer Alliance and other state hospital systems. These same partners, along with HSSC and the Medical University Hospital Authority, will work with the CoEE to develop a distributed tissue repository and a clinical trials network. In the past year, the CoEE, in conjunction with HCC, has formed an alliance with the University of Colorado Comprehensive Cancer Center on a renewal of a NCI-funded Specialized Center of Research Excellence (SPORE) in Lung Cancer. Two faculty members associated with the CoEE, Drs. Gemmill and Drabkin, have clinical trials partnerships with Syndax, Pfizer and Novartis for over $1.25 million in funding. The CoEE also participated in the HCC's submission of a proposal for an NIH Clinical and Translational Science Award and a proposal for NCI Cancer Center designation.

MUSC is actively recruiting the CoEE Chair in Cancer Biomarker Development.

MUSC is actively recruiting the CoEE Chair in Molecular Epidemiology.

CARDIOVASCULAR DISEASE

CoEE: **Molecular Proteomics in Cardiovascular Disease & Prevention**
Award Date: **6/13/06** Award Amount: **$5 million**

This CoEE advances cardiovascular (CV) prevention and treatment "bench" science into clinical "bedside" care. This CoEE's primary goals include: (a) developing measurement systems to detect early heart failure indicators; (b) relating diagnostic protein signatures to clinical outcomes; (c) developing therapeutic management strategies; (d) creating a statewide network to develop, test and improve clinical care of heart failure; and (e) transferring technology into new S.C. industries. In FY 2008, the CoEE began a statewide network of five primary, separate care locations to participate and be linked by a central bioinformatics core. This core will allow patients who currently suffer or are at risk for CV disease from across the state to be screened. The CoEE is in discussions with a company to develop a biomarker testing system which will inexpensively measure protein markers to create individualized risk profiles for chronic heart failure development. A spin-off company is anticipated for the development of plasma protein detection methods using customized beads which have fluorescent antibodies attached to them. This CoEE has potential to yield major economic impact in the short-term. In 2007, the CoEE entered a research contract with Ortho Clinical Diagnostics for $950,000. The CoEE and Ortho Clinical also entered an intellectual property licensing agreement. Researchers associated with the CoEE published 13 scientific papers in FY 2008.

MUSC is actively recruiting the Tourville CoEE Chair in Cardiovascular Imaging for Diagnosis and Prevention and the Volpe CoEE Chair in Cardiovascular Biomarker Development for Diagnosis and Prevention.

CoEE Name: **Proteomics**
Award Date: **6/24/03** Award Amount: **$4 million**

CoEE FACT: The MUSC Proteomics Center is one of only 10 such centers nationwide funded by the National Heart, Lung and Blood Institute in 2002 as an interactive, multidisciplinary effort "to enhance and develop innovative proteomic technologies."

The Proteomics CoEE pursues research in technologies that study and gather information encoded in the genomes of proteins. Because of technology limitations, only limited protein information can currently be accessed and analyzed. However, the field of proteomics research is expected to lead to an understanding of cellular function at the molecular level, particularly how cellular functions go awry in disease. Thus, this CoEE is designed to yield patentable new technology and will provide visibility in the field of bioengineering which will attract industry. The MUSC Proteomics Center has obtained a patent for electrospray ionization, which it hopes will soon lead to licensure. The center was also the 2004 recipient of one of the largest competitive extramural research award ever received in the state ($18.7 million). In addition, a $500,000 NIH grant was secured in 2006 for the purchase of a mass spectrometer for tissue imaging research. In 2007, junior faculty member Dr. Lauren Ball received funding from NIH, the Department of Defense Breast Cancer Research Program, and the American Cancer Society. This CoEE is partnered with the Department of Energy Molecular Foundry at the Lawrence Berkeley National laboratory to develop a new type of microfluidic valve based upon a nanostructured polymer for use in proteomic analysis devices.

MUSC is actively recruiting the COEE CHAIR IN PROTEOMICS.

CoEE Name: **Renal Disease Biomarker**
Award Date: **6/09/08** Award Amount: **$5 million**

The Renal Disease Biomarker COEE addresses the need for reliable and prognostic biomarkers, or biological indicators, for acute kidney injury and chronic renal (kidney) failure. Statewide, medical practice-based networks will conduct proteomic analysis to identify candidate biomarkers of renal disease. Accurate and sensitive biomarkers are essential for early detection and therefore treatment of this disease. The area of research is especially relevant in South Carolina. Diabetes is the leading cause of kidney failure, and South Carolina has a higher rate of diabetes than the U.S. average, according to the Centers for Disease Control and Prevention; more than 9% of South Carolinians have diabetes, compared to 7% nationally. Discoveries generated from this CoEE have the potential to reduce health care costs and bring revenue to the state through intellectual property development and commercialization of newly identified biomarkers for kidney disease. In FY 2008, the CoEE had $4.4 million in federal research funding. Also, in FY2008, faculty associated with the CoEE formed the Southern Acute Kidney Injury Network (SAKInet) with four researchers from Duke University, George Washington University, the University of Tennessee system, and the MD Anderson Cancer Center in order to facilitate biomarker discovery.

MUSC is actively recruiting the COEE CHAIR IN RENAL BIOMARKERS and the COEE CHAIR IN TRANSLATIONAL NEPHROLOGY RESEARCH.

NEUROSCIENCE

CoEE Name: **Neuroscience**
Award Date: **6/24/03** Award Amount: **$3 million**

The Neuroscience CoEE researches age-related neurodegenerative problems including dementia, Alzheimer's, Parkinson's and stroke. This area of research has a major impact on South Carolina, where more than half the population is over the age of 56. This CoEE is a strong component of MUSC's established Neuroscience Institute and also works in collaboration with the MUSC Center on Aging. The endowed chair-holders for this CoEE work to assist in the establishment of biotechnology companies in South Carolina. The CoEE has also supported the creation of SemiAlloGen, Inc., a biotechnology start-up company which develops therapeutics in the field of neurodegenerative disorders and cancer. A CoEE project with Jazz Pharmaceuticals is in development to test mechanisms of action of the drug Xyrem. A medical device company Cyber-onics, Inc. has supplied equipment and consulting expertise in modulating cognitive processes to this CoEE's research efforts. The CoEE has partnered with Cephalon Pharmaceuticals to test one of its compounds in reward function in brain, with potential application in addiction and obesity. Dr. Chimowitz has received a supplement to his NIH award from Boston Scientific for more than $5 million.

CoEE chair Dr. Gary Aston-Jones

Dr. Gary Aston-Jones, WILLIAM H. MURRAY COEE ENDOWED CHAIR IN NEUROPATHOLOGY [appointed 7-1-06]. Aston-Jones' research focus is motivation and cognitive processes. The influence of motivation on cognitive processes is at the center of his work, with particular emphasis on patient focus (the ability to concentrate and disengage on tasks) in certain mental disorders. Aston-Jones' research has led to a new drug treatment for ADD. His other work has applications for better determining the specific processes involved in learning and dementia. Aston-Jones has received continuous NIH funding since 1983.

Dr. Marc Chimowitz, COUNTESS ALICIA PAOLOZZI COEE CHAIR, [appointed 3-1-08]. Chimowitz's research focus is neurodegeneration and treatments to prevent stroke caused by the narrowing of brain arteries. Chimowitz is leading a $25 million NIH-funded clinical trial on stroke prevention, one of the largest research grants in state history. At more than 50 sites across the country, Chimowitz and his colleagues are examining the value of stents to prevent strokes in patients whose brain arteries have hardened and narrowed due to plaque buildup. Stroke research is especially relevant in S.C., which has the nation's second-highest stroke mortality rate. Chimowitz completed a $14 million clinical trial while at Emory University to determine the effectiveness of warfarin versus aspirin for preventing stroke in patients with narrowed brain arteries. He is also the recipient of a Career Investigator Award from the National Institute of Neurological Disorders and Stroke.

CoEE chair Dr. Marc Chimowitz

MUSC is actively recruiting the CoEE ENDOWED CHAIR IN MOVEMENT DISORDERS.

UNIVERSITY OF SOUTH CAROLINA: BUILDING A FOUNDATION OF RESEARCH EXCELLENCE

Dr. Rosemarie Booze

The University of South Carolina is expanding South Carolina's competitive advantages for research through the CoEE Program with a significant role in building a positive future for our citizens. As a testament to the university's commitment to success for this program, USC serves as the lead research institution on 14 CoEEs and a partner institution on nine other Centers. Research partners include Clemson, MUSC, Coastal Carolina University and HSSC.

Each USC COEE builds on the university's solid foundation of excellence in education and research. Collectively, they provide a powerful resource for investigators working in three contemporary fields of acute interest: Biomedicine, Nanotechnology, and Future Fuels™.

Future Fuels™ investigations are progressing in five CoEEs. Three of these are dedicated to the **Hydrogen and Fuel Cell Economy**, **Renewable Fuel Cells**, and **Solid Oxide Fuel Cells**. This research "trifecta" is contributing to critical needs for hydrogen storage materials and fuel cell sensors; deducing catalysts to accelerate alternative fuels' fabrication from renewable sources; and removing barriers to solid oxide fuel cell use. Research dedicated to reducing adverse environmental effects of coal burning electricity generation is underway in a fourth Center committed to **Strategic Environmental Approaches to Electricity Production from Coal**. A fifth, the **Nuclear Science and Energy**, is taking a leadership role in designing, developing, and analyzing the advanced materials required to extend the life of existing nuclear power reactors and develop more efficient reactors for the future. Thus, these CoEEs cluster in an area critical for South Carolina – SECURING OUR ENERGY FUTURE.

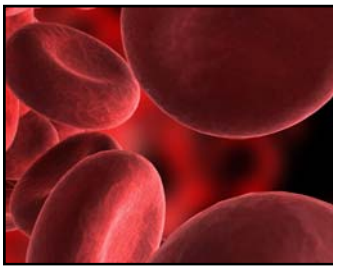
Nanotechnology research in the **Nanostructures CoEE** involves probing experimental nano-scale physics. Concurrently, analyses weighing the scientific, technological, health, economic, legal, and societal effects of molecular scale matter manipulation are moving ahead in the **Nanoenvironmental Research and Risk Assessment CoEE**. Researchers in the **Polymer Nano-composites CoEE** are contributing to the development and fabrication of polymer nano-composite structures for high-energy storage devices and improving materials for our state's polymers market sector.
Biomedical researchers in the **Center for Rehabilitation and Reconstruction Sciences** are providing critical support for expansion of tissue-engineered materials and implantable devices for orthopedic treatments. University administration and biomedical researchers have created a statewide collaboration with MUSC, Clemson, and HSSC in the **Center for Healthcare Quality** to use applied medical research and state-of-the-art information technology to spread healthcare safety, effectiveness and affordability among all South Carolinians.

USC is leading the field to develop next-generation software for the tourism industry. The **Center for Tourism and Economic Development**, along with investigators from Coastal Carolina University, will improve the operational efficiency of hotels, airlines, rental car companies, restaurants, and destination marketers, a key area for economic development in South Carolina.

The CoEE Program has not only raised the academic reputation of the University of South Carolina, but also represents an extraordinary effort for the creation of high-wage jobs through harnessing USC's research investments in energy, materials and health sciences to the needs of South Carolina's citizens.

Dr. Rosemarie Booze is USC Interim Vice President for Research & Economic Development. In addition to her administrative position at USC, Dr. Booze is also the principal investigator of the Childhood Neuro-therapeutics CoEE. [See p. 70.] In the left photo, Dr. Booze is shown examining brain tissue under a microscope with USC undergraduate student Kadian Simms.

2003-2008 University of South Carolina Centers of Economic Excellence[13]



BIOMEDICAL

CoEE Name: **Rehabilitation and Reconstruction Sciences**
Award Date: **6/18/07** Award Amount: **$5 million**

The CoEE in Rehabilitation and Reconstruction Sciences is focused on medical and public health needs in the area of orthopedic disorders, exercise and sports-related injury prevention, treatment and rehabilitation. Collaboration among the four intellectual cores, Cellular Engineering; Rehabilitation and Performance Sciences; Epidemiology and Clinical Translation; and Education, help translate basic science to bedside care. The CoEE investigates the biologics of tissue-engineered materials and implantable devices to find solutions to a variety of musculo-skeletal maladies. Partners of this CoEE include Smith & Nephew, Steadman Hawkins Clinic of the Carolinas, and Orthopaedic Research Foundation of the Carolinas. Representatives from each non-state partner, along with representatives from USC, formed a steering committee which met quarterly throughout 2008. Smith & Nephew, a global leader in medical devices, provides committee participation and substantial funding for this Center.

Once a research agreement between USC and Smith & Nephew is finalized, USC will recruit the COEE CHAIR IN RECONSTRUCTIVE METHODOLOGIES AND MATERIALS.

CoEE: **Strategic Approaches to Electricity Production from Coal**
Award Date: **6/18/07** Award Amount: **$5 million**

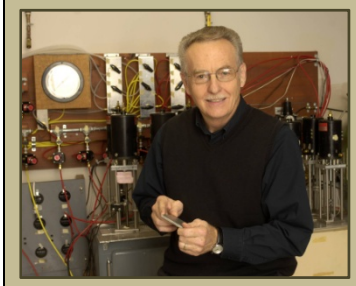
FUTURE FUELS™

Coal is the cheapest and most widely available energy source and will be used for at least another two to three decades by energy providers. However, the environmental impact of coal-burning is substantial. The long-term research objective of the CoEE is to improve the environmental control technologies for coal power plants, including the design of improved environmental control systems for mercury and acid gas emission control and the development of new materials and processes for carbon sequestration and storage/ utilization.

Santee Cooper and the Electric Cooperatives of South Carolina are providing the non-state matching funds for this CoEE. Two research projects have been initiated around the subjects of the refining of crushed coal by particle size and new pressure swing adsorption cycles for CO^2 capture from coal-fired power plants.

USC is actively recruiting the COEE CHAIR IN STRATEGIC ENVIRONMENTAL APPROACHES TO ELECTRICITY PRODUCTION FROM COAL.

[13] Included here are USC's independent Centers. A summary of all collaborative Centers, including ones for which USC is the lead institution, follows on pages 62-75.



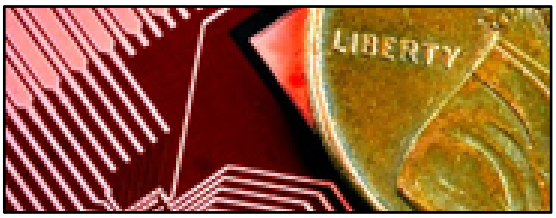
"There's quite a bit of energy research being conducted at USC, so the Future Fuels Center is really a university-wide initiative to focus those efforts. We are going to promote all of the CoEEs that are related to energy, as well as our research programs in solar, nuclear engineering, clean coal, biomass and environmental sustainability."

Dr. Kenneth Reifsnider
CoEE Endowed Chair for Solid Oxide Fuel Cells
Director, Future Fuels Center at USC

CoEE Name: **Hydrogen and Fuel Cell Economy**
Award Date: **8/30/04** Award Amount: **$5 million**

This CoEE conducts research to develop hydrogen storage materials and sensors for fuel cells. Fuel cells produce electricity from hydrogen and hydrogen-rich carbon fuels without thermal combustion and are more efficient for power generation than existing coal and natural gas technology. Along with other components of the Future Fuels™ Initiative, this CoEE will be housed in the Horizon Center, a $55 million public-private facility at USC Innovista. The two endowed chairs will work with public and private sector alliances such as the S.C. Hydrogen and Fuel Cell Alliance and the Greater Columbia Fuel Cell Collaborative. USC presently has the nation's only NSF Industry/University Cooperative Research Center (I/UCRC) for Fuel Cells. The research of this CoEE will increase the number of dues-paying Fuel Cell Center members from companies all over the world. This CoEE has international collaborations with the Korea Institute of Energy Research and the Fraunhofer Institute for Solar Energy in Germany. Along with these two international collaborations, the CoEE has 20 national industrial partners. One start-up company, Palmetto Fuel Cell Technologies, has been created through associated work of the CoEE. It serves the industry with hardware, designs, technologies and component products. Six spin-off companies have been created through associated work of the CoEE. Along with the Renewable Fuel Cells CoEE, this CoEE obtained a U.S. patent and formally filed 12 scientific disclosures, 16 U.S. provisional patent applications, seven U.S. non-provisional patents and international patent applications.

USC is actively recruiting the COEE CHAIR IN SENSORS and the COEE CHAIR IN HYDROGEN STORAGE MATERIALS.



CoEE FACT: The INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH CENTERS (I/UCRCs) program develops long-term partnerships among industry, academe, and government. The centers are catalyzed by a small investment from the National Science Foundation (NSF) and are primarily supported by center members, with NSF taking a supporting role in their development and evolution. I/UCRCs stimulate highly leveraged industry/university cooperation by focusing on fundamental research recommended by Industrial Advisory Boards.

CoEE Name: **Nuclear Science and Energy**
Award Date: **6/09/08** Award Amount: **$3 million**

2008 CoEE

The Nuclear Science and Energy CoEE will focus on the design, development and analysis of advanced materials required to extend the life of existing nuclear power reactors and to develop a new generation of more efficient reactors. As the first order for new nuclear reactors in 29 years has recently been initiated in the United States, USC is poised to be a major academic leader in the field, especially because most nuclear engineering academic programs throughout the country have been terminated. The state is already a national leader in nuclear power, generating 56% of its electricity via nuclear reactors. In conjunction with the USC Nuclear Engineering program, this CoEE will have access to industrial partners including Duke Energy, Progress Energy, SCANA, Westinghouse, and the URS nuclear center. As proposed, the CoEE has three initial projects: (a) Coupled Design Codes and Thermal Hydraulic Test Data; (b) Advanced Materials and Processes for Study, Fabrication and Joining of Materials; and (c) Power Plant Maintenance and Monitoring. Research around these projects has the potential for not only aiding the nuclear energy industry but also impacting the aircraft, process chemical, gas turbine and coal and natural gas power plant industries among others.

USC is actively recruiting the COEE ENDOWED CHAIR IN NUCLEAR POWER AND ADVANCED MATERIALS.

CoEE FACT: Within a 120-mile radius of Columbia, 11 large commercial nuclear power plants provide more than 10% of the nation's nuclear-generated energy.

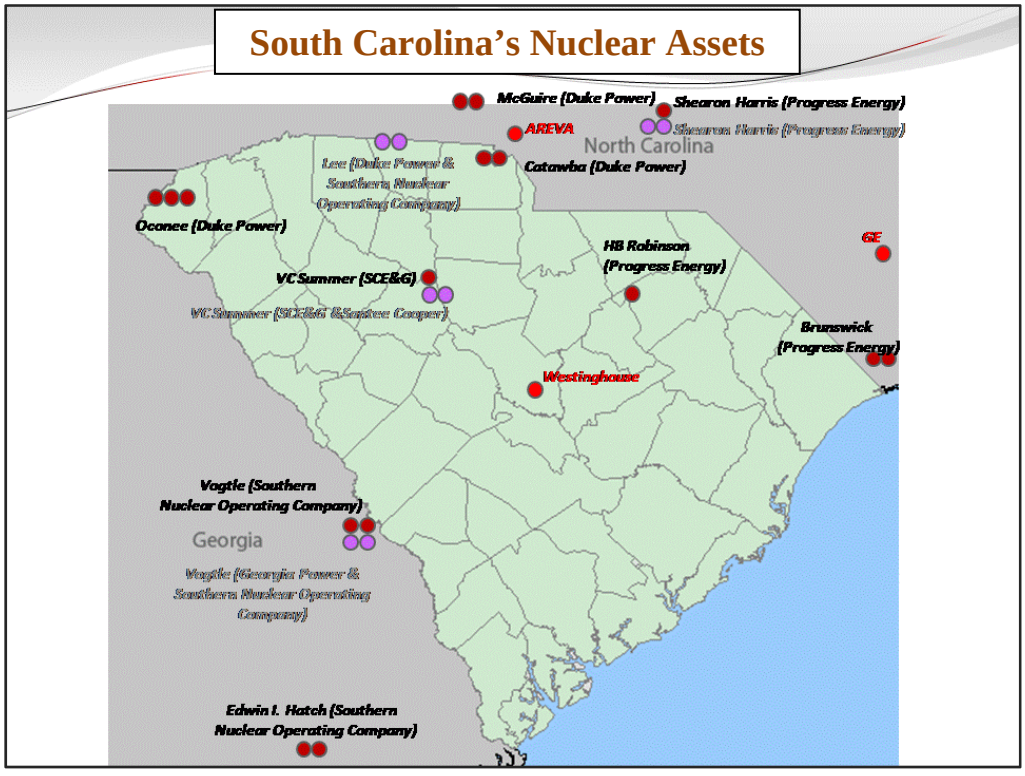


Figure 5. South Carolina's Nuclear Assets.
[Figure courtesy of S.C. Department of Commerce and Savannah River Site.]

CoEE Name: **Renewable Fuel Cells for the Fuel Cell Economy**
Award Date: **6/29/05** Award Amount: **$3 million**

The mission of this CoEE is to coordinate state and local research projects to attract additional capital investment in South Carolina for the fuel cell economy. The CoEE is developing new catalysts that allow alternative fuels to be produced from renewable sources. These new catalysts are the "next wellhead" as the transportation sector moves to less dependence on imported oil and on fuel which recycles carbon. This endowed chair-holder will work with the NSF I/UCRC for Fuel Cells, new and existing industries pursuing fuel cell opportunities, as well as the Savannah River National Laboratory. [See page 54 for additional information regarding the NSF I/UCRC for Fuel Cells.]

USC is actively recruiting the COEE CHAIR IN RENEWABLE FUEL CELLS.

Horizon I is a five-story, 125,320 square-foot university research facility on the USC Innovista campus. This building is currently in Phase I of construction and is expected to open in April 2010. Horizon I will be primarily devoted to the developmental research for future fuels, hydrogen, fuel cells, and polymer nanocomposites. The **Centers of Economic Excellence for Polymer Nanocomposites**, **Hydrogen and Fuel Cell Economy**, **Renewable Fuel Cells for the Fuel Cell Economy**, and **Solid Oxide Fuel Cell**s will all be housed in Horizon I.

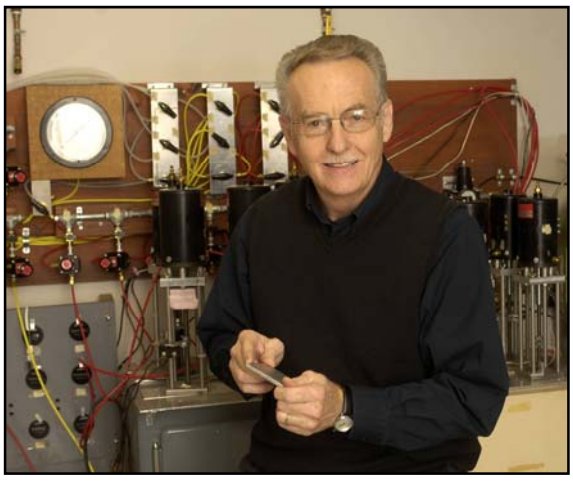
CoEE Name: **Solid Oxide Fuel Cells**
Award Date: **6/13/06** Award Amount: **$3 million**

Solid oxide fuel cells are one of two leading fuel cell types which are expected to find commercialized application in large, high-power systems such as full-scale industrial and large-scale electricity-generating stations Fuel cells are continually replenished with fuel and thus provide a continuous supply of electric power without running down like a battery. Solid oxide fuel cells convert chemical energy directly into electrical energy. Applications for these fuel cells include large-scale power distribution for municipalities, rural areas and industries, as well as energy for homes. They could also provide mobile power for computers, cell phones and other electronics. Solid oxide fuel cells are highly efficient; operate with a number of fuels, including renewable fuels; and produce very low amounts of greenhouse gasses and pollution.

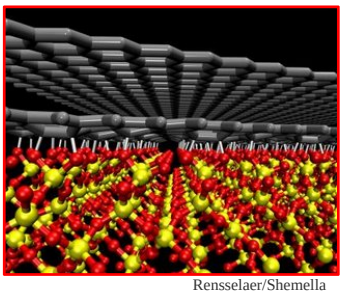
CoEE FACT: CoEE chair Dr. Kenneth Reifsnider is a member of the prestigious National Academy of Engineering and the only NAE member presently working in SC.

This CoEE's work is to remove barriers for the use of solid oxide fuel cells in society by: (a) designing components to accommodate variations in temperature and transport associated with practical uses; (b) understanding long-term behavior and durability of solid oxide fuel cell systems; (c) developing testing protocols that simulate solid oxide fuel cells behavior over prolonged time periods; and (d) developing systems for stationary power generation. Currently, this CoEE has funding totaling more than $2.1 million from the Office of Naval Research, the U.S. Department of Energy (DOE) and the South Carolina Research Authority (SCRA). In the past year, faculty associated with this CoEE generated over $26 million in proposed research funding, including a $22 million DOE proposal; partners on the proposal include four national laboratories and eight universities. This is the first time a research project of this size and scope has been led by USC. This CoEE also has developed a collaboration with the Savannah River National Laboratory, the NASA Glenn Research Center and ENrG, Inc., to create a high temperature electrolysis system with NASA-invented fuel cell technology. The DOE Office of Basic Energy Sciences promised 2009 funding if a working prototype system could be demonstrated in one year's time. SCRA granted $400,000 for the creation of the prototype system.

Dr. Kenneth Reifsnider, COEE CHAIR IN SOLID OXIDE FUEL CELL RESEARCH [appointed 3-1-07]. Reifsnider's research is in the field of mechanical engineering, with a focus on the way materials "behave"—their durability, damage tolerance, and the way they perform over time. His particular interest is in fuel cell science and engineering. In 2008, Reifsnider was named director of the USC Future Fuels Center. He previously served as director of the Connecticut Global Fuel Cell Center and as a Chair of Engineering Science and Mechanics at Virginia Tech. He received his Ph.D. from Johns Hopkins. In 2008, Reifsnider cofounded a company called NextGenEn, Inc. which expects to market its first products in 2009.



Solid Oxide Fuel Cells CoEE Chair Dr. Kenneth Reifsnider.



Rensselaer/Shemella

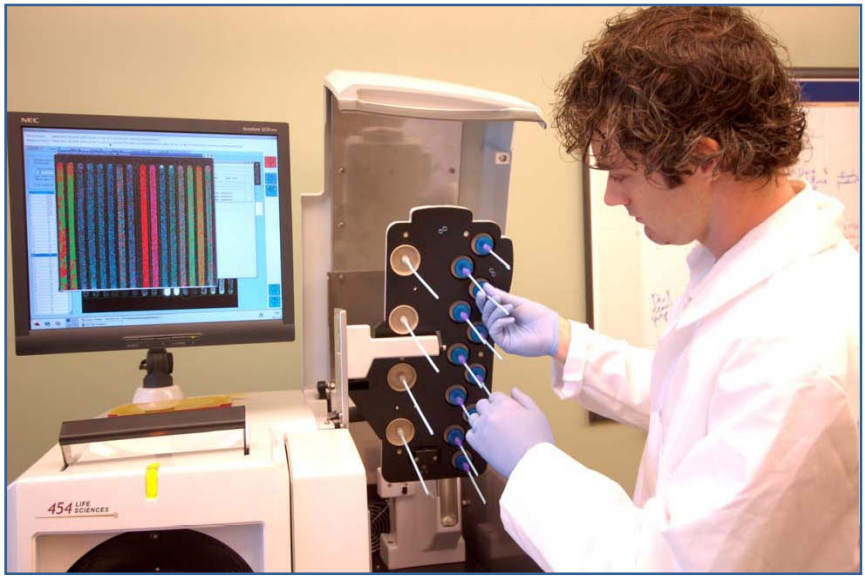
NANOTECHNOLOGY

CoEE Name: **Nanoenvironmental Research & Risk Assessment**
Award Date: **6/09/08** Award Amount: **$3 million**

The Nanoenvironmental Research and Risk Assessment CoEE will focus on the scientific, technological, health, economic, legal and societal effects of nanotechnology on the environment. Since nanomaterials are small enough to cross cell membranes, they are potentially toxic to living things, including humans. A growing demand exists for environmental health services in nanotechnology manufacturing and product assessment. Risk assessment tools are necessary to assure that socioeconomic benefits of nanotechnology are delivered without unacceptable risks of harmful effects on living systems and the environment. In order to help meet this growing demand, the CoEE will build on USC's strong existing program of research in nanoscience, which includes the extensive facilities of the USC NanoCenter, the recently established W.M. Keck Open Laboratory for Bionanoparticle Technology Discovery and Development, and many partnerships with federal agencies and laboratories. The initial area of research for this CoEE will be the nanoparticle environmental impact on estuarine sediments and organisms. The U.S. Environmental Protection Agency has awarded the CoEE research funding totaling over $375,000 to study the effect of single-walled carbon nanotubes on estuarine sediments and organisms. The work of this CoEE has led to a collaborative scientific publication entitled *Transfer of Gold Nanoparticles from the Water Column to the Estuarine Food Web* as well as a U.S. Provisional Patent application for inorganic luminescent materials.

2008 CoEE

USC is actively recruiting the COEE ENDOWED CHAIR FOR NANOENVIRONMENTAL RESEARCH AND RISK ASSESSMENT.



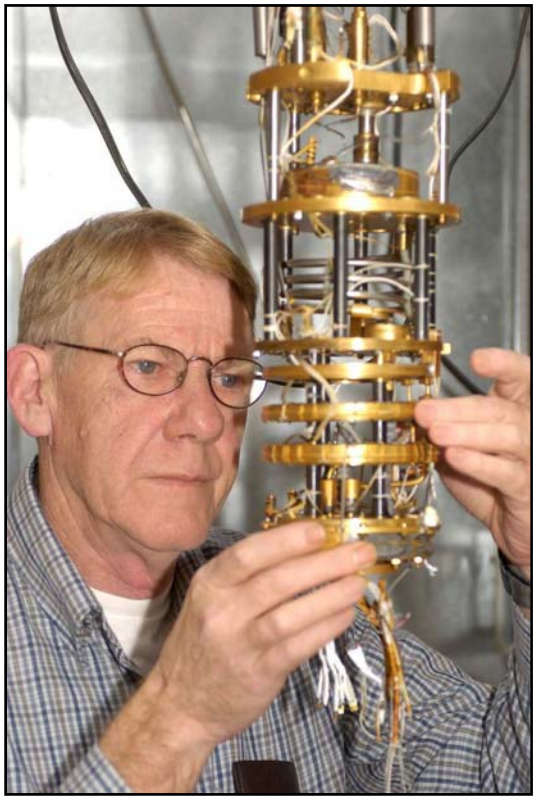
USC technician Daniel Sisco uses the Roche LifeSciences 454 FLX Genome Sequencer in the Environmental Genomics Facility at the Public Health Research Center. This facility is used by the Nanoenvironmental Research & Risk Assessment CoEE.

CoEE Name: **Nanostructures**
Award Date: **6/24/03** Award Amount: **$4 million**

The Nanostructures CoEE concentrates on research in experimental nanoscale physics and is positioning the state to compete in the global future electronics market. The program has five focus areas: (a) synthesis/characterization of nanowires in metals and semiconductors for novel magnetism in electronic circuits; (b) development of high power LEDs, transistors, and optoelectric properties of materials; (c) development of nanomagnetics, high frequency switching, and spintronics; (d) development of novel superconducting states/materials; and (e) discovery of novel concepts for nanoscale sensors for magnetic and structural properties. This CoEE is attempting to develop better and cheaper hydrogen gas sensors and multi-dimensional detection and analysis systems. Research achievements in FY 2008 include progress in understanding the "coherence in magnetic nanostructures" and the importance of "biological systems in potential electronic applications." In 2007, the CoEE received $1.6 million in combined funding from NSF, the U.S. Army Research Office, Seagate Technology and Aerotech Corporation. In 2008, the U.S. Army Research Office renewed its funding for the CoEE's sensors program. CoEE faculty, along with 16 national and international scientists, have begun forming an international materials institute with a concentration in Nanomechanics in Novel Materials. The institute has already garnered five national industrial partners. To support the work of CoEE chair Dr. Webb, three assistant professors have been hired since 2005 with expertise in condensed matter physics, theoretical physics and nanotechnology applications.

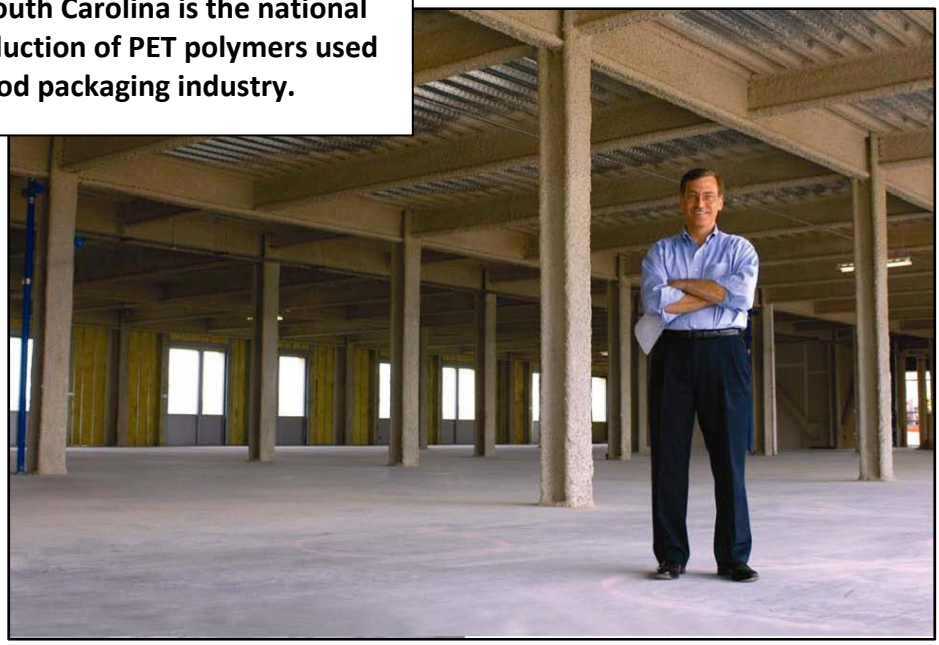
Dr. Richard Webb, COEE CHAIR IN NANOELECTRONICS [appointed 8-16-04].

Webb is researching quantum devices for use in computer electronics and information technology. His scientific accomplishments include fabricating some of the world's smallest electronic circuits, which could pioneer the development of smaller, higher-performing electronic devices. Current products based on Webb's discoveries include sensors which diagnose heart problems and monitor internal faults in metal structures. Previously, Webb managed the quantum electronics program at IBM's T.J. Watson Laboratory. He is a member of the National Academy of Sciences (one of only two USC researchers to hold that distinction) and is a fellow of the American Academy of Arts and Sciences.



Dr. Richard Webb, CoEE Endowed Chair in Nanoelectronics, works the sample wiring for his ultra-low temperature dilution refrigerator, which is capable of cooling samples to 0.003 Kelvin. This machine is equipped with two superconducting quantum interference devices (SQUIDs) used for thermometry as well as an 8 Tesla superconducting magnet.

CoEE FACT: South Carolina is the national leader for production of PET polymers used in the food packaging industry.



Dr. Brian Benicewicz, CoEE Nanocenter Chair of Material Science and Engineering, stands in his future state-of-the-art research space in the Horizon I facility.

CoEE Name: **Polymer Nanocomposites**
Award Date: **4/27/04** Award Amount: **$3.5 million**

Research at this CoEE focuses on the development of new materials with improved properties for the polymers market. The S.C. plastics industry accounts for nearly 5% of the Gross State Product of goods and services. As the plastics industry experiences commoditization of its basic materials (plastic polymers), this CoEE hopes to have a major impact on the state's manufacturing economy. This CoEE also is developing a precompetitive research consortium to study the uses of nanomaterials to improve the performance of a variety of polyester polymers. The CoEE is one of a few national academic groups which has a complete system for making PET nanocomposites by in situ polymerization. The U.S. Air Force Research Laboratory has funded two grants of $901,000 and $500,000 to construct and evaluate polymer nanocomposite structures for application in high energy storage devices. The CoEE anticipates further partnerships with the several capacitor companies in S.C., including KEMET and AVX. In FY 2008, the CoEE also received a $865,000 research grant from NSF, MeadWestvaco and Montana Polysaccharides. Significant achievements of the CoEE include developing a unique approach in the study of polymer nanocomposites where custom-made layered materials (clays and other inorganic solids) are synthesized with surface chemical groups tailored for compatibility with PET or other target polymers. This unique approach will allow further research in the area of PET polymers and will strengthen the CoEE's defense industry work. Relationships have been formed with more than 20 manufacturers, plastic processors, and end-use fabricators including Michelin, MeadWestvaco and PBI Performance Products.

[USC hired Dr. Brian Benicewicz as the CoEE Chair in Materials Science and Engineering on August 16, 2008.]

COLLABORATIVE CENTERS OF ECONOMIC EXCELLENCE: LEVERAGING RESOURCES AND RESULTS

Dr. Jay Moskowitz

South Carolina is fortunate to possess multiple fine research universities, each of which stands on its own unique merits. In 2002, the General Assembly acknowledged their strength and potential as change agents when it passed the Research Centers of Economic Excellence Act. The vision behind this landmark legislation was to use research to fuel economic development, create a knowledge-based economy and increase per capita income in South Carolina.

Early on, the presidents of MUSC, USC and Clemson recognized that in the health sciences, a collaborative approach to research would leverage intellectual, physical and financial resources, and ultimately yield greater results. This played a pivotal role in the creation in April 2004 of Health Sciences South Carolina (HSSC), a statewide collaboration composed of these three universities and their natural partners in biomedicine, the state's three largest health systems: Greenville Hospital System, Palmetto Health and Spartanburg Regional Healthcare System.

In just five years, this unique partnership of universities and health systems has grown rapidly. From the original three HSSC-supported CoEEs, there are now 11, addressing high-profile issues with far-reaching implications for the state's economy and well-being. These include heart and vascular disease, stroke, cancer, the neurosciences, healthcare quality and patient safety, healthcare workforce education, and health facilities design and testing.

HSSC has proved to be a magnet for investment and talent. It has secured millions in funding, including a $21 million grant from The Duke Endowment, the largest health-related grant made by the Charlotte-based philanthropy. World-class researchers and policymakers have been attracted to the possibilities of working within a statewide effort. Among HSSC's most important roles is that of an enabler and builder of a multidisciplinary organizational infrastructure. To this end, HSSC has created the S.C. Institutes for Wellness and Healthcare Improvement, which provides the non-governance organizational structure necessary to foster greater collaboration, communication and coordination among HSSC partners as well as other partners in government, business, trade associations, and foundations.

In addition to the HSSC-supported CoEEs, there are seven other collaborative CoEEs, including partnerships between MUSC and College of Charleston (Marine Genomics) and USC and Coastal Carolina University (Tourism & Economic Development). Scientific research is traditionally an arena of aggressive competition. But in South Carolina, this dynamic has been turned inside-out to great success: the CoEE Program has made institutional collaboration a research standard.

Dr. Jay Moskowitz, President and CEO,
HSSC CoEE Endowed Chair in Translational Clinical Research.

2002-2003 Collaborative Centers of Economic Excellence

CoEE Name: **Brain Imaging** Award Amount: **$5 million**
Lead Institution: **University of South Carolina**
Collaborative Institution: **Medical University of South Carolina**

The Brain Imaging CoEE combines expertise at USC and MUSC to create a world-class brain imaging center. This collaborative CoEE anticipates receiving federal grants and contracts and is likely to spawn start-up companies in the areas of deception detection and minimally invasive brain stimulation technologies. Current research funding is in excess of $10 million, and the CoEE has been selected to submit a proposal as the dedicated neuroimaging core for a $60 million U.S. Department of Defense Congressionally Directed Medical Research Program PTSD/TBI clinical consortium. The CoEE launched a spin-off company, Cephos Corporation, which uses brain imaging technology to detect deception. Cephos has a Charleston office and began publicly marketing its services in March 2008. A partnership has also been formed with Ladson-based Force Protection Industries (FPI), a major Charleston area employer. A leading manufacturer of tanks and armored vehicles, FPI will utilize CoEE research in the prevention of traumatic brain injury due to combat explosions. Two recently acquired MRI systems, a Siemens Trio MRI system and a Bruker 7-Tesla, are attracting important companies such as Glaxo-Smith Kline, Jazz Pharmaceuticals and BioValve, which use the systems to speed drug discovery and development in mood stabilizers, anticonvulsants and cognitive enhancers. The CoEE-launched facility, McCausland Imaging Center, located at Palmetto Richland Hospital, includes dedicated research space and scanner time, allowing scientists to conduct research with neurologically healthy individuals as well as clinical populations. In 2005, the CoEE launched the Center for Animal Imaging which provides translational research in substance abuse and epilepsy therapy. In 2008, MUSC also opened the Center for Advanced Imaging Research.

[MUSC hired Dr. Paul Simon Morgan as the COEE CHAIR IN BRAIN IMAGING on October 1, 2008.]

USC is negotiating a final contract for the COEE CHAIR IN COGNITIVE NEUROIMAGING.

CoEE Chair Dr. Paul Simon Morgan of the Brain Imaging COEE uses MUSC's 3T MRI for translational research. Dr. Morgan also works with Nobel Laureate Peter Mansfield (UK), a pioneer in the use of MRI for medicine.

CoEE Name: **Marine Genomics** Award Amount: **$4 million**
Lead Institution: **Medical University of South Carolina**
Collaborative Institution: **College of Charleston**

The Marine Genomics CoEE researches marine functional genomics and bioinformatics, which include analyzing physiological adjustments in animal and plant genetics that result from environmental changes. Genomics technology is an important tool for the South Carolina oyster and shrimp business. The CoEE's investors and collaborators include Hollings Marine Laboratory (HML), the National Oceanic and Atmospheric Administration, and the S.C. Department of Natural Resources. This CoEE sells diagnostic gene chips to the International Oyster Microarray Consortium on a cost-recovery basis, raising the profile of the marine genomics group in the international community. As an international leader in this field, the CoEE has established the world's only data and tools-based marine genomics website. In 2007, the CoEE generated intellectual property based on a major discovery, with viable commercial possibilities, relating to RNA and viral infections in shrimp. The CoEE has partnered with two private companies, Shrimp Improvement Systems and Biogenmar, and is negotiating a formal relationship with a third company. The CoEE is also in discussion with Chugai Pharmaceutical Company about the development of marine pharmaceuticals using microbial genomics technology. Other contract partners include the University of Delaware and the National Institute of Standards and Technology.

MUSC is in negotiation for the COEE CHAIR IN MARINE BIOINFORMATICS and is actively recruiting the COEE CHAIR IN MARINE GENOMICS.

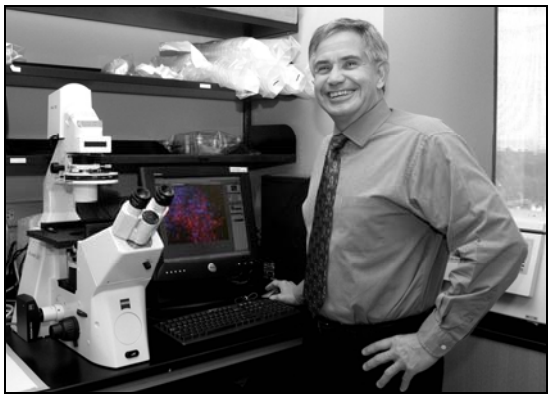
2003-2004 Collaborative Centers of Economic Excellence

CoEE Name: **Regenerative Medicine** Award Amount: **$5 million**
Lead Institution: **Medical University of South Carolina**
Collaborative Institutions: **Clemson, USC**

Regenerative medicine is the regeneration of tissue and organs for the purpose of repairing, replacing and maintaining organ function. The Regenerative Medicine CoEE is a collaboration among all three senior research universities. It combines statewide expertise in developmental biology, adult stem cell technology and tissue engineering. Goals for this CoEE include: (a) fostering basic research in genetics, proteogenomics, developmental biology, cell biology, and physiology of stem cells; (b) translating basic research into novel therapies for genetic and degenerative disorders; (c) collaborating with the private sector to develop business innovation research grants that can lead to partnerships with the business community and the U.S. government; and (d) establishing pre-doctoral and postdoctoral training programs in stem cell technology, developmental biology, biomaterials and tissue engineering. The most significant scientific accomplishments thus far for this CoEE are in the field of bioprinting, the assembly of living 3D human tissues and organs using rapid prototyping technology. In addition, advances in the multiple areas of bioengineering, wound healing, vascular biology, orthopedic materials science and cardiac development have led to an effort to construct a biofabricated blood vessel network. In 2006, MUSC faculty renewed a $10.8 million NIH Center of Biomedical Research Excellence Award and received an Introductory Molecular

Biology Research Experience NIH grant. The CoEE is currently awaiting word on a $9 million grant proposal to the NIH Center of Biomedical Research. A spin-off company, FirstString, was created in 2006, which features new wound repair technology; it has received investments of more than $600,000, including the support of SC Launch! and the NIH Small Business Technology Transfer Program. FirstString is working on the development of a wound repair gel with major economic potential. [See article regarding FirstString on following page.]

Dr. Richard Swaja, CoEE Chair in Regenerative Medicine [appointed 10-1-06]. Swaja's research focus is regenerative medicine and tissue engineering. His current work focuses on regenerative medicine—the application of tissue engineering principles to restore the structure and function of damaged tissues and organs. Swaja is also director of the S.C. Bioengineering Alliance and is working to improve the state's bioengineering capabilities by developing a statewide research and education program to increase technology transfer between research institutions and S.C. companies. Swaja was previously a senior advisor for biomedical engineering with NIH. He has managed research programs at Oak Ridge National Laboratory and served as a U.S. representative to several national and international scientific committees. Swaja also holds professorships at Clemson and USC.



Dr. Richard Swaja,
CoEE Chair in Regenerative Medicine.

[USC hired Dr. Martin Morad as the CoEE BlueCross BlueShield of South Carolina Foundation Endowed Chair in Cardiovascular Health on August 15, 2008.]

Clemson is actively recruiting the Hansjorg Wys Endowed Chair in Regenerative Medicine.

CoEE FACT: Dr. Martin Morad, newly appointed CoEE chair for the Regenerative Medicine CoEE, will lead a team of researchers to invent the world's first biologically-derived pacemaker.

Regenerative Medicine CoEE chair Dr. Martin Morad (left) discusses his research with Mr. Ed Sellers (right), President and CEO of BlueCross BlueShield of South Carolina. In April 2008, the BlueCross BlueShield Foundation of South Carolina announced a $5 million non-state match to the Regenerative Medicine CoEE.

Wound-repair gel approaches market

BY SHELIA WATSON

FirstString Research Inc., a Charleston-based biotechnology company developing a wound-healing process, is ready to move into its clinical trial stage, which will include testing its product on humans.

"We'll begin our phase-one clinical trials early next year," said Gautam Ghatnekar, president of FirstString and one of the developers of the process with Rob Gourdie, a professor of cell biology at Medical University of South Carolina and a Clemson University professor of bioengineering. In that early stage trial, the product or drug candidate is tested on very small groups to evaluate dosage, administration and safety.

The research and testing deals with the wound repair process in the skin using a bioengineered peptide, which is based on a naturally occurring protein in the body that helps regulate communication between cells to accelerate wound healing and tissue regeneration with significantly reduced scarring.

The process was created through research at the Medical University of South Carolina. To make the technology available on the open market, FirstString was formed as a biotechnology, tissue engineering and development company with assistance from MUSC's Foundation for Research Development, which helps university-based technology for business use.

Last year the company met with the Food and Drug Administration and received approval for human testing of its product after the company completed animal testing trials.

Ghatnekar explained that because the drug is a topical gel, the FDA approval process is somewhat less stringent than it is for drugs that are ingested.

"With this type of drug, you don't have to worry about where the drug is traveling to in the body," he said. "So far in all of our testing, there have been no adverse reactions."

Even before testing was completed, the company began to receive accolades. At the recent conference with Southeast BIO, the company was selected out of a group of 60 to present its business case before a panel of venture capitalists. SEBIO is a regional nonprofit organization that fosters growth of the life sciences industry in the Southeast United States.

"We were the first South Carolina biotech company to be a finalist for this event," said CEO Spencer Robert. "What this did is put us before interested investors and industry-experienced entrepreneurs who may be interested in helping us and providing support."

Ghatnekar said one thing that impressed investors at SEBIO was the amount of money the company has raised even in this early stage. To date that amounts to $2 million in private funds plus a $100,000 National Institutes of Health grant with matching funds from the South Carolina Research Authority's SC Launch! program. The NIH grant and matching funds will be used to test the company's product on chronic wounds, such as diabetic ulcers, as well as to test its ability to reduce scars.

Robert said the upcoming clinical testing on humans, expected to last about six months, will move the company closer to full FDA approval for the topical wound-healing gel as well as other products in the works.

"This is the first of many drugs that we're developing," he said. "We have others in the pipeline. Some are used for internal applications like cardiac injuries and spinal cord injuries and cancer."

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CoEE Name: **Translational Cancer Therapeutics** Award Amount: **$5 million**
Lead Institution: **Medical University of South Carolina**
Collaborative Institution: **University of South Carolina**

The Translational Cancer Therapeutics CoEE builds on existing strengths in pharmacology at USC and MUSC and expands opportunities for increased interdisciplinary research to enhance scientific research in the biology common to cancer. As research builds in the discovery and development of cancer drugs, the state economy will be strengthened by biotechnology companies with pharmaceutical interests. Collaborative work with Novelos Pharmaceuticals has led to unrestricted research funding totaling over $475,000 since 2005 to study lung and ovarian cancer. Current federal funding for this CoEE totals over $1 million. An NIH COBRE application in Oxidants, Redox Balance and Stress Signaling for $1.5 million, submitted by the CoEE this past year, received an outstanding initial review. In March 2007, this CoEE co-hosted the Hollings Cancer Center Spring Symposium in Cancer Drug Discovery and Development, which was attended by a host of international pharmaceutical and medical experts and representatives. In 2007, this CoEE also supported the recruitment of three new assistant professors and an associate professor to MUSC. These four individuals from Harvard University, the Fox Chase Cancer Center, the University of Virginia and NIH have formed a drug discovery team under the direction of CoEE chair Dr. Kenneth Tew.

USC is finalizing the search for the COEE CHAIR IN DRUG EFFICACY.

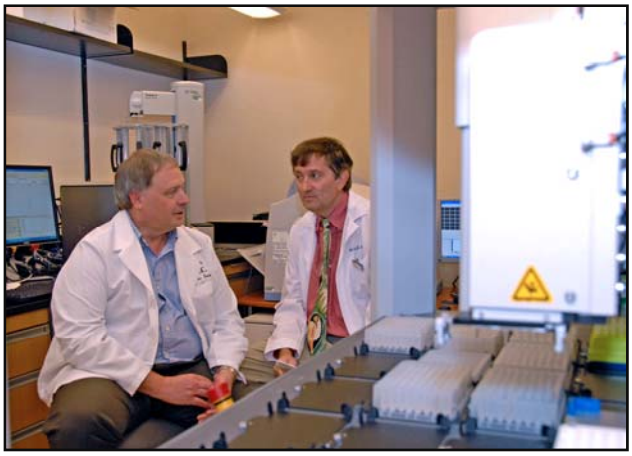
Dr. Kenneth Tew, JOHN C. WEST CHAIR IN CANCER RESEARCH [appointed 1-1-04]. Tew has an international reputation as a cancer drug discovery researcher and developer. His early research was pivotal in the design of treatment for hormone refractory prostate cancer. Tew's research has also proved instrumental in the late-stage clinical testing of two promising drugs, one for ovarian and lung cancer, and another that serves as a modifier of bone marrow-mediated immune function. Tew is presently conducting research on how cancer cells develop resistance to different drugs. Discoveries from his work have suggested links between cancer and Alzheimer's. Tew sits on scientific advisory boards of a number of pharmaceutical companies. He has been awarded a National Cancer Institute Outstanding Investigator Grant and an American Cancer Research Society (ACS) Scientific Excellence Award. He is also chair of MUSC's Department of Cell and Molecular Pharmacology and Experimental Therapeutics. In 2008, Dr. Tew was elected as a Fellow with the American Association for the Advancement of Science, making him one of only two individuals in S.C. so honored. He also currently serves as President of the Association of Medical School Pharmacology Chairs.

2004-2005 Collaborative Centers of Economic Excellence

CoEE Name: **Cancer Drug Discovery** Award Amount: **$5 million**
Lead Institution: **Medical University of South Carolina**
Collaborative Institution: **University of South Carolina**

This CoEE provides mechanisms for target identification and generation of lead compounds in the drug discovery process, thus creating a productive interface (currently lacking in the field) between academics and the biotechnology/pharmaceutical industries. This CoEE also develops research in structural biology for target analysis, chemical biology for designing drug candidates and advanced biomedical screening technologies. The CoEE's success is built upon the expertise and resources of its four endowed chairs (two appointed in 2006). One of these, Dr. Charles Smith, has formed a drug screening core that contains chemical libraries with 50,000 compounds. Using this screening core, Dr. Smith and another colleague identified compounds which inhibit PIM kinases enzymes which are over-expressed in cancer. An article about this discovery was published in the *Journal of Medicinal Chemistry*, and Dr. Smith plans the launch of a company in FY 2009 to create marketable inhibitors to treat cancer. CoEE chair-holder, Dr. John Lemasters, is an expert in the advanced cellular technology of multiphoton confocal microscopy. His current projects center on the role of mitochondria in cell injury in cancer, heart and liver cells. During 2008, the CoEE had more than $3.7 million in federal funding, and CoEE-associated researchers authored 67 scientific publications.

Dr. Charles Smith, CHARLES AND CAROL COOPER COEE ENDOWED CHAIR IN PHARMACY [appointed 2-1-06]. Smith's research mission is to design drugs that fight cancer by unlocking molecular mechanisms important for tumor growth. This work could enable the development of new drugs to fight a variety of inflammatory diseases, including arthritis, Crohn's Disease and diabetic retinopathy. From research largely funded by the NIH, Smith holds nine patents. He has held faculty positions at Duke, Penn State and the Fox Chase Cancer Center (PA).



CoEE chair holders, Drs. Charles Smith (L) and Ken Tew (R), demonstrate robotic high-throughput drug screening instrumentation.

CoEE Chair Dr. John Lemasters.

Dr. John Lemasters, COEE ENDOWED CHAIR IN ADVANCED TECHNOLOGIES [appointed 2-1-06]. Lemasters is a pioneer of techniques that allow scientists to see inside cells during reoxygenation, which occurs following a heart attack or stroke. He specializes in microscopy that allows doctors to view slices of a single cell. His work will help researchers understand the mechanisms by which the liver is injured through chronic alcohol use and how donated organs are damaged while being held for transplant surgery. Lemasters has served as director of the UNC Cell & Molecular Imaging Facility and the Confocal Imaging Facility. He holds five patents.

USC is actively recruiting the COEE CHAIR IN MEDICINAL CHEMISTRY.

MUSC is actively recruiting the COEE CHAIR IN STRUCTURAL BIOLOGY.

CoEE Name: **Tourism & Economic Development**[14] Award Amount: **$2 million**
Lead Institution: **University of South Carolina**
Collaborative Institution: **Coastal Carolina University**

The purpose of the Tourism & Economic Development CoEE is to provide innovation to the tourism industry through the creation of new technological standards that will allow hotels, airlines, rental car companies, restaurants and destination marketers to operate more efficiently. At present, technological applications such as software providers and web-based electronic commerce in the travel and tourism industry are severely outdated. As this CoEE makes new travel and tourism technology discoveries, it hopes to secure contracts with major corporations and tourism ministries as well as impact the South Carolina tourism industry. The CoEE's three primary goals include: (a) assisting technology developers and travel and tourism businesses to establish and adopt technological standards in hardware, software and web-based applications; (b) discovering and testing new technological applications based on new industry standards; and (c) evaluating the effects of new technology on organizational structures with the goal of increasing the efficiency of corporate management. This CoEE currently is developing international collaborations with universities and Ministers of Tourism in several countries, including China, Uruguay, Guatemala and Brazil.

USC is in negotiations for the COEE CHAIR IN TRAVEL AND TOURISM.

CoEE FACT: In 2002, the travel & tourism industry accounted for $14.5 billion in generated revenue in South Carolina.

CoEE FACT: Myrtle Beach offers one of the most concentrated natural laboratories in the world for travel and tourism research, with over 60,000 hotel rooms, 1,500 restaurants, major airlines and rental car companies, numerous entertainment venues, and over 120 golf courses.

CoEE Name: **Vision Science** Award Amount: **$4.5 million**
Lead Institution: **Medical University of South Carolina**
Collaborative Institution: **University of South Carolina**

This CoEE focuses on new gene and pharmaceutical bases for the treatment of macular degeneration, glaucoma, retinitis pigmentosa and other eye diseases. The chairs at this COEE will have expertise in the areas of gene and pharmaceutical-based treatments for retinal degenerative diseases as well as bioengineering and material science techniques to develop novel products for improving surgical outcomes and drug delivery. This CoEE will serve as a platform for new product and business development and will create new jobs through the formation of start-up companies and IP licensing. In 2008, this CoEE obtained research contracts over $1.5 million from a number of companies, including Bausch & Lomb and Pfizer. Other grant funding totaled more than $2.1 million. The most significant scientific accomplishments were in the pathogenesis of macular degeneration and whether or not vitamin A derivatives can be used to treat the disease. This CoEE also seeks to determine whether changing protein acetylation status can prevent or slow vision loss due to glaucoma.

MUSC is actively recruiting a COEE CHAIR IN GENE AND PHARMACEUTICAL TREATMENT OF RETINAL DEGENERATIVE DISEASE and a CoEE Chair in BIOENGINEERING AND MATERIAL SCIENCE TECHNIQUES.

USC is actively recruiting a COEE CHAIR IN GENE AND PHARMACEUTICAL TREATMENT OF RETINAL DEGENERATIVE DISEASE.

[14] In November 2008, the name of this CoEE was formally changed from the Travel & Tourism CoEE to the Tourism & Economic Development CoEE.

2005-2006 Collaborative Centers of Economic Excellence

CoEE Name: **Clinical Effectiveness and Patient Safety** Award Amount: **$5 million**
Lead Institution: **Medical University of South Carolina**
Collaborative Institutions: **USC, Clemson**

This CoEE improves clinical education and patient safety through the use of simulation technology. Its goals include improving the quality of delivered care, advancing the practice and training of the medical workforce from student nurses to practicing physicians, and becoming an international focal point for health sciences education and innovative research in education and safety. The central administrative office for the CoEE is located on the MUSC campus with multiple simulation sites operating or being developed at Palmetto Health Alliance, USC College of Medicine, MUSC and at Greenville Hospital System in partnership with Greenville Technical College. A nursing-focused simulation center will be developed at the USC and Clemson Colleges of Nursing. The Greenville Healthcare Simulation Center offers 41 simulation courses with six courses in development; the MUSC Healthcare Simulation Center offers 28 simulation courses with 15 courses in development. Through 2007, a total of 2,812 students have participated in simulation activities at GHS and MUSC. B-Line Medical is creating a simulation learning management and data system and has engaged the CoEE in its development process. The "Sim Capture" system is the first of its kind and collects simulation data for education and research; the system is in its testing phase at MUSC. Research in FY 2007 provided the impetus for a successful, $100,000-plus grant for Maternal-Fetal Crisis and Emergency Response Team Development and Training. This CoEE is a major recipient of the $21 million Duke Endowment grant.

CEPS CoEE chair Dr. John Schaefer.

Dr. John Schaefer, LEWIS BLACKMAN COEE ENDOWED CHAIR FOR PATIENT SIMULATION AND RESEARCH FOR HEALTH SCIENCES SOUTH CAROLINA [appointed 2-1-06]. Schaefer is working to reduce patient injury during airway management procedures using mannequin-based simulators. These procedures ensure that a person can breathe while receiving treatments such as anesthesia, CPR, or emergency medical attention. Airway management during such procedures is a common source of unintended patient injury. Schaefer founded the Peter M. Winter Institute of Simulation, Education, and Research at the University of Pittsburgh Medical Center, one of the world's leading patient simulation facilities.

[MUSC hired Dr. Jihad S. Obeid as the COEE ENDOWED CHAIR IN BIOMEDICAL INFOMATICS in February 2009.]

USC is actively recruiting a COEE CHAIR IN CLINICAL EFFECTIVENESS & PATIENT SAFETY.

CoEE Name: **Childhood Neurotherapeutics** Award Amount: **$5 million**
Lead Institution: **University of South Carolina**
Collaborative Institution: **Medical University of South Carolina**

The Childhood Neurotherapeutics CoEE utilizes recent advances in pharmacogenetics, metabolic disorders, and neuroinflammatory diseases to study neurological disorders in children. Research at this CoEE will be particularly focused on the prevention of brain damage in premature infants (neuroprotection) and the curing of infant brain diseases through cellular engineering. In collaboration with the Greenville Hospital System, this CoEE operates a statewide team that is developing neural stem cell therapeutic approaches to neurological disorders in children. Neural stem cells have recently been identified as having high repair capacity, particularly during development. This important scientific discovery will allow the CoEE to impact the treatment of these disorders and to transfer research knowledge directly to patient application. NIH is funding a clinical study by MUSC for treatment of mothers with chorioamnionitis, inflammation of the amniotic membranes caused by infection. The Federal Drug Administration has awarded a grant to MUSC and the Children's Hospital of Philadelphia to evaluate the efficacy of atorvastatin, an HMG CoA reductase inhibitor, for patients with Type I diabetes. These studies have prompted the start of a spin-off company, ImmunoMod, which develops drugs for treatment of diabetes. The CoEE has been granted two U.S. patents and has submitted a total of four U.S. provisional and six non-provisional patent applications along with ten international patent applications. Faculty associated with the CoEE had over $13 million in extramural research funding this last year.

CoEE FACT: According to the S.C. Department of Education, in 2000, children with disabilities represented 14% of school-aged children in South Carolina's public schools.

USC is actively recruiting the CoEE Chair in Child & Adolescent Neurochemistry and the CoEE Chair in Translational Therapeutics.

MUSC is actively recruiting the CoEE Chair in Neurodevelopmental Dysfunction.

Jeet Guram (R) and Will Spears (L), students at USC School of Medicine, use a dissection microscope to study brain development.

2006-2007 Collaborative Centers of Economic Excellence

CoEE Name: **Health Care Quality** Award Amount: **$5 million**
Lead Institution: **University of South Carolina**
Collaborative Institutions: **MUSC, Clemson**

This CoEE seeks to become a prominent research center that capitalizes on recent scientific discoveries and technological advances, as well as S.C.'s unique characteristics and resources, to conduct innovative research on the state's major health problems. The goal of this enterprise is to improve the health of the state's population and its economic well-being. This CoEE is creating an electronic health portal and developing a clinical research organization, and it has a partnership agreement with IBM and Siemens to assist with the formation of a statewide information technology infrastructure which will include a clinical data warehouse and clinical trials management systems. In May 2008, the CoEE's Electronic Institutional Review Board (eIRB) was launched. This system is designed to facilitate the mandatory review process of all human clinical trials, which will make CoEE researchers more efficient and competitive for funding. The CoEE also has partnered with Collexis Holdings to form a database directory of biomedical research. In FY 2008, the S.C. Biorepository System was established, which provides tissue and sample data to researchers without violating patient privacy, the ultimate goal being to support clinical research in order to improve clinical outcomes for cancer patients. Through this system, a USC researcher received 29 fresh surgical specimens collected by Lexington Medical Center in order to further his study. The CoEE has partnered with the South Carolina Hospital Association for multiple benefits, including supporting statewide initiatives and translating to hospitals new products and processes discovered by the CoEE. A research project on hospital-acquired infections is being developed. In addition to the partnerships and initiatives mentioned, CoEE Chair Dr. Sanderson received a $7 million grant from the FCC to enhance rural healthcare through telecommunications and information services.


CoEE chair Dr. Iain Sanderson.

Dr. Iain Sanderson, CoEE Chair in Medical Bioinformatics [appointed 11-12-07]. Sanderson leads initiatives in medical informatics across the state's four largest healthcare delivery systems and three research universities. The goal of his work is improving health care quality in S.C. by creating secure databases for medical records that make it easier for healthcare systems to share vital information that is relevant for clinical trials and research. These improvements raise the level of care as well as the efficiency and profitability of the state's health care providers and could also help attract companies within the informatics field to the state. Sanderson served in the Duke department of anesthesiology for 15 years, where he was associate CIO for the Duke University Health System. Sanderson is the developer of a software portal, ORview, used over two million times a year at Duke area hospitals as the means of processing operating room schedules, anesthesia records, preoperative medical visits, postoperative visits, and pharmacy charges. ORview won the ComputerWorld Honor Program's 21st Century Achievement Award for Medicine in 2006.

[USC hired Dr. Jay Moskowitz as the CoEE Chair in Translational Clinical Research on August 16, 2008.]

CoEE Name: **Health Facilities Design and Testing** Award Amount: **$5 million**
Lead Institution: **Clemson University**
Collaborative Institution: **MUSC**

This CoEE is an interdisciplinary platform for collaborative educational, research and public service initiatives to study relationships between the design of healthcare settings, human health and healthcare delivery. The primary purpose of the CoEE is to expand and disseminate knowledge on how health facility design impacts health and healthcare delivery, and how to create architectural settings that better support the health and well-being of patients and staff. Through research, this CoEE will address the relationship between the physical healthcare environment and the four following areas: health and clinical outcomes; patient, family and staff satisfaction; operational efficiencies; and the ability to accommodate change. The CoEE has been awarded a subcontract with the Department of Defense entitled PATIENT ROOM OF THE FUTURE. The first two phases provided the CoEE with over $850,000 in research funding. Partners in this project include Carleton University (Ottawa), the Rensseleaer Polytechnic Institute, Vantage/Legrand Lighting (Utah), Hill-Rom, and IoA Healthcare Furniture. The physical prototype room is set to be completed in July 2008, and analysis will begin on topics such as the impact of nature views on health, headwall design performance, and lighting design concepts. The PATIENT ROOM OF THE FUTURE Project has been highlighted at the June 2008 Union of International Architects-Public Health Group Conference (Florence, Italy) and at four national conferences. In January 2008, Dr. David Allison, PI for the CoEE, was awarded as one of "Twenty Who Are Making a Difference" by *Healthcare Design* magazine.

Clemson is actively recruiting the COEE CHAIR IN ARCHITECTURE AND HEALTH RESEARCH.

MUSC is actively recruiting the COEE CHAIR IN HUMAN FACTORS MEDICAL RESEARCH.

CoEE FACT: According to the U.S. Census Bureau, in October 2006, there were $43 billion dollars in healthcare-related construction projects nationwide–a 15% increase from 2005.

Working with Clemson architecture professor Dina Battisto, Ellen Vincent, a doctoral student associated with the Health Facilities Design and Testing CoEE, is studying the impact of nature views displayed in a patient mockup room at Clemson's School of Nursing.

CoEE Name: **SeniorSMART™ Center** Award Amount: **$5 million**
Lead Institution: **University of South Carolina**
Collaborative Institution: **Clemson University**

The SeniorSMART™ CoEE focuses on multidisciplinary research to foster independence for seniors through developing technologies and strategies that prevent, delay or mitigate the main causes and impacts of disabilities. This CoEE has three major themes: SMARTBrain™ (helping maintain intellectual activity); SMARTWheels™ (promoting independent mobility outside the home); and SMARTHome™ (helping maintain independent mobility inside the home). Collaborations for SMARTHome™ investigations have begun with Lutheran Homes of S.C., Still Hopes Episcopal Retirement Community, and the Fraunhofer Institutes at the University of Kaiserslautern (Germany) for SMARTHome™ technology. A November 2007 planning retreat allowed 43 representatives of USC, Clemson, MUSC, Palmetto Health and Greenville Hospital System to meet with professionals from AARP, HSSC, Palmetto Senior Care, Georgia Tech, Still Hopes, Washington University, Lutheran Homes of S.C., and the Fraunhofer Institutes at the University of Kaiserslautern to discuss further collaboration. One project identified at the retreat involved a survey to determine seniors' acceptance of home technology and home monitoring. Another result of the retreat is a potential partnership with Grand Care, a home monitoring service. Three levels of test homes will be created for study in the SMARTHome™ component of the CoEE; Lutheran Homes of S.C. has donated two homes on one of its campuses for laboratory settings, while Still Hopes is partnering with USC in creating level two and three labs at a new facility in Innovista. A study is being conducted for the SMARTBrain™ component on novel rehabilitative techniques for chronic stroke. In FY 2008, the CoEE received $3.9 million in research funding from NIH, the Fullerton Foundation, and S.C. Health and Human Services.

USC was awarded a CoEE Chair for Community and Social Support and a CoEE Chair for Memory and Brain Function.

Clemson was awarded a CoEE Chair for Driving, Mobility, and Physical Functioning.

CoEE Name: **Stroke** Award Amount: **$5 million**
Lead Institution: **Medical University of South Carolina**
Collaborative Institution: **University of South Carolina**

This CoEE enhances the existing stroke program at MUSC and strengthens the clinical and basic stroke research in South Carolina. The reduction in the incidence of stroke and the provision of acute stroke care are goals of this CoEE. With three endowed chair positions, this CoEE will increase translational stroke research and stimulate the development of new therapeutics, emphasizing drug discovery and bio-technology. This collaborative effort enhances the research programs of MUSC, USC, Greenville Health Systems and the Greenwood Genetics Center. In FY 2007, this CoEE began to develop the REACH (Remote Evaluation of Acute Ischemic Stroke) Network. The network provides around-the-clock, Internet-based stroke consultation for patients within the first three hours of a stroke occurrence. Both MUSC and USC serve as hubs for this network, with "virtual spokes" reaching out to community hospitals throughout the state. Five community hospitals have already agreed to connect to this network, including McLeod Health (Florence), with six

other hospitals considering connection. In May 2008, REACH was activated at MUSC, and doctors there began treating stroke victims at community hospitals remotely with t-PA (Tissue Plasminogen Activator) thrombolytic therapy through telemedicine. Because of the REACH Network, in a few months at McLeod Health, twice the number of stroke patients were treated with t-PA thrombolytic therapy than were treated in the full previous year. In the near future, the CoEE plans to extend the REACH network to seven counties, with a coverage of almost 1,000 beds and 200,000 emergency room visits per year.

REACH STROKE NETWORK
A Health Sciences South Carolina Supported Initiative

CoEE Chair Paula Harper Bethea discusses the great success of the Stroke CoEE REACH Network with CoEE Stroke Chair Dr. Robert Adams.

Dr. Robert Adams, COEE CHAIR IN STROKE [appointed 8-01-07].

Dr, Adams' research is in the field of clinical neurology, with a focus on preventing strokes and on developing new ways to deliver stroke care to patients. Working with the American Stroke Association, Adams is spearheading a program to help hospitals obtain designation as a certified Joint Commission on Accreditation of Healthcare Organizations (JCAHO) Stroke Center. The certification is designed to better prepare hospitals to provide comprehensive stroke treatment. He has established the REACH program, which connects MUSC neuroscience specialists with partner sites via the Internet to provide round-the-clock stroke care. In his mission to web-enable hospitals, Adams helped develop the company REACH Call, Inc. REACH Call provides system equipment, software and decision support for urgent specialist consultations via the Internet. He was previously at the Medical College of Georgia in Augusta, where he was the Presidential Distinguished Chair and Regents Professor of Neurology and also co-director of the Cerebrovascular Research Program in the Department of Neurosurgery. He is past chair of both the Stroke Council Leadership Committee and the American Stroke Association Stroke Advisory Committee.

MUSC is actively recruiting the COEE CHAIR IN CLINICAL NEUROLOGY.

USC is actively recruiting the COEE CHAIR IN TRANSLATIONAL NEUROLOGY.

CoEE FACT: According to the Centers for Disease Control, in 2005, South Carolina had the fifth highest stroke mortality rate in the nation.

2008 CoEE

2007-2008 Collaborative Centers of Economic Excellence

CoEE Name: **Cancer Stem Cell Biology** Award Amount: **$5 million**
Lead Institution: **Medical University of South Carolina**
Collaborative Institution: **Clemson University**

The CoEE in Cancer Stem Cell Biology will focus on developing new technologies for isolating, growing and manipulating cancer stem cells. Cancer stem cells are adult stem cells that have the ability to reproduce themselves and develop into cancer. The CoEE will also find ways to use adult stem cells from bone marrow or organs to treat cancer. The work of this CoEE will generate further understanding of cancer stem cells and ways to eradicate them without harming healthy cells. It could also lead to the engineering of healthy adult stem cells that can replace cancerous cells in the body. In its work, the CoEE will seek to add a repository of adult cancer stem cells to the HSSC tissue repository for use in further research across South Carolina. Another objective of the CoEE is to use novel treatments, such as carbon nanotubes, to inhibit the growth of cancer stem cells. Two current projects focus on stem cells of fibroblastoma/myofibroblastoma and glioblastoma tumors.

This CoEE has been awarded two endowed professorships: one in TRANSLATIONAL BIOMEDICAL SCIENCE and one in BIOMEDICAL ENGINEERING.

2008 CoEE

CoEE Name: **Advanced Tissue Biofabrication** Award Amount: **$5 million**
Lead Institution: **Medical University of South Carolina**
Collaborative Institutions: **USC, Clemson**

The long-term vision for the CoEE in Advanced Tissue Biofabrication involves industrial-scale production of complex tissues and organs for the repair, replacement or restoration of diseased cells, tissues and organs. Researchers will focus on "bioprinting," a technique of assembling human tissues and organs by layering living cells and a hydrogel, or polymer. Previously, production of bioprinted tissue has been limited to cartilage and similar structures that do not require blood flow. CoEE researchers aim to generate a vascular supply for bioprinted tissue that would allow a larger variety of structures and organs to be created in this manner. The CoEE will add to South Carolina's growing program in bioengineering, which includes the CoEE in Regenerative Medicine [see page 63] and the South Carolina Bioengineering Alliance. Working relationships will also be forged with the Polymer Nanocomposites CoEE, the Neuroscience CoEE and the Advanced Fiber-based Materials CoEE.

MUSC is actively recruiting the COEE ENDOWED CHAIR IN BIOFABRICATION BIOLOGY.

USC is actively recruiting a COEE ENDOWED CHAIR IN BIOFABRICATION ENGINEERING.

Clemson is actively recruiting a COEE ENDOWED CHAIR IN BIOFABRICATION ENGINEERING.

VI. CoEE Economic Impact Achievements

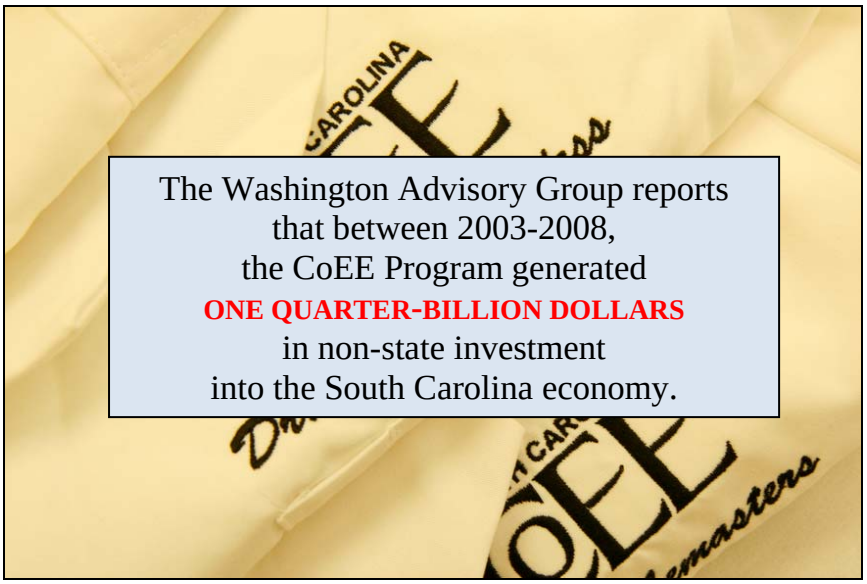
Clemson President James F. Barker accepts a check for $2 million from Fluor Corp. Chairman and CEO Alan Boeckmann for the Fluor Endowed Chair in Supply Chain Optimization and Logistics.

"The South Carolina General Assembly created the CoEE program in 2002 as a bold action to stimulate research and development and high-wage job creation. … The evaluation team has found that the CoEE program has had a profound and positive impact on the prospects for economic growth and diversification in the State of South Carolina. … Economic impacts in terms of increased external funding, new job creation, and business location decisions have been significant and can be expected to grow as the program continues and matures."

from the 2003-2008 CoEE Program Comprehensive Evaluation

"These professorships serve as the nucleus for unique, university-based research centers which cultivate critical, public-private industrial partnerships, expand the state's knowledge base, create well-paying jobs, and enhance economic opportunities and improve the quality of life for the people of South Carolina."

from the CoEE Program Mission Statement



The Washington Advisory Group reports that between 2003-2008, the CoEE Program generated **ONE QUARTER-BILLION DOLLARS** in non-state investment into the South Carolina economy.

ECONOMIC ENHANCEMENT LEADS TO JOB CREATION

ROBERT "BOBBY" M. HITT III

Our economy is going through a critical time. Our collective response to this new environment is equally as critical. Based on my ongoing involvement with economic development in South Carolina, I believe that this specific juncture calls for us to rely on fundamental basics.

One such fundamental truth is that collaboration breeds great ideas that make great things happen. One of the ways you enhance economic opportunities in a state is to create activity, many of which are research-based. Talent-pooling is a key facet of developing any significant economic opportunity.

At a time when the majority of the people in our nation are concerned about jobs, I encourage the leadership of our state to continue its focus on the success brought about by economic opportunities that were birthed of collaborative efforts. The South Carolina Research Centers of Economic Excellence Act endorses exactly this.

Currently, 60 percent of the people residing in South Carolina are not indigenous. They did not come here because of our great weather. I believe they moved here because something was happening in this part of the country that is unique and forward-thinking.

Clemson University's CU-ICAR project is successful because a group of people came together and made it happen. MUSC's recruits for the Hollings Cancer Center are coming to South Carolina because they see the ability to impact an area in which opportunity exists. In such a manufacturing-driven state like South Carolina, we have to train people in Mechatronics, an interdisciplinary study combining mechanical, electronic and computer engineering, in order to keep our plants operating. While we have bridges to build, the presence of willing, collaborative parties is the first step in making something happen.

Robert "Bobby" M. Hitt III
Director, Media & Public Affairs
BMW Manufacturing USA

As the Department Manager for Corporate Communications at BMW Manufacturing, I can assure you that managing BMW Manufacturing's response to the economy has become our top priority over the last several months; however, we remain unwaveringly focused on our current $750 million expansion project.

Why?

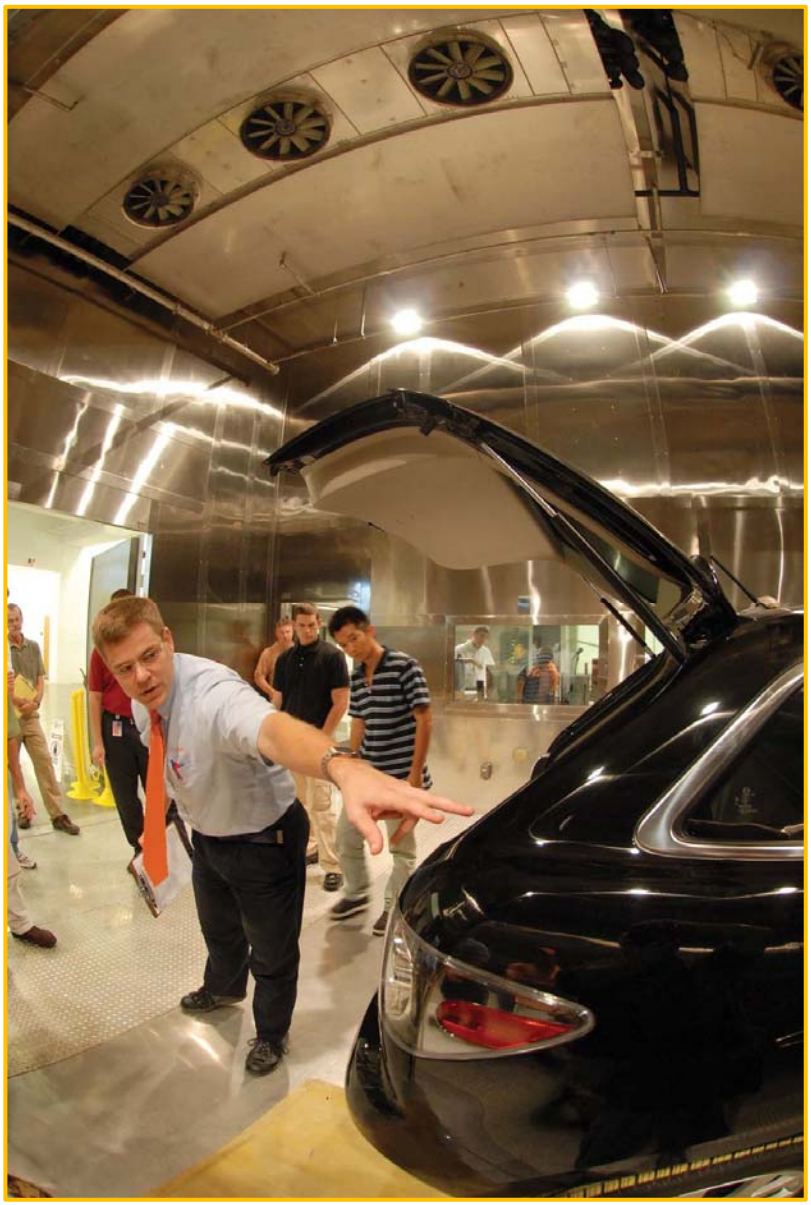
Because it is a perfect example of a collaborative partnership – by the state, by the university system, by our suppliers – driven by a successful economic engine. And because of the foresight of this group, together we are creating jobs for the future.

It takes a lot more than currency exchanges to plan the building of 1.5 million square feet of manufacturing space and everything that comes along with that. In 1992, BMW moved into South Carolina in a large way and will continue that momentum because of the collaborative partnerships that continue to embrace our company. We couldn't have done what we've accomplished if the environment in South Carolina wasn't an economic opportunity environment.

There is an economic buzz in South Carolina. And it has a lot to do with the CoEE Program. If the legislature and business community focus too much on job creation, we will squander the overarching economic impact that the CoEE Program embodies. There is tremendous economic impact taking place in South Carolina, and this gives the business community and investors the confidence to continue investing and generating revenue …and with that, comes job creation.

"The General Assembly finds that it is in the public interest to create incentives for the senior research universities of South Carolina consisting of Clemson University, the Medical University of South Carolina, and the University of South Carolina to raise capital from the private sector to fund endowments for professorships in research areas targeted to create well-paying jobs and enhanced economic opportunities for the people of South Carolina…."

S.C. RCEE Act (2-75-5)



Clemson BMW Automotive Manufacturing Chair Tom Kurfess uses CU-ICAR's seven-post shaker test cell for a teachable moment with students in Clemson's automotive engineering graduate program, whose faculty comprise four CoEEs, in manufacturing, automotive design & development, electronic systems integration, and automotive systems integration.

The Technology Transfer Cycle

Following the award of a Center of Economic Excellence, each research institution has 78 months in which to raise all non-state matching funds and draw down the sum total of the state award (between $4 million to $10 million). Approximately the same amount of time can be required to recruit a world expert in the rarefied research field of an individual CoEE.

Once an CoEE endowed chair is appointed and his or her research team is fully assembled, the process of **technology transfer** begins: Technology transfer takes groundbreaking science—*intangible* intellectual property—and converts it into *tangible* products and services. Technology transfer spurs the knowledge-based economy and leads to the development of companies and the creation of new jobs.

When a CoEE researcher makes a laboratory discovery, it is registered via a form called a "disclosure." Once a disclosure has been registered, the technology transfer office at each senior research institution studies it to consider its commercial possibilities. Patents are then sought for the most commercial/marketable discoveries. Once a patent is obtained, the institution seeks to license the discovery with industry, often toward product development.

A patent provides an institution with exclusive rights to an invention (idea). However, applying for a patent is a lengthy and expensive process, sometimes requiring five years or more. In addition to U.S. patents, institutions often seek international patents which secure invention rights in all major industrialized countries.

The big payoff in technology transfer is licensing. The institution owns some form of intellectual property (IP) and licenses with another entity to use that technology. The licensing income is divided between the university and the inventor, who by law is entitled to a percentage of revenue. If a specific product is being developed, the institution may negotiate to receive a royalty for each product sold.

The full technology transfer process requires considerable time. First, a faculty member has to be recruited and appointed. Once hired, the faculty member must begin doing research, and making a significant discovery also takes time. Then applications for patents must be filed. Upon receiving exclusive rights to a discovery, the discovery must be marketed to industry. In the life sciences, any product requires an additional seven to ten years for FDA approval.

The Technology Transfer Cycle.

In 1999, the Milken Institute reported that university technology transfer contributed more than $40 billion to the U.S. economy and accounted for 270,000 jobs.

CoEE Economic Impact Success Stories

Only six years into the program, a number of Centers of Economic Excellence have already made a major impact on the state's economy. Below are some major program economic development highlights through the end of FY 2008:[15]

"In South Carolina, we compete in a global marketplace, and maximizing our opportunities is vital to our success and that of the next generation. CU-ICAR takes that challenge seriously. It builds upon the existing strengths of our great state, developing new ideas, new products and services and a new generation of high-tech workers. We are pleased to be a part of CU-ICAR and its work and mission and look forward to the collaboration announced today for our future."

Pamela Lackey
President, AT&T South Carolina

FY 2008 marked a significant year of new partnerships for Clemson's CU-ICAR chairs. An investment of $1.5 million from the Okuma America Corporation and Morris South, Machine Tool Systems was provided. Also in FY 2008, Mazda North American Operations partnered with CU-ICAR by providing graduate fellowships, drive trains and a Mazda CR 7 Crossover vehicle for testing. In June, the Ozen Engineering (California) with its associates CADFEM GMbH (Germany) and EnginSoft, SpA (Italy) decided to locate their North American headquarters at CU-ICAR. This partnership will provide CU-ICAR with significant software, training and support services for Automotive Engineering. INTEC, U.S., Inc. has also chosen CU-ICAR as the site for its U.S. presence; INTEC is a automotive industry software leader and will provide approximately $1.1 million in training and support services to the Automotive Engineering program. The CU-ICAR chairs and their research teams were awarded 33 grants totaling more than $5 million from federal and corporate sources with six pending proposals submitted totaling nearly $2.5 million. The endowed chairs also reported eight invention disclosures.

The **Timken CoEE endowed chair in Automotive Design and Development**, part of the CU-ICAR initiative, has partnered with Timken Company (Fortune 500), a well-known provider of auto-motive industry products and solutions based on friction management and power transmission. Timken has established research and development facilities on the CU-ICAR campus in Greenville and has relocated its auto-motive powertrain engineering re-sources to a new worldwide power train engineering center at CU-ICAR. This partnership has already generated more than 200 high-paying jobs in the Upstate.

The **BMW CoEE endowed chairs in Automotive Manufacturing** and **Automotive Systems Integration** (CU-ICAR) are in major discussions to establish private sector partnerships with companies such as General Motors, IBM, Toyota, Honda, Daimler-Chrysler, Hewlett-Packard, Nissan, and the Robert Bosch Corporation. These chairs have conducted workshops for several

[15] For a complete list of all technology transfer data, please consult the table and detailed summary beginning on page 87.

years with BMW, Michelin, Timken, and Siemens to promote industry involvement in CU-ICAR's research initiatives. BMW has located its Information Technology Research Center on the CU-ICAR campus. More than 300 personnel are housed in this facility.

The **Michelin CoEE endowed chair in Vehicle Electronic Systems Integration** (CU-ICAR) has established the Clemson Vehicular Electronics Consortium which provides companies access to automotive research at Clemson. In 2008, an ETS-Lindgren FACT-3 RF semi-anechoic test chamber was installed; CU-ICAR is the only full-vehicle EMC test capability in the Southeast, which will save automotive companies' time and resources and attract industry into the state.

The **CoEE in Proteomics** has been successful in obtaining a patent for electrospray ionization, which will hopefully soon lead to licensure. This CoEE has applied for a total of seven invention disclosures, three provisional U.S. patents and three U.S. patents. The MUSC Proteomics Center is also the recipient of the largest competitive extramural research award (granted in 2003-04) ever received in the state ($18.7 million). In addition, a $500,000 NIH Shared Instrumentation Grant was secured in FY 2006 for the purchase of a mass spectrometer for tissue imaging research. This CoEE is partnered with the U.S. Department of Energy Molecular Foundry at the Lawrence Berkeley National Laboratory to develop a new type of microfluidic valve based upon a nanostructured polymer for use in proteomic analysis devices.

As a component of the Neuroscience Institute, **the CoEE in Neuroscience** will continue MUSC's affiliations with companies such as AstraZeneca, Pfizer, Merck, and Janssen Pharmaceuticals. The Center has also supported the creation of SemiAlloGen, Inc., a biotech start-up company which develops therapeutics in the field of neurodegenerative disorders and cancer. The CoEE is developing a project with Jazz Pharmaceuticals to test mechanisms of action of their drug Xyrem. A medical device company Cyberonics, Inc. has supplied equipment and consulting expertise in modulating cognitive processes to the CoEE. The CoEE has partnered with Cephalon Pharmaceuticals to test one of its compounds in brain reward function with potential application in addiction and obesity. **CoEE Endowed Chair Dr. Chimowitz** has received a supplement to his NIH award from Boston Scientific for more than $5 million.

The **CoEE in Marine Genomics** has begun to market its intellectual property as well as tangible products to the business and scientific community. The genomics group has sold a diagnostic gene chip to the International Oyster Microarray Consortium on a cost-recovery basis. This continuing relationship has raised the profile of the marine genomics group in the international community. The CoEE has generated intellectual property based on a major discovery that RNA injected into shrimp could protect them against viral infections. This discovery has major implications on shrimp aquaculture, which is periodically devastated by viral infections. Commercial opportunity is strong if an effective pathway of RNA delivery, other than injections, is developed. The CoEE has partnered with two private companies, Shrimp Improvement Systems and Biogenmar, and is negotiating a formal relationship with a third company. These relationships have strong potential to translate intellectual property into licenses, products and jobs in the aquaculture and bioscience areas. The CoEE is also in discussion with Chugai Pharmaceutical Company about the development of marine pharmaceuticals using microbial genomics technology. Through 2008, the CoEE has reported eight invention disclosures, six provisional U.S. patent applications, one U.S. patent application, six international patents and two licenses.

The **CoEE in Regenerative Medicine** has fostered a spin-off company, FirstString, which markets new wound repair technology. In its start-up phase, FirstString has garnered over $600,000 worth of investment and was chosen for support by the SC Launch! Program and the NIH Small Business Technology Transfer Program. FirstString Research is preparing for its first U.S. human clinical trials. MUSC and the Mayo Clinic are among options for the testing sites. In 2006, MUSC faculty renewed a $10.8 million NIH Center of Biomedical Research Excellence Award and received an Introductory Molecular Biology Research Experience NIH grant. The CoEE is currently awaiting approval of a $9 million grant proposal to the NIH Center of Biomedical Research.

The **CoEE in Nanostructures** has received funding in the amount of $1.6 million from the U.S. Army Research Office, NSF, Seagate Technology and Aerotech Corporation. Areas of study include integrated sensor technologies for chemical, biological, and radiation detection; reprogrammable parallel nanomanufacturing and fundamental experimental properties of mesoscopic systems; and coherently-controlled ultrafast magnetic fields for switching magnetic recording media. In 2008, the U.S. Army Research Office renewed its funding for the CoEE's sensors program. Also, CoEE faculty, along with 16 national and international scientists, have begun forming an international materials institute with a concentration in Nanomechanics in Novel Materials. The institute already includes five national industrial partners. Through FY 2008, the CoEE has filed six invention disclosures, and two US provisional patent applications. A spin-off company, LuminOF, LLC, has also been created.

Endowed chair-holder Dr. Charles Smith of the **CoEE in Cancer Drug Discovery** has formed a drug screening core that contains chemical libraries with 50,000 compounds. Using this screening core, Dr. Smith and another colleague identified compounds which inhibit PIM kinases enzymes which are over-expressed in cancer. An article about this discovery was published in the Journal of Medicinal Chemistry, and Dr. Smith plans the launch of a company in FY2009 to create marketable inhibitors to treat cancer. During 2008, the CoEE had over $3.7 million in sponsored federal funding. As more researchers are added to the CoEE, funding is expected to increase by eight to ten percent annually over the next five years. Through FY 2008, the CoEE filed 5 invention disclosures, four U.S. provisional patent applications and one U.S. patent application.

The **CoEE in Brain Imaging** launched a spin-off company, Cephos Corporation, which uses brain imaging technology to detect deception. Cephos has opened a Charleston office and began publicly marketing its services in March 2008. A partnership has been formed with Ladson-based Force Protection Industries, a major Charleston area employer. As a leading manufacturer of tanks and armored vehicles, this company will utilize CoEE research in the prevention of traumatic brain injury due to combat explosions. Companies including Glaxo-Smith Kline, Jazz Pharmaceuticals, and BioValve are using the CoEE's imaging facilities and personnel to speed drug discovery and development in anticonvulsants, mood stabilizers, and cognitive enhancers. The Center was also successful in launching the McCausland Imaging Center in Columbia and the Center for Animal Imaging which conducts translational research in substance abuse and epilepsy therapy. In 2008, MUSC opened the Center for Advanced Imaging Research (CAIR), with advanced instrumentation such as a state-of-the-art Siemens 3T Trio MRI scanner. Similar equipment allows researchers to facilitate multicenter recruitment and scanning for a range of

studies. Current federal funding is in excess of $10 million, and the CoEE has been selected to submit a proposal as the dedicated neuroimaging core for a $60 million U.S. Department of Defense Congressionally Directed Medical Research Program PTSD/TBI clinical consortium. Through FY 2008, the CoEE has filed six inventions disclosures, three U.S. provisional patent applications, six U.S. patent applications and one international patent application.

Clemson's Center for Optical Materials Science and Engineering Technologies (COMSET), of which the **CoEE in Optical Materials** is an integral component, receives constant visits from private sector representatives due to the fiber fabrication infrastructure and expert research activity . With this Endowed Chair, the CoEE is expected to continue and increase to economic impact. This CoEE has had an indirect impact on the launching of two spin-off companies: Advanced Photonic Crystals, and Tetramer Technologies. Through FY 2008, the CoEE has filed 26 invention disclosures, 16 provisional U.S. patent applications, three U.S. patent applications with three U.S. patents being issued. The CoEE has four active executed licenses.

Endowed chair-holder **Dr. Kenneth Tew** has established a mutual program between the **CoEE in Translational Cancer Therapeutics** and Novelos Pharmaceuticals. This partnership has produced a translational research effort in the arenas of lung and ovarian cancer. Since 2005, the company has awarded MUSC $475,000 for continued research. Current federal funding for this CoEE totals over $1 million. An NIH COBRE application in Oxidants, Redox Balance and Stress Signaling for $1.5 million, submitted by the CoEE this past year, received an outstanding initial review.

The **CoEE in Polymer Nanocomposites** has received two grants of $901,000 and $500,000 from the U.S. Air Force Research Laboratory to construct and evaluate polymer nanocomposite structures for application as high energy storage devices. In FY 2008, the CoEE received a $865,000 research grant from NSF, MeadWestvaco and Montan Polysaccharides. Relationships have been formed with more than 20 manufacturers, plastic processors and end-use fabricators, including Michelin and PBI Performance Products. The CoEE has filed one invention disclosure, three U.S. patent applications and one international patent application.

The **CoEE in Hydrogen and Fuel Cell Economy and the CoEE in Renewable Fuels for the Fuel Cell Economy** work with public and private sector alliances such as the South Carolina Hydrogen and Fuel Cell Alliance and the Greater Columbia Fuel Cell Collaborative. These CoEEs help to increase dues-paying members for the Fuel Cell Center, the only NSF-funded Industry/University Cooperative Research Center for Fuels (I/UCRC). The CoEEs have ongoing collaborations with the Korea Institute of Energy Research and the Fraunhofer Institute for Solar Energy in Germany. Along with these two international collaborations, the CoEEs have 20 additional industrial partners nationally through the CFC. One start-up company, Palmetto Fuel Cell Technologies, has been created through associated work of these CoEEs. It serves the industry with hardware, designs, technologies and component products. Six spin-off companies have been created through associated work of these CoEEs. ZDD, Inc. focuses on water purification processes. R&H Associates' objective is the design and development of cost-effective experiments for educational and training purposes. Palmetto Fuel Cell Analysis & Design provides advanced software and consulting services to the fuel cell industry while. DEnergy LLC focuses on new technology for compact, economical storage and generation of

hydrogen gas for fuel cell applications. Hydrogen Hybrid Mobility integrates the technology of the Segway and fuel cell and hydrogen fuel canisters. AlphaPore, Inc. is a membrane modification company serving the fuel cell industry. Through FY 2008, the CoEEs presented 12 invention disclosures and applied for 16 provisional U.S. patent applications, seven U.S. patent applications, and two international patent applications with one U.S. patent issued.

The **Tourism and Economic Development CoEE** hopes to collaborate with major corporations to secure tourism contracts around the world. This Center is building international collaborations, including Ministers of Tourism in countries such as China, Uruquay, Guatemala and Brazil.

In FY 2008, the **Vision Science CoEE** obtained research contracts totaling over $1.5 million from a number of companies including Bausch & Lomb, and Pfizer. Other grant funding totaled more than $2.1 million. The CoEE filed two invention disclosures.

> The CoEE Program is an outstanding program which demonstrates the enlightened thinking of State and University leaders. It is attracting national attention and will produce new ideas resulting in the creation of new, high quality jobs for the citizens of South Carolina.
>
> *2007-2008 CoEE Onsite Review Panel Report*

The **CoEE in Supply Chain Optimization and Logistics** has received sponsored research funding from Southern Company, Michelin and Lockheed Martin. Clemson has also secured Center funding from the NSF for the creation of an Industry University Cooperative Research Center. Additional discussions regarding research funding are in process with Aerospace Engineering, IntelliTrans Solution, Alabama Power and Electric, AGS Resources and SPAWAR. In FY 2008, the CoEE had one invention disclosure.

The **CoEE in Advanced Fiber-based Materials** is pursuing leads with several major corporations for potential support of the Center's research and endowed chair. In FY 2008, the CoEE had three invention disclosures.

The **CoEE in Molecular Proteomics in Cardiovascular Disease Prevention and Treatment** is in early discussions with a company to fund its concept for a biomarker testing system. This device is envisioned as a desktop, office instrumentation which will simply and inexpensively measure protein markers to create individualized risk profiles for development of chronic heart failure. Also, a spin-off company is anticipated for the development of plasma protein detection methods using customized beads which have fluorescent antibodies attached to them. This Center has potential to yield high economic impact in the short-term. In 2007, the CoEE received $950,000 from Ortho Clinical Diagnostics through a research contract. The CoEE filed four invention disclosures, two U.S. provisional patent applications, and two international applications. It has two active executed licenses.

The **CoEE in Childhood Neurotherapeutics** has received funding from the National Institutes of Health for a clinical study in treatment of mothers with chorioamnionitis, inflammation of the amniotic membranes caused by infection. The Federal Drug Administration has awarded a grant

to MUSC and the Children's Hospital of Philadelphia to evaluate the efficacy of atorvastatin, an HMG CoA reductase inhibitor, for patients with type 1 diabetes. These studies have prompted the start of a spin-off company, ImmunoMod, which develops drugs for treatment of diabetes. The CoEE has been granted two U.S. patents and has submitted a total of four U.S. provisional and six non-provisional U.S. patent applications along with 13 international patent applications.

Currently, the **Solid Oxide Fuel Cells CoEE** has funding totaling more than $2.1 million from the Office of Naval Research, the U.S. Department of Energy (DOE) and the South Carolina Research Authority (SCRA). In the past year, faculty associated with this CoEE generated over $26 million in proposed research funding, including a $22 million DOE proposal; partners on the proposal include four national laboratories and eight universities. This is the first time a research project of this size and scope has been led by USC. This CoEE also has developed a collaboration with the Savannah River National Laboratory, the NASA Glenn Research Center and ENrG, Inc., to create a high temperature electrolysis system with NASA-invented fuel cell technology. The DOE Office of Basic Energy Sciences promised 2009 funding if a working prototype system could be demonstrated in one year's time. SCRA granted $400,000 for the creation of the prototype system.

The **SeniorSMART™ CoEE** is in discussion with Grand Care, a home monitoring service, about a potential partnership regarding the SMARTHome™ component of the CoEE. Also, Lutheran Homes of S.C. has donated two homes on one of its campuses for laboratory settings for this CoEE's SMARTHome™ component. Still Hopes Episcopal Retirement Community is also partnering with USC in creating level two and three labs at a new facility in Innovista. In FY 2008, the CoEE received $3.9 million in research funding from NIH, the Fullerton Foundation and S.C. Health and Human Services.

The **Stroke CoEE** has partnered with five community hospitals in the state to create the Remote Evaluation of Acute Ischemic Stroke (REACH) Network. Six other hospitals are considering a connection to this network. In May 2008, REACH was activated at MUSC, and doctors there began treating stroke victims at community hospitals remotely with t-PA (Tissue Plasminogen Activator) thrombolytic therapy through telemedicine. Because of the REACH Network, in just several months in FY 2008 at McLeod Health, twice the number of stroke patients were treated with t-PA thrombolytic therapy than were treated in the entire previous year. In the near future, the CoEE plans to extend the REACH network to seven counties, with a coverage of almost 1,000 beds and 200,000 emergency room visits per year.

The **Health Facilities Design and Testing CoEE** has been awarded a subcontract with the U.S. Department of Defense entitled Patient Room of the Future. The first two phases provided the CoEE with over $850,000 in research funding. Partners in this project include Carleton University (Ottawa), the Rensseleaer Polytechnic Institute, Vantage/Legrand Lighting (Utah), Hill-Rom, and IoA Healthcare Furniture.

The **Renal Disease Biomarker CoEE** had $4.4 million in federal research funding in FY 2008.

The U.S. Environmental Protection Agency has awarded the **Nanoenvironmental Research and Risk Assessment CoEE** research funding totaling over $375,000 to study the effect of single-walled carbon nanotubes on estuarine sediments and organisms.

Major partners of the **Gastrointestinal Cancer Diagnostics CoEE** include the Spartanburg Regional Healthcare System, the U.S. Department of Veteran Affairs, DHEC, the South Carolina Cancer Alliance, Roche Carolina and Bank of America. CoEE faculty, along with other MUSC cancer researchers, have submitted a proposal for a NIH Clinical and Translational Science Award and a proposal for a National Cancer Institute Cancer Center designation.

The **Tobacco-Related Malignancy CoEE**, in conjunction with the Hollings Cancer Center, has formed an alliance with the University of Colorado Comprehensive Cancer Center on a renewal of a NCI-funded Specialized Center of Research Excellence (SPORE) in Lung Cancer. Two faculty members associated with the CoEE have clinical trials partnerships with Syndax, Pfizer and Novartis for over $1.25 million in funding. The CoEE also participated in the HCC's submission of a proposal for an NIH Clinical and Translational Science Award.

The **Health Care Quality CoEE** has partnered with Collexis Holdings to form a database directory of biomedical research. In FY 2008, the S.C. Biorepository System was established, which provides tissue and sample data to researchers without violating patient privacy, the ultimate goal being to support clinical research in order to improve clinical outcomes for cancer patients. Through this system, a USC researcher received 29 fresh surgical specimens collected by Lexington Medical Center in order to further his study. The CoEE has partnered with the South Carolina Hospital Association for multiple benefits, including supporting statewide initiatives and translating to hospitals new products and processes discovered by the CoEE. A research project on hospital-acquired infections is being developed. In addition to the partnerships and initiatives mentioned, **CoEE Chair Dr. Sanderson** received a $7 million grant from the FCC to enhance rural healthcare through telecommunications and information services.

Drs. Soumitra Ghoshroy and Douglas Blom of the Nanostructures CoEE use the JEOL 2100F aberration-corrected STEM to study the composition and structure of nanomaterials in USC's Electron Microscopy Center.

CoEE Technology Transfer 2003-2008

CoEE Name	CoEE Award Date	Chairs Approved	Chairs Hired	Center Expenditures *	Invention Disclosures	Provisional U.S. Patents Applications	U.S. Patent Applications	U.S. Patents Issued	Int'l. Patent Applications	Int'l. Patents Issued	Active Licenses	Licenses & Options Executed	Spin-Off Comp.†
Automotive Systems Integration	2002-03	1		$11,613,028	0	0	0	0	0	0	0	0	0
Automotive Manufacturing	2002-03	1	1	$13,158,629	3	0	0	0	0	0	0	0	0
Nanostructures	2002-03	1	1	$5,823,675	6	2	1	0	0	0	0	1	1
Brain Imaging	2002-03	2		$5,475,158	6	3	6	0	1	0	0	0	1
Proteomics	2002-03	1		$1,283,767	7	3	3	1	0	1	0	0	0
Neuroscience	2002-03	3	2	$2,760,357	0	0	0	0	0	0	0	0	1
Marine Genomics	2002-03	2		$8,085,093	8	6	1	0	6	0	0	2	0
Automotive Design & Development	2003-04	1	1	$12,402,126	1	0	0	0	0	0	0	0	0
Electronics Systems Integration	2003-04	1	1	$11,802,807	4	0	0	0	0	0	0	0	0
Photonic Materials	2003-04	1		$14,871,821	26	6	16	3	0	0	4	4	2
Polymer Nanocomposites	2003-04	1		$2,120,026	1	0	3	0	1	0	0	0	0
Hydrogen & Fuel Cell Economy/ Renewable Fuel Cells for Fuel Cell Economy **	2003-04/ 2004-05	3		$6,314,761	12	16	7	1	2	0	0	0	6
Regenerative Medicine	2003-04	3	1	$1,938,330	0	0	0	0	0	0	0	0	1
Translational Cancer Therapeutics	2003-04	2	1	$3,472,366	0	0	0	0	0	0	0	0	0
Tourism & Economic Development	2004-05	1		$5,000	0	0	0	0	0	0	0	0	0
Gastrointestinal Cancer Diagnostics	2004-05	2	1	$119,974	13	5	5	0	2	0	0	0	0
Cancer Drug Discovery	2004-05	4	2	$6,052,749	5	4	1	0	0	0	0	0	0
Vision Science	2004-05	3		$1,174,847	2	0	0	0	0	0	0	0	0
Supply Chain Optimization & Logistics	2005-06	1		$61,795	1	0	0	0	0	0	0	0	0
Urban Ecology & Restoration	2005-06	1		$0	0	0	0	0	0	0	0	0	0
Advanced Fiber-Based Materials	2005-06	1		$52,450	3	0	0	0	0	0	0	0	0
Molecular Nutrition	2005-06	1		$0	0	0	0	0	0	0	0	0	0
Solid Oxide Fuel Cells	2005-06	1	1	$3,058,285	0	0	0	0	0	0	0	0	0
Childhood Neurotherapeutics	2005-06	3		$0	8	4	6	2	13	0	4	4	1
Molecular Proteomics in CV Disease & Prevention	2005-06	2		$119,890	4	2	0	0	2	0	2	2	0
Clinical Effectiveness & Patient Safety	2005-06	3	1	$1,807,987	0	0	0	0	0	0	0	0	0
Health Facilities Design and Testing	2006-07	2		$34,242	0	0	0	0	0	0	0	0	0
Rehabilitation and Reconstruction Sciences	2006-07	1		$0	0	0	0	0	0	0	0	0	0
Strategic Appr. to Electricity Prod. from Coal	2006-07	1		$0	0	0	0	0	0	0	0	0	0
Healthcare Quality	2006-07	2	1	$998,102	0	0	0	0	0	0	0	0	0
SeniorSMART™ Center	2006-07	3		$0	0	0	0	0	0	0	0	0	0
Tobacco-Related Malignancy	2006-07	2		$13,375	0	0	0	0	0	0	0	0	0
Stroke	2006-07	3	1	$587,959	0	0	0	0	0	0	0	0	0
Optoelectronics	2007-08	1		$0	0	0	0	0	0	0	0	0	0
Cyber-Institute	2007-08	1		$0	0	0	0	0	0	0	0	0	0
Nanoenvironmental Research and Risk Assessment	2007-08	1		$0	0	1	0	0	0	0	0	0	0
Nuclear Science & Energy	2007-08	1		$0	0	0	0	0	0	0	0	0	0
Renal Disease Biomarker	2007-08	2		$0	0	0	0	0	0	0	0	0	0
Cancer Stem Cell Biology	2007-08	2		$0	0	0	0	0	0	0	0	0	0
Advanced Tissue Biofabrication	2007-08	3		$0	0	0	0	0	0	0	0	0	0
2008 TOTALS		**71**	**15**	**$115,208,599.36**	**110**	**52**	**49**	**7**	**27**	**1**	**10**	**13**	**13**
2007 TOTALS		**61**	**11**	**$82,923,751.11**	**71**	**37**	**29**	**7**	**23**	**0**	**8**	**8**	**11**

* This column represents all expenditures including institutional investment.

** Technology transfer statistics are reported for two separate CoEEs.

† A spin-off company is defined as a new or relatively new enterprise in which an institution has a revenue-based relationship via the licensure of an invention, the development of a technology/invention or the provision of service using institutional-derived expertise. This differs from a start-up company, in that while the enterprise may have a similar business model or goals to a spin-off company, the institution does not presently maintain a revenue-based relationship (although other major relationships are likely to exist, such as space sharing or leasing, the employment or internship of graduate students, etc.).

Detailed Summary of CoEE Technology Transfer: 2003-2008

[Note: Fiscal agent listed first in parenthesis.]

Photonic Materials CoEE (Clemson)

Disclosures

- *Materials for Freezing Light*
- *Core-shell Nanoparticles for Controlled Energy Transfer Between Rare Earth Dopants*
- *Light Emitting Nanoparticle Coated Channeled Fiber Structures*
- *Gain-Guiding Index anti-Guiding Fiber Laser Structure Employing Dispersive Core and Cladding*
- *Growth of Single Crystals with Step Gradient Domains of Dopants*
- *Magnetic-Optic core Fiber and Applications*
- *Light Emissive Nanocomposites Know How*
- *Raman Fiber Amplifier with Crystalline Core*
- *Moving Zone Process for Fiber core Recrystallization*
- *Electro-optic Crystalline Core Optical Fiber and Method*
- *Silicon Optical Fiber*
- *Electro-optic Optical Fiber*
- *Novel Infrared and Nonlinear Optical Fibers*
- *Method to Reduce Insertion Losses in Optical Fibers*
- *Capillary-channeled Polymer Fibers as Support Media for Various Spectroscopic Probes*
- *Polymeric Bragg Diffraction Fibers for Light Guiding and Fiber Substrate Reflectance Modifications*
- *Light Emissive Nanocomposites Know How*
- *Light Emitting Nanoparticle Coated Channeled Fiber Structures*
- *Organic Thin Film Laser with Tuneable Bragg Reflector*

Photonic Materials (cont'd)

- *Conducting Polymer Inks Comprised of Conducting Polymer-coated Latex Core-shell Colloidal Nanoparticles in the Application of Direct-Print*
- *Electro Chromic Inks, Containing Conducting Polymer Colloidal Nanocomposites and the Fabrications of Electro Chromic Display Devices*
- *Polymer Colloid Based, Color Tailorable Organic Light-Emitting Diode*
- *Hydrothermal Growth of Rhombohedral Potassium Fluoroberyllium Borate Crystals for Use in Laser and Non-Linear Optical Applications and Devices*
- *Hydrothermal Growth of Large Single Crystals of Lanthanide Oxides, Ln203*
- *Growth of Single Crystals with Step Gradient Domains of Dopants*
- *Integrated Waveguide Including Glass Surface Layer Deposited from a Solution*

U.S. Provisional Patent Applications

- *Organic Thin Film Laser with Tuneable Bragg Reflector*
- *Conducting Polymer Inks Comprised of Conducting Polymer-coated Latex Core-shell Colloidal Nanoparticles in the Application of Direct-Print*
- *Polymeric Bragg Diffraction Fibers for Light Guiding and Fiber Substrate Reflectance Modifications*
- *Electrochromic Inks Including Conducting Polymer Colloidal Nanocomposites, Devices Including the Electrochromic Inks and Methods of Forming Same*
- *Optical Fiber Systems and Method*
- *Color-tailored Polymer Light Emitting Diodes Including Emissive Colloidal Particles and Method of Forming Same*

U.S. Patent Applications

- *Plasmon-Photon Coupled Optical Devices*
- *Acentric Lanthanide Borate Crystals, Method for Making & Applications*
- *Hydrothermal Growth of YV04 and Doped YV04 Single crystals-APC License*
- *Core-shell Nanoparticles for Controlled Energy Transfer Between Rare Earth Dopants*

Photonic Materials (cont'd)

- *•Hydrothermal Growth of Rhombohedral Potassium Fluoroberyllium Borate Crystals for Use in Laser and Non-Linear Optical Applications and Devices*
- *•Hydrothermal Growth of Hexagonal Beryllim Borate Crystals for Use in Laser and Briefringent Applications and Devices*
- *•Hydrothermal Growth of New Rhombohedral Single Crystals*
- *•Fluoropolymer Carbon Nanotube Compositions, Methods and Products for Employing Such Compositions*
- *•Halogen Containing-polymer Nano-composite Compositions, Methods and Products Employing Such Compositions*
- *•Polymeric Bragg Diffraction Fibers for Light Guiding and Fiber Substrate Reflectance Modifications*
- *•Hydrothermal Growth of Large Single Crystals of Lanthanide Oxides, Ln203 (La=Sc, Y-yb, Ln)*
- *•Electrochromic Inks Including Conducting Polymer Colloidal Nanocomposites, Devices Including the Electrochromic Inks and Methods of Forming Same*
- *•Conducting Polymer Ink*
- *•Conjugated Polymer Functionalization of Fullerenes*
- *•Color-Tailored Polymer Light Emitting Diodes Including Emissive Colloidal Particles and Method of Forming the Same*

U.S. Patents Issued

- *•Materials for Freezing Light*
- *•Plasmon-Photon Coupled Optical Devices*

Active Licenses and License Income Received

4 licenses (resulting in $104,250 in licensing income)

Spin-off Companies

two corporate relocations

Advanced Fiber-Based Materials CoEE (Clemson)

Disclosures

- • R-TEX: A Fiber-based Non-woven Panel System for Construction
- •Activated Carbon Fiber as a New Electrode Material for Fuel Cell and Lithium Battery Applications
- •Method of Environmentally Friendly Shrink-proofing of Wool

Supply Chain Optimization and Logistics CoEE (Clemson)

Disclosures

- •Web-based Surveillance and Auditing Tool – WebSAT

Vehicular Electronic Systems Integration CoEE (Clemson)

Disclosures

- •Comb-clip Multi-layer Capacitor for Stacked Chip Decoupling
- •Low-loss Controlled-current Source for Charging Capacitors
- •Multi-layer Capacitor for Electromagnetic Bandgap Filter Arrays
- •Ringed-stem Capacitor

Automotive Design and Development CoEE (Clemson)

Disclosures

- •Compliant Link for Vehicle Suspension

Automotive Manufacturing CoEE (Clemson)

Disclosures

- •An Apparatus to Detect Small Changes in Mass At High g's
- •An Apparatus to Pack Soil into Testing Samples
- •An Apparatus to Simulate the Effects of High-g Decelleration on Mechanical Models to •Study Viscous-folid Interfaces

Nanostructures CoEE (USC)

Invention Disclosures

- *•Reprogrammable Parallel Nano-manufacturing* (utility application filed)
- *•Spintronic Chemical Sensor* (utility application filed)
- *•Novel Method for Chemical and Bio-molecular Sensors Using a Micro-cantilever-based System* (app. filed)
- *•Radiation Sensor/Dosimeter Employing Sythetic DNA and Electromagnetic Readout*

Nanostructures CoEE (cont'd)

Invention Disclosures (cont'd)
- *Phosphor for Near UV AIGaN/GaN UV LEDs*
- *Novel White Light Phosphors*

U.S. Provisional Patent Applications
- *New Family of Inorganic Luminescent Materials*
- *Novel White Light Phosphors for Fluorescent Lighting*

U.S Patent Applications
- *Reprogrammable parallel nanomanufacturing*

Licenses/Options
- *A New Family of Inorganic Luminescent Materials with LuminOF, LLC*

Spin-Off Companies
- *LuminOF, LLC*

Polymer Nanocomposites CoEE (USC)

Invention Disclosures
- Layered Mixed-Metal Phosphonates for High Dielectric Strength Polymer Nanocomposties

U.S. Patent Applications
- *Polymer Composite Materials Containing Synthetic Oxide Particles and Process for Producing Same* (filed)
- *Process for Creating Composite Materials to Produce Polymer Nanocomposite Films that Exhibit Improved Light Fastness Properties*
- *Polymer/Clay Nanocomposite Films with Improved Light Fastness Properties and Process for Producing Same*

International Patent Application
- *Polymer Composites Containing Exfoliated Phosphonate or Synthetic Oxide Particles* (filed)

Hydrogen and Fuel Cell Economy CoEE & Renewable Fuels for Fuel Cell Economy CoEE[16] (USC)

Invention Disclosures
- *Bimetallic Cluster Derived Electrocatalysts* (pending)

Hydrogen and Fuel Cell Economy CoEE & Renewable Fuels for Fuel Cell Economy CoEE (cont'd)

Invention Disclosures (cont'd)
- *Compact Storage and Reaction System for Hydrogen Fuel Source* (pending)
- *Pulse Electrodeposition of Platinum for PEMFC Electrodes using Wetting Agent* (pending)
- *Powering Segway Human Transporter Using Hydrogen Fuel Cells* (pending)
- *Reversible Hydrogen Storage Materials*(active PPA)
- *Highly Active and Stable Carbon-Based Electrocatalysts for Proton Exchange Membrane Fuel Cells* (combined with other technology)
- *Hydrogen from Hot Chemical Hydride Solution* (pending)
- *Heavy Reflux Pressure Swing Adsorption Cycles* (pending)
- *Electroless Deposition Methods to Prepare Pt-Containing, Bimetallic Catalysts Having Improved Fuel Cell Performance*
- *Electrochemical Preferential Oxidizer of Carbon Monoxide in Fuel Cell Reformate*
- *Hydrogen from Biomass Syngas*
- *Hydrolysis reactor for hydrogen production*

U.S. Provisional Patents
- *Multiphase, Thermally Integrated Hydrogen Fuel Source* (filed)
- *Steam Hydrolysis of Chemical Hydride to Produce Hydrogen* (filed)
- *Compact Hydride Device for Hydrogen Production* (filed)
- *Sub-stack Module Design for Hydrogen Fuel Cells* (filed)
- *Novel Metal-Free Catalysts for PEM Fuel Cells* (filed)
- *Novel Electrocatalyst Support and Catalyst Supported Thereon* (filed)
- *Solar Power Generation Apparatus Maximum Power Point Tracking Method* (filed)
- *Bimetallic Cluster Derived Electrocatalysts* (filed)
- *Reversible Hydrogen Storage Materials* (filed)
- *Reversible Hydrogen Storage Materials* (filed)
- *Electroless Deposition Methods to Prepare Pt-Containing, Bimetallic Catalysts Having Improved Fuel Cell Performance*

[16] Technology transfer data for both Centers are listed together in institutional annual reports.

Hydrogen and Fuel Cell Economy CoEE & Renewable Fuels for Fuel Cell Economy CoEE (cont'd)

U.S. Provisional Patents (cont'd)
- •*Improved Catalysts for Fuel Cell Applications Using Electroless Deposition*
- •*Production of Low Temperature Electrolytic Hydrogen*
- •*Development of PEM Fuel Cell Electrodes Using Pulse Electrodeposition*
- •*Hydrogen From Biomass Syngas*
- •*Hydrolysis Reactor for Hydrogen Production*

U.S. Patent Applications
- •*Apparatus and Method for Enhanced Solar Power Generation and Maximum Power Point Tracking* (filed)
- •*Composite Catalysts Supported on Carbon Substrates and Methods of Making the Same* (filed)
- •*Production of Low Temperature Electrolytic Hydrogen*
- •*Carbon-Based Composite Electrocatalysts for Low Temperature Fuel Cells*
- •*Polypyrrole and Silver Vanadium Oxide Composite*
- •*Reversible Hydrogen Storage materials*
- •*Physiochemical Pathway to Reversible Hydrogen Storage*

U.S. Patent Issued
- •*Method and System for Improving the Performance of a Fuel Cell* (issued)

International Patents
- •*Polypyrrole and Silver Vanadium Oxide Composite* (filed)
- •*Improved Catalysts for PEM Fuel Cell Applications Using Electroless Deposition* (filed)

Spin-off Companies
- •ZDD, Inc.
- •R&H Associates
- •Palmetto Fuel Cell Analysis & Design
- •AlphaPore, Inc.
- •DEnergy LLC
- •Hydrogen Hybrid Mobility

Start-up Companies
- •Palmetto Fuel Cell Technologies

Nanoenvironmental Research and Risk Assessment CoEE (USC)

U.S. Provisional Patent Applications
- •New Family of Inorganic Luminescent Materials

MUSC
MEDICAL UNIVERSITY of SOUTH CAROLINA

Proteomics CoEE (MUSC)

Invention Disclosures
- •*Electrospray Ionization From Pointed Fibers*
- •*Fingertip Stylus for Personal Data Devices*
- •*Monolithic chromatography column array/fraction collection device*
- •*Carbon Conductors for Polymeric Microfluidic Devices*
- •*Nanostructered Surfaces As a Dual Ionization LDI-DESI Platform for Increased Peptide Coverage In Shotgun Proteomic Analysis*
- •*Peptoid Diversity Libraries for Use in Concentrating Low Concentration Analytes in Samples and for Removing Low Concentration Impurities in the Purification of Proteins*
- •*Fluidic Interconnection System for Microfluidic Devices*

U.S. Provisional Patent Applications
- •*Nanostructured Surfaces as a Dual Ionization LDI-DESI Platform for Increase Peptide Coverage in Proteomic Analysis (filed)*
- •*Electrospray Ionization Using Pointed Fibers*
- •*Planar Electrical Conductors and Processes and Methods for Making Planar Electrical Conductors on Plastic Surfaces (filed)*

U.S. Patent Applications
- •*Electrospray Ionization Using Pointed Fibers (issued)*
- •*Coplanar Electrical Conductors and Processes and Methods For Producing Same (filed)*

Proteomics CoEE (cont'd)

U.S. Patent Applications (cont'd)
- *Nanostructured Surfaces As a Dual Ionization LDI-DESI Platform for Increased Peptide Coverage In Proteomic Analysis*

U.S. Patent Issued
- *Electrospray Ionization from Pointed Fibers (issued, attempting to license)*

Neuroscience CoEE (MUSC)

Start-up Companies
- SemiAlloGen, Inc.

Gastrointestinal Cancer Diagnostics CoEE (MUSC)

Invention Disclosures
- *Use of the KS1/4 Gene For Detection and/or Diagnosis of Lung Cancer*
- *Use of the KS1/4 Gene for Detection and/or Diagnosis of Epithelial Cancers Excluding Lung*
- *Use of gene-specific priming for reverse transcription of RNA into DNA*
- *Use of a Six-Gene Marker Panel For the Detection of Esophageal Cancer*
- *Development of a Quantitative Multi-Tiered Algorithm For Discrimination of Benign and Malignant Disease*
- *Use of the XAG Gene For Detection of Metastatic Breast, Lung, and Pancreatic Cancer in Lymph Nodes*
- *A Multimarker Gene Panel For Detection of Metastatic Disease In Epithelial-Derived Cancers*
- *Molecular Discrimination of Pancreatic Cancer From Pancreatitis*
- *A Molecular Based Two-Marker Assay that Predicts Outcome of Adenocarcinoma Patients*
- *A Molecular-Based Two Marker Assay that Predicts the Outcome of Squamous Carcinoma Patients*
- *Use of EpCAM2 for Detection of Prostate Cancer Cells*
- *Molecular Prognostic Assay for Colon Cancer Using Spint2 and/or E-cadherin*
- *A Two-Gene Prognostic Assay for Stage II Colon Cancer*

U.S. Provisional Patent Applications
- *Methods and Compositions for Diagnosing Epithelial Cell Cancer*

G.I. Cancer Diagnostics CoEE (cont'd)

U.S. Provisional Patent Applications (cont'd)
- *Enhanced Detection of RNA Using a Panel of Truncated Gene-Specific Primers for Reverse Transcription*
- *Methods For the Detection and Treatment of Cancer (60/777,402)*
- *Methods For the Detection and Treatment of Cancer (60/784,009)*
- *A Molecular Based Two-Marker Assay that Predicts Outcome of Adenocarcinoma Patients*

U.S. Patent Applications
- *Methods and Compositions for Diagnosing Epithelial Cell Cancer (11/003,223)*
- *Methods and Compositions for Diagnosing Epithelial Cell Cancer (12/152,423)Methods for the Detection and Treatment of Cancer*
- *Molecular Based Two-Marker Assays That Predict Outcome Of Adenocarcinoma Patients*
- *Enhanced Detection Of RNA Using Panel Of Truncated Gene-Specific Primers For Reverse Transcription*

International Patent Applications
- *Methods and Compositions for Diagnosing Epithelial Cell Cancer*
- *Enhanced Detection of RNA Using a Panel of Truncated Gene-Specific Primers for Reverse Transcription*

Molecular Proteomics in Cardiovascular Disease and Prevention CoEE (MUSC)

Invention Disclosures
- *Predicting Heart Failure Risk and Presence In Patients Following Myocardial Infarction By Protease and Protease Inhibitor Profiling*
- *Detecting Diastolic Heart Failure By Protease And Protease Inhibitor Plasma Profiling*
- *Hypertrophic Non-Failure Mouse Model*
- *Prediction of Structural Remodeling and Clinical Outcomes in Hypertensive Heart Disease by Plasma Profiling Multiple Biomarkers of Matrix Remodeling*

Provisional U.S. Patent Applications
- *Detecting Diastolic Heart Failure By Protease And Protease Inhibitor Plasma Profiling*

Molecular Proteomics in Cardiovascular Disease and Prevention CoEE (cont'd)

Provisional U.S. Patent Applications (cont'd)
- *Predicting Heart Failure Following Myocardial Infarction By Protease and Protease Inhibitor Profiling*

International Patent Applications
- *Predicting Heart Failure Following Myocardial Infarction by Protease and Protease Inhibitor Profiling* (PCT)
- *Detecting Diastolic Heart Failure by Protease and Protease Inhibitor Plasma Profiling* (PCT)

Active Licenses & Options Executed
- *Two licenses for the detection of cardiovascular diseases in humans* [formal names protected by confidentiality agreements] ($125,000 in licensing income)

COLLABORATIVE CENTERS

Regenerative Medicine CoEE (MUSC/Clemson/USC)

Spin-off Companies
- First String

Cancer Drug Discovery CoEE (MUSC/USC)

Invention Disclosures
- *Cell Repair and Regeneration By Suramin and Related Polysulfonated Naphthylureas*
- *7-hydroxy-4H-chromen-4-one Derivaties Promote Mitochondrial Biogenesis*
- *Identification and Optimization of a Selective Inhibitor of Calpain 10*
- *Protein Kinase C Zeta Inhibition to Treat Vascular Permeabilit*
- *Pim-1 Protein Kinase Inhibitor*

U.S. Provisional Patent Applications
- *Cell Repair and Regeneration By Suramin and Related Polysulfonated Naphthylureas*
- *Modulators Of Mitochondrial Biogenesis*
- *Calpain 10 Inhibitors and Uses Thereof*

Cancer Drug Discovery CoEE (cont'd)

U.S. Provisional Patent Applications (cont'd)
- *Inhibitors of PIM-1 Protein Kinase, compositions, and methods for treating prostate cancer*

U.S. Patent Applications
- *Cell Repair and Regeneration by Suramin and Related Polysulfonated Naphthylureas*

Vision Science CoEE (MUSC/USC)

Invention Disclosures
- *Pharmacological Enhancement of the Natriuretic Peptide Systems within the Eye*
- *Dual Specific Phosphatases in Glaucoma*

Childhood Neurotherapeutics CoEE (USC/MUSC)

Invention Disclosures
- *Combination therapy of lovastatin (as an inhibitor of HMG- COA reductase) and AICAR (as an activator of AMP activated Protein Kinase) for inflammatory diseases including disorders of NO (from iNOS) and cytokines*
- *AICAR activates proapoptic pathway in breast cancer cells*
- *Attenuation of Ischemia/Reperfusion Injury*
- *Methods and Compositions For the Prevention and Treatment of Inflammatory Diseases or Conditions*
- *Method for prevention and treatment of inflammatory disease and disease conditions with inhibitors of glucosyl - and galctosyltransferase inhibitors for the synthesis of lactosylceramide and compound that increase intracellular cAMP*
- *Anti inflammatory and insulin therapy for Diabetes*
- *Lovastatin Restores Remyelination Process In EAE*
- *Methods of Treating TH-1Cell Mediated Autoimmune Diseases*

U.S. Provisional Patent Applications
- *Methods For Treating Inflammatory Disorders*
- *Methods of Treating TH-1Cell Mediated Autoimmune Diseases*
- *Methods and Compositions For the Prevention and Treatment of Inflammatory Diseases or Conditions*

Childhood Neurotherapeutics CoEE (cont'd)

U.S. Provisional Patent Applications (cont'd)
- •*Lovastatin Restores Remyelination Process in EAE*

U.S. Patent Applications
- •*Dopamine Receptor Agonists in the Treatment and Prevention of HIV-induced Dementia* (filed)
- •*Use of Dopamine D3 Receptor Antagonists in the Treatment of Neurological Disorders* (filed)
- •*Attenuation of Ischemial Reperfusion Injury* (filed)
- •*Methods of Treating Juvenile Type 1 Diabetes Mellitus*
- •*Methods for Treating Inflammatory Disorders*
- •*Protection of Transplanted Stem Cells with HMG-CoA Reductase Inhibitors*

U.S. Patents Issued
- • *Methods of Treating Nitric Oxide and Cytokine Mediated Disorders* (issued)
- • *Compounds for Reducing Ischemial Reperfusion Injury* (issued)

International Patent Applications
- •*Dopamine Receptor Agonists in the Treatment and Prevention of HIV-Induced Dementia* (filed)
- •*Attenuation of Ischemial Reperfusion Injury* (filed)
- •*Methods and Compositions for the Prevention and Treatment of Inflammatory Diseases or Conditions* (filed)
- •*Methods for Treating Inflammatory Disorders*
- •*Protection of Transplanted Stem Cells with HMG-CoA Reductase Inhibitors*
- •*Methods of Treating Juvenile Type 1 Diabetes Mellitus*

Active Licenses and Options Executed
- •*Attenuation of Ischemia/Reperfusion Injury*
- •*Methods and Compositions For the Prevention and Treatment of Inflammatory Diseases or Conditions* (licensed to two companies)
- •*Method for prevention and treatment of inflammatory disease and disease conditions with inhibitors of glucosyl - and galctosyltransferase inhibitors for the synthesis of lactosylceramide and compound that increase intracellular cAMP*

Childhood Neurotherapeutics CoEE (cont'd)

License Income Received
- • $25,000

Spin-off Companies
- •ImmunoMod

Marine Genomics CoEE
(MUSC/College of Charleston)

Invention Disclosures
- •*Use of double stranded RNA genetic interference for disease control in crustaceans*
- •*Use of Double Stranded RNA To Induce Antiviral Immunity In Marine Crustacea*
- •*Systems for delivery of double stranded RNA to protect marine crustacea against infectious disease*
- •*Yeast-based delivery of double stranded RNA to protect marine crustacea against infectious disease*
- •*Monoclonal Antibodies Reactive to WSSV*
- •*Use of Chitin and Derivatives For the Oral Delivery of Double-Stranded RNA*
- •*Use of Long Double-Stranded RNA (dsRNA) To Protect Vertebrate Animals from Infectious Disease*
- •*Identification of an Algal Toxin for Potential Anti-Cancer Applications*

U.S. Provisional Patent Applications
- •*Methods and Compositions For Inducing Non-Specific and Specific Immune Response in Crustaceans and Other Invertebrates (60/498,603)*
- •*Methods and Compositions For Inducing Non-Specific and Specific Immune Responses in Crustaceans and Other Invertebrates (60/505,714)*
- •*Use of Chitin and Derivatives For the Oral Delivery of Double-Stranded RNA*
- •*Methods and Compositions for Inducing Non-Specific and Specific Immune Responses in Crustaceans and other Invertebrates (60/564,295)*
- •*Use of double stranded RNA genetic interference for disease control in invertebrates*
- •*Use of Algal Toxin Compounds For Anti-Cancer Therapy*

U.S. Patent Applications
- •*dsRNA Induced Specific and Non-Specific Immunity in Crustaceans and Other Invertebrate sand Biodelivery Vehicles For Use Therein*

Marine Genomics CoEE (cont'd)

International Patent Applications

- *dsRNA Induced Specific and Non-Specific Immunity in Crustaceans and Other Invertebrate sand Biodelivery Vehicles For Use Therein*

License Income Received

$145,025 (from two licenses now inactive)

Brain Imaging CoEE (USC/MUSC)

Invention Disclosures

- *Using Interleaved TMS/fMRI to Detect Regional Brain Effects of CNS Active Compounds*
- *Using Ampakine Compounds to Mitigate the Cognitive Deficits Caused by ECT or Other Forms of Brain Stimulation or Brain Surgery*
- *Systems for Using Psychophysiological Responses to Determine the Optimum VNS Dose for Individual Patients (Including a method for rapidly determining TMS MT)*
- *Extending the Uses and Power of Brain Stimulation with the Techniques of Classical Conditioning*
- *The Use of Transcrannial Magnetic Stimuation (TMS) for the Treatment of Acute Surgical Pain and Chronic Pain Syndromes*
- *Transcranial Magnetic Stimulation (TMS) for Improving the Accuracy of Motor Cortex Stimulator Placement in Neurosurgery*

U.S. Provisional Patent Applications

- *Methods and Systems for Using Psychophysiological Responses to Determine the Optimum VNS Dose for Individual Patients and Method and System for Rapidly •Determining TMS MT Methods and Devices for the Treatment of Surgical and Chronic Pain with Transcranial Magnetic Stimulation (TMS)*
- *System and Methods for Measuring Effects of Central Nervous System Active Compounds*

U.S. Patent Applications

- *Methods and Systems For Using Transcranial Magnetic Stimulation and Functional Brain Mapping For Examining Cortical Sensitivity, Brain Communication, and Effects of Medication (10/535,775)*

Brain Imaging CoEE (cont'd)

U.S. Patent Applications (cont'd)

- *Methods and Systems For Using Transcranial Magnetic Stimulation and Functional Brain Mapping For Examining Cortical Sensitivity, Brain Communication, and Effects of Medication (12/035,997)•Methods and Systems For Using Psychophysiological Responses To Determine the Optimum VNS Dose For Individual Patients and Method and System for Rapidly Determining TMS MT (10/980,620)*
- *Methods and Systems For Using Psychophysiological Responses To Determine the Optimum VNS Dose For Individual Patients and Method and System For Rapidly Determining TMS MT (11/155,938)*
- *Methods and Systems For Using Psychophysiological Responses To Determine the Optimum VNS Dose For Individual Patients and Method and System for Rapidly Determining TMS MT (11/955,993)*
- *Methods and Devices for the Study and Treatment of Surgical and Chronic Pain with Transcranial Magnetic Stimulation (TMS)*

International Patent Applications

- *Methods and Systems for Using Psychophysiological Responses to Determine the Optimum VNS Dose for Individual Patients and Method and System for Rapidly Determining TMS MT*

Spin-off Companies

- Cephos Corporation

CoEE Extramural Research Awards 2003-2008

[non-state investment above and beyond the dollar-for-dollar non-state match requirement]

Institution(s)	Proposal	Extramural Research Awards by CoEE *	Extramural Research Awards by CoEE Chair *	CoEE Chair (if hired)
2002-03				
Clemson	Automotive Systems Integration	$388,754	$0	
Clemson	Automotive Manufacturing	$4,143,334	$3,910,949	Kurfess
USC	Nanostructures	$4,448,413	$2,744,000	Webb
USC/MUSC	Brain Imaging	$11,056,930	$0	
MUSC	Proteomics	$2,231,752	$0	
MUSC	Neuroscience	$11,970,056	$10,870,056	Aston-Jones / Chimowitz
MUSC/Coll of Charleston	Marine Genomics	$1,888,983	$0	
2003-04				
Clemson	Automotive Design & Development	$581,036	$500,258	Ziegert
Clemson	Electronics Systems Integration	$338,584	$338,584	Hubing
Clemson	Photonic Materials	N/A	N/A	
USC	Polymer Nanocomposites	$2,359,180	$0	
USC	Hydrogen & Fuel Cell Economy	$0	$0	
MUSC/Clemson/USC	Regenerative Medicine	$180,083	$180,083	Swaja
MUSC/USC	Translational Cancer Therapeutics	$1,269,085	$917,038	Tew
2004-05				
USC	Renewable Fuel Cells for Fuel Cell Economy	$0	$0	
USC/Coastal Carolina	Tourism & Economic Development	$0	$0	
MUSC	Gastrointestinal Cancer Diagnostics	$0	$0	
MUSC/USC	Cancer Drug Discovery	$3,707,155	$2,800,940	LeMasters / Smith
MUSC/USC	Vision Science	$3,616,501	$0	
2005-06				
Clemson	Supply Chain Optimization & Logistics	$0	$0	
Clemson	Urban Ecology & Restoration	$0	$0	
Clemson	Advanced Fiber-Based Materials	$0	$0	
Clemson	Molecular Nutrition	$0	$0	
USC	Solid Oxide Fuel Cells **	$28,335,433	$25,227,366	Reifsnider
USC/MUSC	Childhood Neurotherapeutics	$13,446,591	$0	
MUSC	Molecular Proteomics in CV Disease & Prevention	$3,974,265	$0	
MUSC/USC	Clinical Effectiveness & Patient Safety	$2,119,644	$2,119,644	Schaefer

CoEE Extramural Research Awards 2003-2008 (cont'd)

[non-state investment above and beyond the dollar-for-dollar non-state match requirement]

Institution(s)	Proposal	Extramural Research Awards by CoEE *	Extramural Research Awards by CoEE Chair *	CoEE Chair (if hired)
2006-07				
Clemson/MUSC	Health Facilities Design and Testing	$934,590	$0	
USC	Rehabilitation and Reconstruction Sciences	$0	$0	
USC	Strategic Appr. to Electricity Prod. from Coal	$0	$0	
USC/MUSC/Clemson	Healthcare Quality ***	$7,994,950	$7,994,950	Sanderson
USC/Clemson	SeniorSMART™ Center	$9,169,130	$0	
MUSC	Tobacco-Related Malignancy †	$2,260,000	$0	
MUSC/USC	Stroke	$708,150	$708,150	Adams
2007-08				
Clemson	Optoelectronics	$0	$0	
Clemson	Cyber-Institute	$0	$0	
USC	Nanoenvironmental Research & Risk Assessment	$399,817	$0	
USC	Nuclear Science and Energy	$0	$0	
MUSC	Renal Disease Biomarker	$4,714,884	$0	
MUSC/Clemson	Cancer Stem Cell Biology & Therapy	$0	$0	
MUSC/USC/Clemson	Advanced Tissue Biofabrication	$0	$0	
MUSC/USC/SCSU	Cancer Disparities	$0	$0	
MUSC/USC	Medication Safety & Efficacy	$0	$0	
	Total	**$122,237,300**	**$58,312,018**	14

* Does not include CoEE state award funds or CoEE non-state matching funds. Does include federal and private awards above and beyond non-state match requirements.

** Extramural funding for this CoEE includes a $22M grant with Dept of Engergy Office of Basic Energy Sciences (with 8 universities, 4 national labs).

*** Does not include the $21M Duke Endowment grant, which has been mostly portioned among other CoEEs as non-state matches.

† Extramural funding for this CoEE includes grants by Drs. Gemmill and Drabkin, MUSC chairs who conduct research on behalf of this CoEE.

VI. Program Academic Achievements

Improving the state's knowledge base and economy is not the only byproduct of CoEE research. Major indirect contributions of the CoEE Program include the education, training and scholarly output of students, especially graduate students, and other faculty members or research partners working in conjunction with the CoEE endowed chairs. By mandate of the CoEE Review Board, each CoEE must be supported by affiliated graduate programs. As the research conducted at each CoEE gradually builds the reputation of each affiliate graduate program, it becomes easier to recruit, nationally and internationally, the very best students and postdoctoral researchers in each CoEE field. As industry builds around each CoEE and CoEE cluster, students and faculty members are likely to remain in state and continue building the state's knowledge economy. Listed below are some academic achievements which have resulted from the CoEE Program:

The **BMW CoEE endowed chair in Automotive Manufacturing** and the **Timken Automotive Design and Development** have developed and refined the M.S. and Ph.D. graduate program in Automotive Engineering. (This is the first automotive engineering doctoral program offered in the country.) The curriculum was finalized in FY 2007. The **Michelin CoEE endowed chair in Vehicle Electronic Systems Integration** proposed two courses for the new automotive engineering curriculum: Introduction to Automotive Electronic Systems and Automotive Electronics Design. The program changes have been approved by CHE and the Southern Association of Colleges and Schools (SACS). The first doctoral students under the refined programs were admitted in August 2006, and the first classes were held in August 2007. As of Fall 2008, 33 graduate and 20 doctoral students are participating in the Automotive Engineering program, surpassing the initial goal of 50 students. During FY 2008, **the CoEE chairs at CU-ICAR** published a total of 32 academic, peer-reviewed papers. They also presented at 19 conferences, including inter-national ones in Switzerland, Italy, Singapore, Japan and Korea.

The **CoEE in Optical Materials** is a component of the larger initiative COMSET (see page 36), which received CHE approval in 2004 as the state's only optics research center. As of the FY 2007, approximately 50 graduate and 20 undergraduate students were affiliated with COMSET. Also, an interdisciplinary graduate program (M.S. and Ph.D.) in Photonics is presently being developed between COMSET and the Clemson Graduate School. The Carolina MicroOptics Triangle (CMOT) is a regional optics cluster that brings together research and economic development between Clemson, UNC-Charlotte and Western Carolina University. Nationally launched in 2006, CMOT added industrial affiliates in the past year and is recognized as one of only four university photonics clusters in the U.S. Additionally, COMSET will formalize the Carolinas Photonics Consortium which adds Duke University and N.C. State to the CMOT. The focus of these consortia is to advance the development of new optical materials, devices, and components in support of the existing photonics industry in the Carolinas.

Related faculty of the **CoEE in Molecular Nutrition** published 30 scientific papers in FY 2008.

The **CoEE in Supply Chain Optimization and Logistics** reported five students graduated with doctoral degrees and ten students graduated with master's degrees from the Industrial Engineering Department in the supply chain area in FY 2008. Ten more doctoral students and fifteen master's students were recruited into the field. In order to further Clemson's success in this scientific field, the university requested and received approval in November 2008 from the South Carolina Commission on Higher Education for a master's in Industrial Engineering with a concentration in Supply Chain Optimization and Logistics.

The **CoEE in Nanostructures** supports a research group that includes four research assistant professors, nine doctoral students, two graduate students, seven undergraduate students and one high school student. **CoEE chair Dr. Richard Webb** is collaborating with the USC Department of Electrical Engineering to create a new nanofabrication laboratory for use by undergraduate and graduate students; Dr. Thomas Crawford has integrated an undergraduate nanotechnology research lab in the USC Department of Physics; Drs. Bazaliy and Dr. Crittenden are developing two new courses on Molecular Biophysics which will be offered in the Spring of 2009 . The CoEE has developed academic collaborations with scientists at 36 national and international entities including universities, corporations and government agencies. During FY 2008, CoEE staff were invited to present at two international conferences. CoEE staff members also participated in four university seminars, contributed to eight international presentations and authored a total of 32 academic publications.

The **CoEE in Hydrogen and Fuel Cell Economy** and the **CoEE in Renewable Fuel for the Fuel Cell Economy** have developed graduate-level courses in Electrochemistry, Mathematical Modeling, Fuel Cell Engineering, and Interfacial Engineering. Over 60 graduate students have been associated with both CoEEs over the past four years. During FY 2007, Scientists associated with these CoEEs have presented and/or exhibited at four international conferences, including a featured exhibit at the world's largest trade show for fuel cells, the Hannover Fuel Cell Fair. They also presented keynote speeches at a symposium in Stuttgart, Germany, and at the National Research Council of Canada Workshop in Vancouver. The USC Fuel Cell Center also hosted the second Annual USA-Korea Symposium on Fuel Cells and Hydrogen Technologies in Columbia in May 2007. In 2009, the National Hydrogen Association Meeting will be held in Columbia.

The **CoEE in Polymer Nanocomposites** is currently supporting two graduate students and one postdoctoral student in Chemistry. Another postdoctoral student completed her thesis in September 2007 regarding synthesis and characterization of oxide materials. Other students associated with the CoEE include three postdoctoral students, five doctoral students and one

undergraduate student. In the past year, scientists associated with the CoEE produced three publications in the field and were invited to present at two conferences including The Future of Nanoplastics 2007 in Texas.

As of FY 2008, the **Solid Oxide Fuel Cell CoEE** has recruited two postdoctoral, three doctoral and two graduate students to work at the center. In addition, three undergraduate students are working in the CoEE laboratories. Faculty in this CoEE produced three publications and were invited to give lectures in six countries. CoEE endowed chair-holder Dr. Reifsnider gave keynote speeches at conferences in Greece, Japan and Germany.

"It is time to reverse the brain drain that has caused so many of our talented young people to seek their fortunes elsewhere. The state's research universities want to look South Carolina's teenagers in the eye and reassure them that we are working hard to create good, high-paying jobs for their future. Newly created Centers of Economic Excellence … are building blocks for giving our teenagers vibrant and rewarding opportunities in their home state."

Raymond S. Greenberg, MUSC President
letter to the editor, the *State* (January 7, 2008)

MUSC
MEDICAL UNIVERSITY *of* SOUTH CAROLINA

The **CoEE in Proteomics** has ten doctoral students and 15 postdoctoral fellows working on proteomics research.

In FY 2008, **Neuroscience CoEE chairs Aston-Jones and Chimowitz** produced 14 published works. Currently, one graduate student, one doctoral candidate, three rotation students, three Summer Undergraduate Research Program students and one undergraduate research student from College of Charleston are associated with the CoEE

Faculty associated with the **CoEE in Gastrointestinal Cancer Diagnostics** produced eight scientific publications. A surgical resident and a summer undergraduate student were associated with the CoEE this past year.

The work of the **CoEE in Molecular Proteomics in Cardiovascular Disease Prevention and Treatment** led to 13 published papers in FY 2008. This CoEE is supporting one post doctoral fellow in cardiac research.

The **CoEE in Tobacco-Related Malignancies** will support three summer undergraduate students, one pre-doctoral student, and two MD/Ph.D. combined degree students in FY 2009. Work in the CoEE led to the production of eight scientific publications.

COLLABORATIVE CENTERS

The **CoEE in Marine Genomics** has created a new Marine Genomics track in the program leading to the M.S. degree in Marine Biology at the College of Charleston. This track complements a highly innovative undergraduate degree program in Discovery Informatics at the College of Charleston. In May 2005, MUSC and NSF held an international workshop in Charleston on marine genomics which resulted in several scientific collaborations. In June 2005, NSF sponsored a genomics workshop on the organism *Fundulus* at the Hollings Lab in Charleston. In the past year, the College of Charleston committed funds to support up to four graduate fellowships per year in Marine Genomics. This commitment enables recruitment of nationally outstanding students to the Graduate Program in Marine Biology (GPMB) which acts as a strong "feeder" program for doctoral study in Marine Biomedicine and Environmental Sciences (MBES) at MUSC. Both the GPMB and the MBES have added new graduate courses in Marine Genomics, Eco-genomics and Marine Molecular Ecology, thus far with 60 graduate students participating. Three graduates of the doctoral program at MUSC have taken positions with the FBI, the Center of Marine Biotechnology at the University of Maryland and the National Cancer Institute/Johns Hopkins School of Public Health. Also, a student with the MBES program recently won a highly competitive NSF pre-doctoral fellowship based on genomics technology applied to a marine organism. Through its work with shrimp, this CoEE has also partnered with Clemson University's Genome Institute (CUGI); this partnership and collaboration have produced three mini-symposiums and led to CoEE faculty becoming adjunct faculty at Clemson and vice versa. Also, a memorandum of understanding on global climate change was signed by Clemson, MUSC, College of Charleston and the S.C. Department of Natural Resources, providing an "umbrella focus" on the application of marine genomics technologies to global climate changes. Faculty associated with the CoEE created three scientific publications and one conference abstract/poster this past year.

The **CoEE in Brain Imaging** has been successful in recruiting junior faculty for the program at USC and MUSC. In the past three years, scientists associated with the CoEE have produced 33 publications. A Brain Imaging course for graduate and undergraduate students is currently offered at USC and MUSC. Five students have earned Ph.D.s with four individuals currently conducting doctoral research. Over 50 undergraduates have been instructed by the CoEE as well. The CoEE has sponsored three international symposiums featuring scientists from Johns Hopkins University, Duke University, UCLA and the University of Arizona.

The **CoEE in Regenerative Medicine** currently supports six graduate students. In FY 2008, preliminary conceptual and structural planning was completed for the Bioengineering Building on the MUSC campus; construction will begin in FY 2009.. The South Carolina Bioengineering Alliance (SCBA), which is closely affiliated with this CoEE, conducted a bioengineering summit in June 2007 with attendance of over 200. The SCBA continued the success of the summit by hosting two statewide topical workshops on gastrointestinal and orthopedic applications this past year with plans to continue this education during FY 2009. The work of the CoEE led to 17 scientific publications in the past year.

The **CoEE in Translational Cancer Therapeutics** has recruited four accomplished faculty members from the Fox Chase Cancer Center (Philadelphia), NIH, Harvard University and the University of Virginia. During the past year, individuals associated with the CoEE have published four peer-reviewed manuscripts, six book chapters and six abstracts. The CoEE has partially funded to postdoctoral fellows, one which won a Abney Foundation Fellowship. Also, a course entitled Development of Molecular Cancer Therapies: From Bench to Bedside is offered to graduate students and post-doctoral fellows.

Ten postdoctoral fellows and eight graduate students were associated with the **CoEE in Cancer Drug Discovery** during FY 2008. In this same year, researchers associated with the CoEE authored 67 scientific publications.

The work of the **CoEE in Vision Science** led to the publication of 51 papers in leading ophthalmic and basic science peer-reviewed journals and 14 chapters in academic text books. Also, four graduate students, eight medical and scientific postdoctoral fellows and 12 ophthalmic residents were associated with this Center in FY 2008.

The **CoEE in Travel and Tourism Technology** developed a baccalaureate degree in Tourism Management and a master's degree in International Hospitality and Tourism Management.

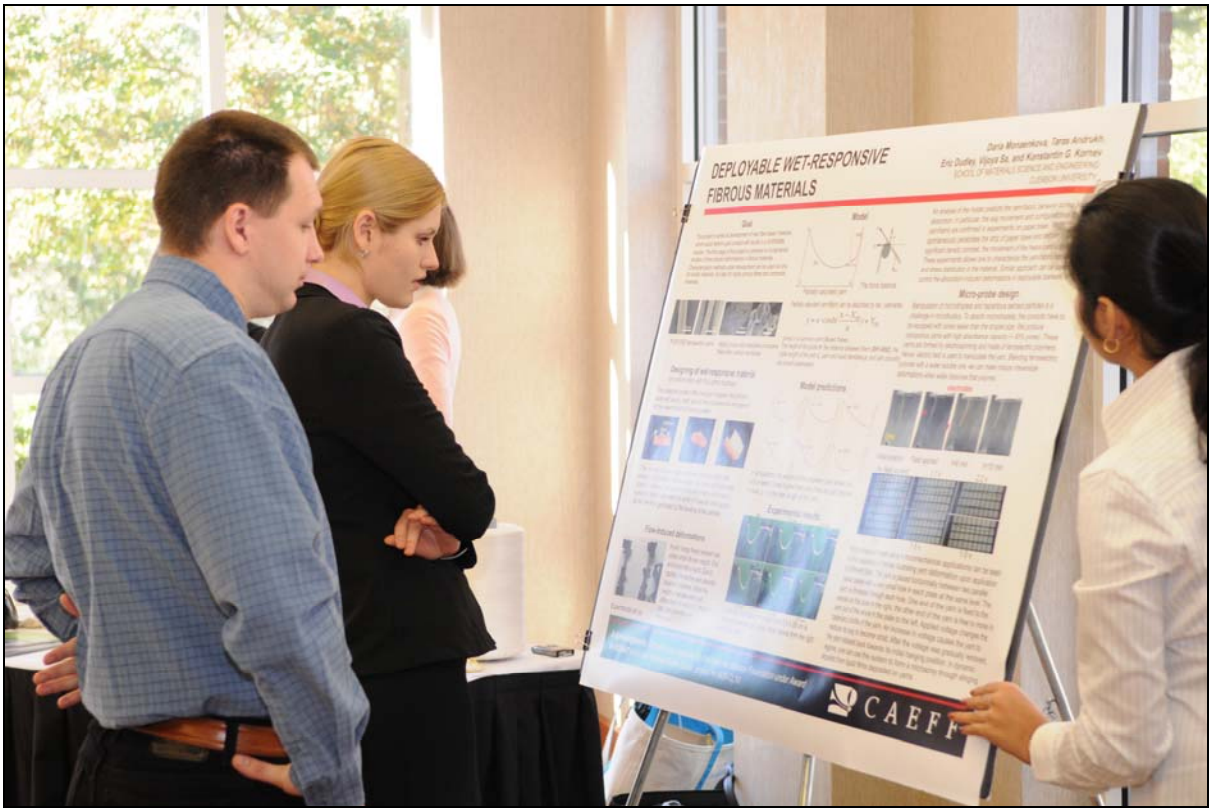
CoEE Chair Dr. John Schaefer of the **CoEE in Clinical Effectiveness and Patient Safety** was invited to lecture at an international conference and gave seven other national speeches in FY 2008. The Greenville Hospital System Simulation Center currently offers 41 simulation courses with six more courses in development while the MUSC Simulation Center offers 28 courses with 15 more in development. Through 2007, a combined total of 2,812 students participated in simulation activities at GHS and MUSC. Simulation sessions include medical emergency team training, difficult airway management, fiber-optic bronchoscopy, pediatric simulation, emergency room residency skills, pelvic exam for sexual assault nurse examiner, and labor and delivery skill application.

The **CoEE in Health Facilities Design and Testing** is enhancing multiple academic programs at Clemson University, including the Architecture graduate programs and the Ph.D. in Environmental Design and Planning. The Department of Defense Patient Room of the Future Project has involved 31 students across multiple disciplines, including Architecture, Fine Art, Industrial Design, Landscape Architecture, Nursing, Psychology and Human Factors, Materials Science and Engineering and Computer and Electrical Engineering.

The work of the **CoEE in Stroke** led to the publication of nine scientific journal articles in FY 2008. Also, a second-year medical student and second year neurology resident are both involved with research at the CoEE.

The **CoEE in Healthcare Quality** has established a clinical research education unit through funding from the Duke Endowment and HSSC. Through this initiative, the CoEE will train researchers in funding agency selection, study design, standard proposal outlines, team selection and budget development. The CoEE will also provide workshops in the areas of human trials ethics and the Institutional Review Board process, the design of human trials, evaluating statistics, audits, samples and data management.

The **SeniorSMART™ CoEE** began an educational series between clinical researchers, engineers and geriatricians for cross-discipline understanding and knowledge. A repository of literature has also been developed. The CoEE and one of its partners, the University of Kaiserslautern (Germany), created a graduate student exchange involving two doctoral students from USC. In 2008, faculty associated with the CoEE produced 37 publications.



Advanced Materials research was showcased in a graduate student poster exhibit and industry expo during the announcement of funding completion for the Clemson University CoEE in Advanced Fiber-based Materials.

VIII. Centers of Economic Excellence Review Board

NOTE: In June 2008, the S.C. Research Centers of Economic Excellence Act was amended to provide two new CoEE Review Board appointees, one each nominated by the Chair of the Senate Finance Committee and the Chair of the House Ways & Means Committee. Both first-term appointments were made during the 2009 fiscal year and are included in the CoEE Review Board Member Biography section starting on page 107.

2002-2003

NAME	POSITION	APPOINTMENT
Margaret Addison	Member	Governor I
Harry Lightsey, Jr.*	Member	Governor II
Samuel J. Tenenbaum	Vice Chair	Governor III
Anthony O'Neill	Member	Senate President Pro Tempore I
William Amick	Member	Senate President Pro Tempore II
James Bailey	Member	Senate President Pro Tempore III
Edward T. McMullen, Jr.	Chair	Speaker of the House I
Benjamin T. Rook	Secretary	Speaker of the House II
Rita Allison**	Member	Speaker of the House III
James F. Barker	Ex-Officio	
Raymond S. Greenberg	Ex-Officio	
Andrew A. Sorensen	Ex-Officio	

* Robert W. Pearce, Jr. replaced Harry Lightsey, Jr. as a Governor appointee during FY 2002-03.
** Paula Harper Bethea replaced Rita Allison as a Speaker of the House appointee during FY 2002-03.

2003-2004

NAME	POSITION	APPOINTMENT
Margaret Addison	Member	Governor I
Robert W. Pearce, Jr.	Member	Governor II
Samuel J. Tenenbaum	Vice Chair	Governor III
Anthony O'Neill	Member	Senate President Pro Tempore I
William Amick	Member	Senate President Pro Tempore II
James Bailey	Member	Senate President Pro Tempore III
Edward T. McMullen, Jr.	Chair	Speaker of the House I
Benjamin T. Rook	Secretary	Speaker of the House II
Paula Harper-Bethea	Member	Speaker of the House III
James F. Barker	Ex-Officio	
Raymond S. Greenberg	Ex-Officio	
Andrew A. Sorensen	Ex-Officio	

2004-2005

NAME	POSITION	APPOINTMENT
John Molnar*	Member	Governor I
Robert W. Pearce, Jr.	Member	Governor II
Samuel J. Tenenbaum	Vice Chair	Governor III
Anthony O'Neill	Member	Senate President Pro Tempore I
William Amick**	Member	Senate President Pro Tempore II
James Bailey	Member	Senate President Pro Tempore III
Edward T. McMullen, Jr.	Member	Speaker of the House I
Benjamin T. Rook	Chair	Speaker of the House II
Paula Harper-Bethea	Secretary	Speaker of the House III
James F. Barker	Ex-Officio	
Raymond S. Greenberg	Ex-Officio	
Andrew A. Sorensen	Ex-Officio	

* John M. Rivers replaced John Molnar as a Governor appointee during FY 2004-05.
** Harry M. Lightsey, III replaced William Amick as a President Pro Tempore appointee during FY 2004-05.

2005-2006

NAME	POSITION	APPOINTMENT
John M. Rivers	Member	Governor I
Robert W. Pearce, Jr.	Member	Governor II
Samuel J. Tenenbaum	Vice Chair	Governor III
Anthony O'Neill	Member	Senate President Pro Tempore I
Harry M. Lightsey, III	Member	Senate President Pro Tempore II
Donald Babb	Member	Senate President Pro Tempore III
Edward T. McMullen, Jr.	Member	Speaker of the House I
Benjamin T. Rook	Chair	Speaker of the House II
Paula Harper-Bethea	Secretary	Speaker of the House III
James F. Barker	Ex-Officio	
Raymond S. Greenberg	Ex-Officio	
Andrew A. Sorensen	Ex-Officio	

2006-2007

NAME	POSITION	APPOINTMENT
John M. Rivers*	Member	Governor I
Robert W. Pearce, Jr.	Member	Governor II
Samuel J. Tenenbaum**	Member	Governor III
Anthony O'Neill***	Member	Senate President Pro Tempore I
Harry M. Lightsey, III†	Member	Senate President Pro Tempore II
Donald Babb	Vice-Chair	Senate President Pro Tempore III
Edward T. McMullen, Jr.	Member	Speaker of the House I
Benjamin T. Rook‡	Member	Speaker of the House II
Paula Harper-Bethea	Chair	Speaker of the House III
James F. Barker	Ex-Officio	
Raymond S. Greenberg	Ex-Officio	
Andrew A. Sorensen	Ex-Officio	

* Keith D. Munson replaced John M. Rivers as a Governor appointee during FY 2007.

** J. Lyles Glenn replaced Samuel J. Tenenbaum as a Governor appointee during FY 2007.

*** Melvin C. Williams replaced Anthony O'Neill as a Senate President Pro Tempore appointee during FY 2007.

† Gregg F. Morton replaced Harry M. Lightsey, III as a Senate President Pro Tempore appointee during FY 2007.

‡ Patricia E. Wilson replaced Benjamin T. Rook as a Speaker of the House appointee during FY 2007.

2007-2008

NAME	POSITION	APPOINTMENT
Keith Munson	Member	Governor I
Robert W. Pearce, Jr. *	Member	Governor II
J. Lyles Glenn	Member	Governor III
Melvin C. Williams	Member	Senate President Pro Tempore I
Gregg F. Morton **	Secretary	Senate President Pro Tempore II
Donald Babb	Vice-Chair	Senate President Pro Tempore III
Edward T. McMullen, Jr. ***	Member	Speaker of the House I
Patricia E. Wilson	Member	Speaker of the House II
Paula Harper-Bethea	Chair	Speaker of the House III
James F. Barker	Ex-Officio	
Raymond S. Greenberg	Ex-Officio	
Andrew A. Sorensen	Ex-Officio	

* Charles M. Condon replaced Robert W. Pearce, Jr. as a Governor appointee during FY 2008.

** Pamela Lackey replaced Gregg F. Morton as a Senate President Pro Tempore appointee during FY 2008.

*** Robert W. Pearce, Jr. replaced Edward T. McMullen, Jr. as a Speaker of the House appointee during FY 2008.

S.C. CoEE Review Board Member Biographies[17]

Paula Harper-Bethea (Chair)
Harper-Bethea is director of external relations for the McNair Law Firm. She has served as a board member and past chairwoman of the S.C. Chamber of Commerce, as chair emeritus of the United Way of America's Board of Governors, and as past chair of the United Way of S.C. She is a founding board member of the Palmetto Institute, a member of the board of the Health Sciences Foundation, and vice-chair of the Presbyterian College Board of Trustees. She is a past member of the S.C. State Ethics Commission and a recipient of The Order of the Palmetto, the state's highest award for volunteer service. She and her husband were honored as the S.C. Chamber of Commerce's 2006 Business Leaders of the Year. They reside in Hilton Head.

Pamela P. Lackey (Vice Chair)
Lackey is president of AT&T's S.C. operations and lives in Columbia. She has worked with BellSouth since 1997, first as sales manager for education and government markets, then as the government relations director. Before her tenure with BellSouth, she served the S. C. Department of Education as a senior executive assistant. Lackey has been active in numerous community and civic organizations, including the South Carolina Chamber of Commerce, Palmetto Center for Women Business Advisory Committee, Junior League of Greenville and Columbia, and the SCETV Midlands Citizen's Advisory Committee. Lackey received undergraduate and graduate degrees from the University of Alabama.

Robert W. Pearce, Jr. (Secretary)
Pearce is a partner of Nelson Mullins Riley & Scarborough. His practice focus includes real estate finance, lender representation, corporate law, private securities offerings, venture capital, mergers and acquisitions, and trademark law. He has served as general counsel for the Charleston Metro Chamber of Commerce; as past local board member of BB&T Bank; as past board chairman and cofounder of ThinkTEC; and has recently been appointed to the S.C. Council of Competitiveness. Pearce was honored by the Governor in 2004 as an Economic Development Ambassador. He is the cofounder of the technology newsletter, *CyberWatch*®. Pearce has a J.D. from USC, an M.B.A. from USC, and a B.A. in Economics from Washington and Lee University.

Melvin C. Williams
Williams is the business developer of the Charleston branch of SM&E, a southeastern engineering firm. He is director at-large of the South Carolina section of the American Society of Civil Engineers and serves on the board of the American Subcontractors Association of the Carolinas. He is a member of the Charleston Civil Engineers Club, the Charleston Contractors' Association, and the Society of American Military Engineers. He is an alumnus of South Carolina State University and was recognized as a "Stellar Alumnus" in 2006.

[17] Current through April 2009.

Patricia E. Wilson

Wilson has chaired several state and local cultural organizations including the South Carolina Arts Commission, the South Carolina Arts Foundation, and the Columbia Arts Task Force. She has also served on the boards of the Columbia Museum of Art and the South Carolina State Museum. She is a member of the National Arts Society and is a recipient of the Yale University Award for Cultural Achievement. Wilson received a B.A. from the University of South Carolina, where she also completed postgraduate studies.

Keith D. Munson

Munson is an attorney with Womble, Carlyle, Sandridge & Rice. He is a trial lawyer with nearly 20 years of experience. His civic activities include serving as a member/spokesperson for Governor Sanford's Transition Team; board member of the S.C. Public Service Authority (Santee Cooper); and board member of the Upstate Alliance. His military service includes serving as a U.S. Army Captain with the 24th Infantry Division during the first Persian Gulf War. He has a J.D. from the UVA Law School and a B.A. in Political Science from Clemson.

J. Lyles Glenn

Glenn is a principal with Keenan Development Associates, LLC, a real estate development firm focused on public/private partnerships. He also serves in an Of Counsel capacity with the law firm Ellis, Lawhorne and Sims, P.A. His previous positions include vice president, chief operating officer, and chief executive assistant to the president of the University of South Carolina, and he has served as executive assistant to a former lieutenant governor of South Carolina. He has a J.D. and B.A. from the University of South Carolina.

Charlie Condon

Condon runs his own law practice in Mount Pleasant with an emphasis on governmental relations, criminal defense, licensing issues, personal injury, and litigation. Condon served as S.C. Attorney General from 1995 to 2003. He has also served as Ninth Judicial Circuit Solicitor, as Assistant Solicitor in Charleston County, and as Securities Commissioner of S.C. while he was Attorney General of South Carolina. He received his J.D. from Duke University and his B.A. from Notre Dame. He is married and has four children.

Bobby Hitt

Hitt is public affairs department manager for BMW Manufacturing in Greer. Previous positions include planning and development director for Nelson Mullins and various editor positions for major S.C. newspapers. Currently, Hitt is the vice chair of the board for the S.C. Manufacturers' Alliance and president/tournament chairman of S.C. Charities Inc. (BMW Charity Pro-Am). Additionally, he serves on the executive committees of Advance SC and the Upstate Alliance and on the boards of the Hollings Cancer Center and the S.C. Governor's School for Science and Mathematics. Hitt is an alumnus of USC.

Regan Voit

Voit is the retired president of Chem-Nuclear Systems, where he led two corporate mergers and managed the transition to a state Public Service Commission–regulated operation. While at Chem-Nuclear Systems, he received the 1997 S.C. Governor's Total Quality Award and the 1996 Tennessee Valley Authority Key Supplier Award. Voit previously worked for LN Technologies Corporation, NUS Process Services Corporation, and the U.S. Department of Energy's Savannah River Plant. He also served as a U.S. Navy Officer. Voit has served on various committees related to the S.C. Education and Economic Development Act and is a past participant of the S.C. Teachers Education Performance Standards Steering Committee and S.C. 2020 Vision Steering Committee. He is an alumnus of USC and the University of Virginia.

Michael Couick

Couick is president and CEO of the Electric Cooperatives of South Carolina. Previously he was the director of research and attorney for the South Carolina Senate Judiciary Committee, positions he held for 21 years. Couick serves on the board of directors of S.C. Educational Communications, Inc., the programming arm of the ETV Endowment of South Carolina. Couick is a graduate of the University of South Carolina and the USC School of Law. He lives in Columbia.

(Left to right) S.C. Speaker of the House Bobby Harrell, with CoEE Review Board Members Patricia Wilson, Melvin Williams, Clemson President James Barker, MUSC President Raymond Greenberg, USC President Harris Pastides, Bobby Hitt and Regan Voit at the January 2009 press conference to release the Washington Advisory Group *2003-2008 CoEE Program Comprehensive Evaluation*.

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CoEE Review Board Meeting Materials,
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APPENDIX I

SOUTH CAROLINA
CENTERS OF ECONOMIC EXCELLENCE
PROGRAM

DETAILED SUMMARY
OF FUNDED CoEE PROPOSALS
[through June 30, 2008]

South Carolina Centers of Economic Excellence
Summary of Funded Proposals 2003-2008

Institution(s)	Proposal	Proposal Amount	State Funds Drawn	Match Pledged	Match Received	Date of Inception	18 month Pledge Window	Pledge Deadline Met	60 Month Draw Down Window	No. of Chairs	Chair(s) Hired	Chair Holder
Funding Year 2002-03												
Clemson	Automotive Systems Integration	$5 Million	$5,000,000	$5,000,000	$5,000,000	6/24/2003	12/24/2004	yes	12/24/2009	1		
Clemson	Automotive Manufacturing	$5 Million	$5,000,000	$5,000,000	$5,000,000	6/24/2003	12/24/2004	yes	12/24/2009	1	1	Kurfess
USC	Nanostructures	$4 Million	$2,016,700	$4,000,000	$2,265,088	6/24/2003	12/24/2004	yes	12/24/2009	1	1	Webb
USC/MUSC	Brain Imaging	$5 Million	$2,970,800	$5,000,000	$4,120,896	6/24/2003	12/24/2004	yes	12/24/2009	2		
MUSC	Proteomics	$4 Million	$1,762,385	$4,000,000	$1,762,385	6/24/2003	12/24/2004	yes	12/24/2009	1		
MUSC	Neuroscience	$3 Million	$2,400,000	$3,000,000	$2,400,861	6/24/2003	12/24/2004	yes	12/24/2009	3	2	Aston-Jones Chimowitz
MUSC/Coll of Charles.	Marine Genomics	$4 Million	$1,500,000	$4,000,000	$1,500,000	6/24/2003	12/24/2004	yes	12/24/2009	2		
	Total 2002-03	$30 Million	$20,649,885	$30,000,000	$22,049,230							
Funding Year 2003-04												
Clemson	Automotive Design & Development	$5 Million		$5,000,000	$61,056	8/25/2003	2/25/2005	yes	2/25/2010	1	1	Ziegert
Clemson	Electronic Systems Integration	$3 Million	$3,000,000	$3,000,000	$3,000,000	4/27/2004	10/27/2005	yes	10/27/2010	1	1	Hubing
Clemson	Photonic Materials	$5 Million	$4,313,458	$5,000,000	$4,313,458	4/27/2004	10/27/2005	yes	10/27/2010	1		
USC	Polymer Nanocomposites	$3.5 Million	$1,866,620	$3,500,000	$1,868,459	4/27/2004	10/27/2005	yes	10/27/2010	1		
USC	Hydrogen & Fuel Cell Economy (I) **	$2.5 Million	$1,840,945	$2,500,000	$1,841,018	4/27/2004	10/27/2005	yes	10/27/2010	2		
MUSC/Clemson/USC	Regenerative Medicine	$5 Million	$2,500,000	$5,000,000	$3,099,444	8/25/2003	2/25/2005	yes	2/25/2010	3	1	Swaja (MUSC)
MUSC/USC	Translational Cancer Therapeutics	$5 Million	$5,000,000	$5,000,000	$5,000,000	4/27/2004	10/27/2005	yes	10/27/2010	2	1	Tew (MUSC)
	Total 2003-04	$29 Million	$18,521,023	$29,000,000	$19,183,435							

South Carolina Centers of Economic Excellence
Summary of Funded Proposals 2003-2008 [cont'd]

Institution(s)	Proposal	Proposal Amount	State Funds Drawn	Match Pledged	Match Received	Date of Inception	18 month Pledge Window	Pledge Deadline Met	60 Month Draw Down Window	No. of Chairs	Chair(s) Hired	Chair Holder
2004-05												
Clemson	Restoration [WITHDRAWN 7-11-07]	[$3 Million]				8/30/2004						
Clemson	Electron Imaging [WITHDRAWN 12-21-07]	[$5 Million]				6/29/2005						
USC	Renewable Fuel Cells for Fuel Cell Economy	$3 Million	$1,160,900	$3,000,000	$1,160,972	6/29/2005	12/29/2006	yes	12/29/2011	1		
USC	Hydrogen & Fuel Cell Economy (II) **	$2.5 Million		$2,500,000		8/30/2004	2/28/2006	yes	2/28/2011	[See 03-04]		
USC/Coastal Carolina	Tourism & Economic Development	$2 Million	$925,000	$2,000,000	$925,000	8/30/2004	2/28/2006	yes	2/28/2011	1		
MUSC	Gastrointestinal Cancer Diagnostics	$5 Million	$4,007,802	$5,000,000	$4,007,802	6/29/2005	12/29/2006	yes	12/29/2011	1	1	Thomas (MUSC)
MUSC/USC	Cancer Drug Discovery	$5 Million	$4,723,468	$5,000,000	$4,723,468	8/30/2004	2/28/2006	yes	2/28/2011	4	2	LeMasters (MUSC), Smith (MUSC)
MUSC/USC	Vision Science	$4.5 Million	$4,367,192	$4,500,000	$4,367,192	6/29/2005	12/29/2006	yes	12/29/2011	3		
	Total 2004-05	$22 Million	$15,184,362	$22,000,000	$15,184,434							
Funding Year 2005-06												
Clemson	Supply Chain Optimization & Logistics	$2 Million	$1,000,000	$2,000,000	$1,000,000	9/16/2005	3/16/2007	yes	3/16/2012	1		
Clemson	Urban Ecology & Restoration	$2 Million	$2,000,000	$2,000,000	$2,000,000	9/16/2005	3/16/2007	yes	3/16/2012	1		
Clemson	Advanced Fiber-Based Materials	$4 Million	$3,001,989	$3,493,989	$3,001,989	6/13/2006	12/13/2007	Extension II	12/13/2012	1		
Clemson	Molecular Nutrition	$2 Million				6/13/2006	12/13/2007	Extension II	12/13/2012	1		
USC	Solid Oxide Fuel Cells	$3 Million				6/13/2006	12/13/2007	Extension II	12/13/2012	1	1	Reifsnider (USC)
USC/MUSC	Childhood Neurotherapeutics	$5 Million		$5,000,000	$2,500,000	6/13/2006	12/13/2007	yes	12/13/2012	3		
MUSC	Molecular Proteomics in CV Disease & Prevention	$5 Million	$3,589,941	$5,000,000	$3,589,941	6/13/2006	12/13/2007	yes	12/13/2012	2		
MUSC/USC/Clemson	Clinical Effectiveness & Patient Safety	$5 Million	$2,502,432	$5,000,000	$2,502,432	9/16/2005	3/16/2007	yes	3/16/2012	3	1	Schaefer (MUSC)
	Total 2005-06	$28 Million	$12,094,362	$22,493,989	$14,594,362							

South Carolina Centers of Economic Excellence
Summary of Funded Proposals 2003-2008 [cont'd]

Institution(s)	Proposal	Proposal Amount	State Funds Drawn	Match Pledged	Match Received	Date of Inception	18 month Pledge Window	Pledge Deadline Met	60 Month Draw Down Window	No. of Chairs	Chair(s) Hired	Chair Holder
2006-07												
Clemson/MUSC	Health Facilities Design and Testing	$5 Million				6/18/2007	12/18/2008		12/18/2013	2		
USC	Rehabilitation and Reconstruction Sciences	$5 Million		$5,000,000	$500,000	6/18/2007	12/18/2008	yes	12/18/2013	1		
USC	Strategic Appr. to Electricity Prod. from Coal	$5 Million		$5,000,000		6/18/2007	12/18/2008	yes	12/18/2013	1		
USC/MUSC/Clemson	Healthcare Quality	$5 Million		$5,000,000		8/28/2006	2/28/2008	yes	2/28/2013	2	1	Sanderson (MUSC)
USC/Clemson	SeniorSMART™ Center ***	$5 Million				8/20/2007	2/20/2009		2/20/2014	3		
MUSC	Tobacco-Related Malignancy	$5 Million		$1,200,000	$1,200,000	6/18/2007	12/18/2008		12/18/2013	2		
MUSC/USC	Stroke	$5 Million				6/18/2007	12/18/2008		12/18/2013	3	1	Adams (MUSC)
	Total 2006-07	$35 Million	$0	$16,200,000	$1,700,000							
2007-08												
Clemson	Optoelectronics	$2 Million				6/9/2008	12/9/2009		12/9/2014	1		
Clemson	Cyber-Institute	$2 Million				6/9/2008	12/9/2009		12/9/2014	1		
USC	Nanoenvironmental Research & Risk Assessment	$3 Million				6/9/2008	12/9/2009		12/9/2014	1		
USC	Nuclear Science and Energy	$3 Million				6/9/2008	12/9/2009		12/9/2014	1		
MUSC	Renal Disease Biomarker	$5 Million				6/9/2008	12/9/2009		12/9/2014	2		
MUSC/Clemson	Cancer Stem Cell Biology & Therapy	$5 Million				6/9/2008	12/9/2009		12/9/2014	2		
MUSC/USC/Clemson	Advanced Tissue Biofabrication	$5 Million				6/9/2008	12/9/2009		12/9/2014	3		
	Total 2007-08	$25 Million	$0	$0	$0							
	Totals Since Program Inception:	$169 Million	$66,449,632	$119,693,989	$72,711,461					70	15	
	Total Lottery Appropriations (2002-2008):	$180 Million										

** The Hydrogen & Fuel Cell Economy CoEE was approved during 2003-2004. Funding for one half of this CoEE was provided in 2003-04, the other half in 2004-2005.

*** The SeniorSMART CoEE was approved in 2007-2008. Funding was provided from 2006-2007 dollars.

Last updated June 30, 2008

CoEE Program Mission Statement

The South Carolina Centers of Economic Excellence program serves the public interest by creating incentives for the state's research universities, in cooperation with other institutions of higher education in the state, to raise capital from non-state sources to fund endowments for specialized research professorships. These professorships in turn serve as the nucleus for unique, university-based research centers which cultivate critical, public-private industrial partnerships, expand the state's knowledge base, create well-paying jobs, and enhance economic opportunities and improve the quality of life for the people of South Carolina.

The *South Carolina Centers of Economic Excellence Annual Report to the South Carolina General Assembly and the South Carolina Budget & Control Board Report* is published annually by the South Carolina Centers of Economic Excellence Review Board and the South Carolina Commission on Higher Education in accordance with S.C. 2-75-10.

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Clemson BMW Automotive Manufacturing Chair Dr. Tom Kurfess uses CU-ICAR's seven-post shaker test cell for a teachable moment with students in Clemson's automotive engineering graduate program. CU-ICAR has four CoEE chairs: in MANUFACTURING, AUTOMOTIVE DESIGN AND DEVELOPMENT, ELECTRONIC VEHICULAR SYSTEMS, and SYSTEMS INTEGRATION.