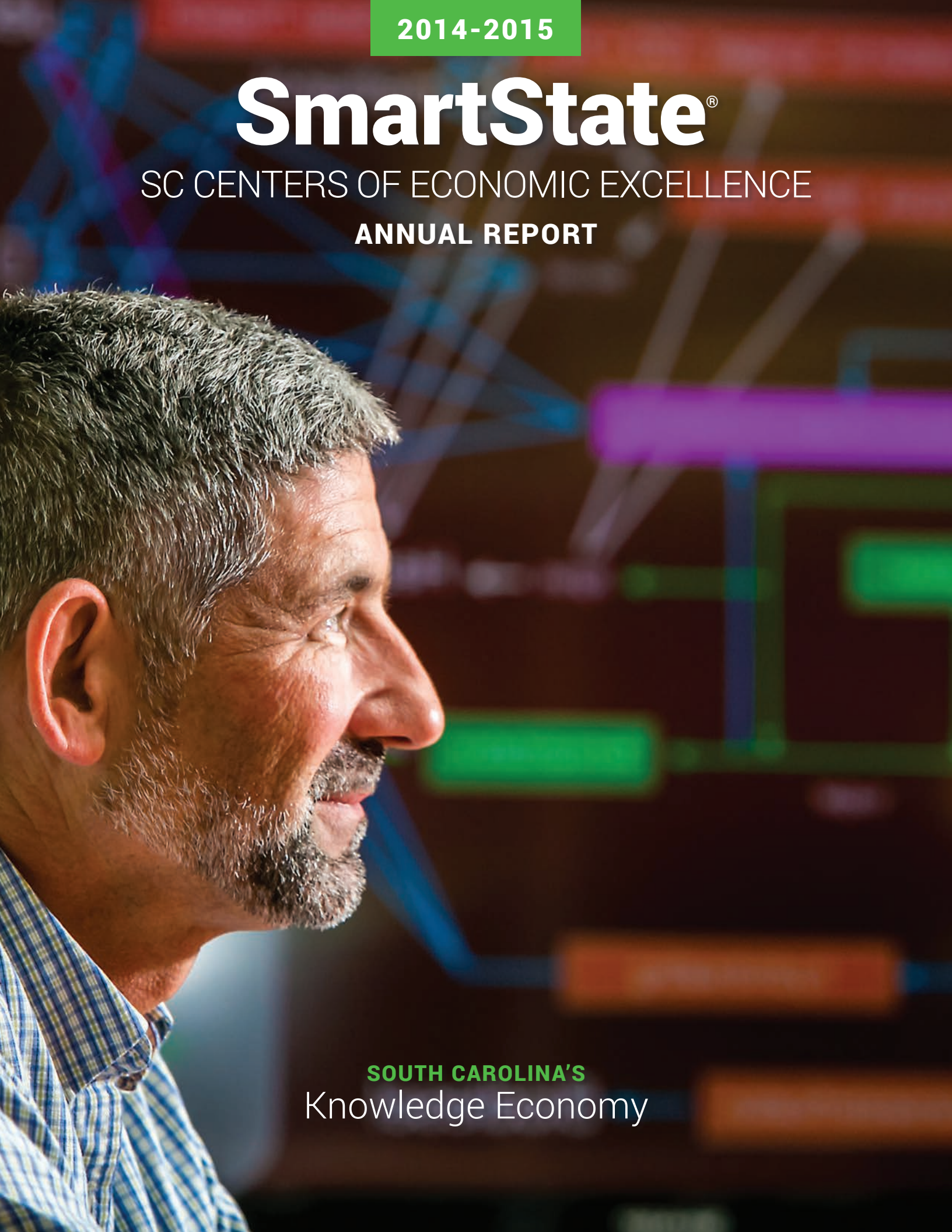
2014-2015

SmartState®

SC CENTERS OF ECONOMIC EXCELLENCE

ANNUAL REPORT



SOUTH CAROLINA'S

Knowledge Economy

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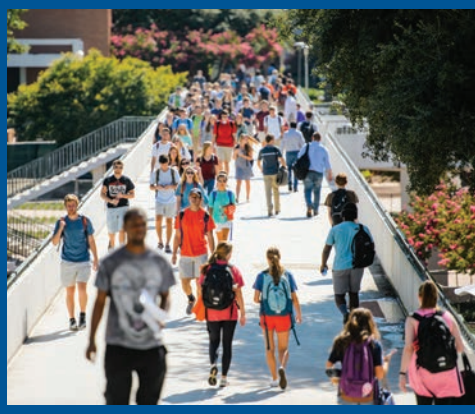
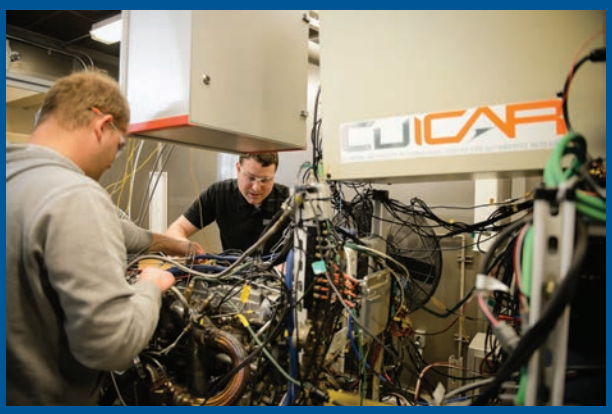
ON THE COVER:

Dr. John Regalbuto, SmartState® Endowed Chair in Renewable Fuels, University of South Carolina

MISSION

The South Carolina SmartState® 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, enhance economic opportunities, and improve the quality of life for the people of South Carolina.





AN INTRODUCTION FROM **REGAN VOIT, CHAIR**

In the early 2000s, the Palmetto State was reeling from the loss of much of its textile industry and looking for new opportunities.

Harvard University Professor Michael Porter was hired to assess South Carolina's competitiveness. Porter's findings pointed to a new model of economic development that included collaborative processes involving companies, government, teaching and research universities, technical education colleges, and new institutions. The ultimate goal was to create a "knowledge economy" in South Carolina, one that included more high-tech companies and higher salaries.

It was during this time that the South Carolina General Assembly created the SmartState® Program, a groundbreaking program designed to attract endowed chairs in areas of global and national importance to South Carolina's research universities. These SmartState® Endowed Chairs would serve as catalysts of innovation and technology in collaborations between research universities and external partners in business, industry, health care, and private foundations.

In the 13 years since the SmartState® Program was established, South Carolina has succeeded in creating a knowledge economy. Thanks to major economic development victories, we are now home to some of the biggest names in the automotive, aviation and energy industries. Our state is leading the nation in health informatics-driven research thanks to a unique statewide collaborative of universities and health systems that are recognized as being among the nation's elite in solving issues of public health and healthcare policy. Citizens in our state have more opportunities than ever to find well-paying careers in high-tech fields.

The SmartState® Program was, and remains, a very smart idea for South Carolina!

In this SmartState® Program Annual Report, we profile the people, universities, and collaboratives that have played a critical role in making the vision of a knowledge economy a reality. We are honored to feature South Carolina's Secretary of Commerce, Robert M. "Bobby" Hitt, who had the unique distinction of serving on the Review Board of the SmartState® Program. Secretary Hitt played a pivotal role in one of the state's most historical economic development wins, the recruitment of BMW, and then assisting with BMW's multi-million dollar investment in two SmartState® Endowed Chairs. We also profile Helga Rippen, a national leader in health informatics, who now leads Health Sciences South Carolina, a dynamic statewide research collaborative that was born of the SmartState® Program.

As in past issues, we introduce you to six SmartState® Endowed Chairs, two each of Clemson University, the Medical University of South Carolina and the University of South Carolina. This year three of those profiled are women whose centers are addressing new and sustainable American rubber sources, which could benefit our state's burgeoning tire industry; the designing of safer, more ergonomic operating rooms; and the identification of more precise means of diagnosing breast cancer. The other chairs are leading the charge on sustainable biofuels, healthcare econometrics, and heart disease mitigation..

In dosing, I would like to thank the many political and business leaders whose shared vision created the SmartState® Program, along with the university leaders, endowed chairs, staff, and students who live the dream daily. Because of you, South Carolina is a better place for all of us.

Regan Voit, Chair
SmartState® Review Board

The SmartState® Program does not receive taxpayer dollars to fund economic development-related initiatives to benefit the state; it is funded through revenue generated by the South Carolina Education Lottery, which is then matched dollar-for-dollar by non-state businesses and foundations.

REVIEW BOARD

The SmartState® Review Board consists of eleven members who serve three-year terms. Three are appointed by the Governor, three by the President Pro Tempore of the State Senate, three by the Speaker of its House of Representatives, one by the Senate Finance Committee, and one by the Chairman of the House Ways and Means Committee. The Review Board oversees operations of the SmartState® Program. The presidents of South Carolina's three research universities serve as ex-officio, non-voting board members.

REGAN VOIT, CHAIR
Appointed by Chairman of the Senate Finance Committee

MELVIN WILLIAMS, VICE CHAIR
Appointed by President Pro Tempore of the Senate

CHARLES W. "CHUCK" GARNETT
Appointed by the Governor

KAROLY "CHARLES" KEREKES
Appointed by the Governor

LISA MAIN
Appointed by Speaker of the House

ROBERT W. PEARCE, JR.
Appointed by Speaker of the House

JASON P. PREMO
Appointed by the Governor

PATRICK W. TURNER
Appointed by President Pro Tempore of the Senate

ROBERTA BANKHEAD WOOD
Appointed by the Chairman of House Ways and Means Committee

SOUTH CAROLINA'S **SENIOR RESEARCH UNIVERSITIES**

The Knowledge Economy's Catalysts + Collaborators

The SmartState® Program funds Centers of Economic Excellence at South Carolina's three senior research universities: Clemson University, the Medical University of South Carolina (MUSC), and the University of South Carolina (USC). Other state universities such as South Carolina State University and the College of Charleston are included as collaborative research partners.

In 2002, members of the South Carolina General Assembly recognized the critical role research universities play in advancing innovation, creating economic and educational opportunities, and improving overall quality of life for the state's citizens when it acted with foresight and an eye to the future, passing the enabling legislation of the SmartState® Program. Today, other states look to South Carolina's SmartState® Program as the model of university-based public-private partnerships that foster innovation, launch companies, and create jobs.

Ranked #21 among national public universities, Clemson University is a major land grant, science- and engineering-oriented research university that is an inclusive, student-centered community characterized by high academic standards, a culture of collaboration, school spirit, and a competitive drive to excel. With agricultural and forestry research centers and innovation campuses located from Greenville to Charleston, and a presence in every county, Clemson's campus is truly the entire state of South Carolina.

Clemson is finalizing a new strategic plan, Clemson*Forward*, which emphasizes high-impact engagement opportunities to prepare students for a knowledge-based global economy, and growing research and doctoral education to help find solutions to real-world problems. The plan also supports economic development and creates jobs, enhances quality of life and builds the university's national academic reputation. The plan identifies six innovation clusters to support development of multi-disciplinary teams and large research projects: Health Innovation, Sustainable Environment, Human Resilience, Big Data Science, Complex Engineered Systems, and Advanced Materials.

MUSC has served the citizens of South Carolina since 1824. MUSC has expanded from a small private college for the training of physicians to a state university with a medical center and six colleges for the education of a broad range of health professionals, biomedical scientists, and other health-related personnel. MUSC has colleges in medicine, nursing, dental medicine, pharmacy, health professions, and graduate studies. MUSC Health is among the state's largest and most innovative health systems.

Established in 1805, USC is home to more than 200 years of history and tradition, with more than 46,000 students at its eight campuses across the state. The main campus in Columbia offers 324 degree programs through its 14 colleges and schools, which include medical schools in Columbia and Greenville, and a law school in Columbia. The Sonoco International Business Department within the Darla Moore School of Business offers an undergraduate international business major that is consistently ranked as #1 by U.S. News & World Report. USC is one of only 63 public universities listed by the Carnegie Foundation in the highest tier of research institutions in the United States.

CLEMSON UNIVERSITY

MUSC MEDICAL UNIVERSITY of SOUTH CAROLINA

UNIVERSITY OF SOUTH CAROLINA

"The SmartState® Program has had a tremendous impact on Clemson University by helping us recruit and support outstanding scholars and researchers, whose work spurs economic growth, enhances the quality of life for the people of South Carolina and elevates the quality and value of a Clemson education. Its success is a testament to the value of collaboration among states, universities and the private sector."

— **James P. Clements, Ph.D.**
President
Clemson University

"The SmartState® Program in South Carolina is one of the most valuable assets available to research universities in South Carolina. In 2002, the South Carolina General Assembly had the foresight to create the South Carolina Research Centers of Economic Excellence, or SmartState. This program has enabled South Carolina's research universities to recruit and retain world-class scientists and, in turn, attract and leverage new federal and private funding for research that has created high-wage, innovative jobs. This reality continues to have a positive ripple effect for the state and beyond. It is also through SmartState® that we will continue high-level collaborative research with Clemson University and the University of South Carolina that allows us to retain the best students in our state. We must encourage policy-makers to continue this important investment in South Carolina that allows us to successfully participate in a highly competitive knowledge economy."

— **DAVID J. COLE, M.D.**
President
Medical University
of South Carolina

"When South Carolina's SmartState® Program was created in 2002, we envisioned highly productive partnerships between the state's research universities and businesses that would spark a competitive edge as well as new jobs and new federal and private funding. Thirteen years later, the vision is self-fullfilling and successful. As importantly, the SmartState® Program has launched a new knowledge-based economy that supports job-creating research in high-growth, high-wage industries while connecting some of our brightest students with world-class scientists and engineers. As our students participate in these SmartState® Programs, they soon become graduates who are aligned with industry and highly sought after employees. It's a win-win for South Carolina as the program entices top scientists and researchers while offering our best students every reason to excel right here at home."

— **HARRIS PASTIDES, PH.D.**
President
University of South Carolina

Robert “Bobby” M. Hitt, III
SC SECRETARY OF COMMERCE

“ **UNIVERSITIES** must continue to work toward **GREATER INTEGRATION** with business. ”

HIGH ON THE KNOWLEDGE ECONOMY

Robert "Bobby" M. Hitt III has a knack for finding sweet spots.

For 17 years, Bobby Hitt worked at The State and Columbia Record newspapers, rising to managing editor. Later, while with the Nelson Mullins Riley & Scarborough Law Firm, he played a key role in recruiting BMW to Spartanburg, South Carolina, the state's largest economic development success story.

Hitt went on to join BMW and was instrumental in engaging the German automaker in the SmartState® Program. BMW invested $10 million in two SmartState® Endowed Chairs at Clemson University's International Center for Automotive Research (CU-ICAR), creating the most dynamic business-university partnership in the state's history. Hitt is also among an elite corps of state leaders who have served on the SmartState® Review Board.

Today, as Governor Nikki Haley's Secretary of Commerce, Hitt oversees the economic development of a state on fire. South Carolina is now a world leader in automotive design, engineering, and manufacturing. Under Hitt's watch and with his Team South Carolina approach, Mercedes-Benz Vans and Volvo Cars have also either located or announced plants in South Carolina. Thanks to Bridgestone, Continental, Michelin, Giti Tire Group and a host of other companies, the Palmetto State is now the nation's tire capital. And, with the successful recruitment of Boeing in 2009, the state scored a new growth industry in aviation and aerospace. It's quite a turnaround for a state that lost nearly its entire manufacturing base — textiles — in the late 1990's.

Hitt attributes South Carolina's successes to state leaders' vision of creating a knowledge economy, one advanced by the creation of the SmartState® Program in 2002. At that time, and for the first time, the state's research universities were incentivized to establish public-private partnerships with businesses and recruit internationally-renowned researchers to spur economic development. Today, the program has research and education dusters that mimic the state's business clusters: automotive, energy, health care, information technology, and tourism.

Aviation and aerospace are new focal points for the Palmetto State. Three South Carolina businesswomen — Darla Moore , Anita Zucker, and Marva Smalls — have invested $11 million, collectively, to establish the University of South Carolina's McNAIR Center for Aerospace Innovation & Research. Named for South Carolina-born astronaut Ronald E. McNair, the center will create opportunities for companies like Boeing and the state's future aerospace workforce.

> "The recruitment of **BMW** was **TRANSFORMATIONAL** for South Carolina. Our attitude changed. Finally, we were the ones **WINNING**."

Hitt believes South Carolina's sweet spot is "extreme" manufacturing but says the work is far from over. Universities must continue to advance the state's knowledge economy by providing businesses critical services like research, market analysis, and workforce educational programs. The rapid pace of change will require institutions of higher learning to work toward greater integration with business to ensure that degrees, programs, learning environments, and methodologies between the two are in sync.

One solution may be hybrid academic and workplace apprenticeships. Said Hitt, "Developing an educated workforce with strong earning potential is one of our top priorities. We need to bridge the gap between the highly educated and the newly educated to more rapidly move people into well-paying jobs."

> "Three businesswomen **INVESTED $11 MILLION** for a new center in **AEROSPACE**."

Helga Rippen, MD, PhD, MPH, FACPM

PRESIDENT + CEO

HEALTH SCIENCES SOUTH CAROLINA

“Thanks to the **VISION** of HSSC’s founders, South Carolina now has a **NATIONALLY RECOGNIZED**, one-of-a-kind informatics infrastructure to support health and health research.”

HEALTH COLLABORATIVE PROPELS SOUTH CAROLINA **TO NATIONAL STAGE**

Information is power.

For Health Sciences South Carolina (HSSC), that power lies in the form of a statewide collaborative and a health informatics infrastructure linking the state's largest research universities and health systems.

The story begins in 2004, just two years after the creation of the SmartState® Program, when university and health system leaders founded HSSC with the vision of improving the health and economic wellbeing of South Carolina through collaborative health sciences research and creation of a learning healthcare system. Each of the six partners — Clemson University, Medical University of South Carolina (MUSC), University of South Carolina (USC), Greenville Health System, Palmetto Health, and Spartanburg Regional Healthcare System — pledged to invest. The money was eligible for a one-to-one state match through the SmartState® Program.

True to its word, HSSC helped fund twelve SmartState® Centers, in areas ranging from brain imaging to SeniorSMART®. HSSC has since expanded its geographic reach and now includes AnMed Health, McLeod Health and Self Regional.

A goal of the SmartState® Program is to attract outside investment. To this end, HSSC forged a synergistic relationship with The Duke Endowment, a Charlotte-based philanthropy organization. Over the last decade, The Duke Endowment has awarded grants totaling $47.55 million to HSSC. Some of these funds were subsequently awarded by HSSC to various SmartState® Centers.

With the Endowment's investment, HSSC and its member organizations have created an unprecedented statewide informatics infrastructure, linking the state's health systems and universities while giving researchers access to information critical to research. This infrastructure is now being used to help reduce hospital readmissions, a project with the South Carolina Hospital Association; improve surgical safety, a project supported by the BlueCross Blue Shield of South Carolina Foundation; and numerous other studies aimed at improving health in South Carolina.

These efforts have propelled South Carolina to the national stage. In 2014, the Association of American Medical Colleges (AAMC) presented HSSC with its prestigious AAMC Learning Health System Champion Research Award, one of just eight awards given. In January 2015, HSSC recruited Helga Rippen, a national expert in health information technology (IT), to serve as its president and CEO. Rippen, who played a key role in creating the nation's health IT infrastructure and public policy, was recently named a member of the U.S. Department of Health and Human Services' National Committee on Vital and Health Statistics.

> “We are grateful for **THE DUKE ENDOWMENT** whose support has enabled us **TO ADVANCE HEALTH** and healthcare systems in the **CAROLINAS**.”

Under Rippen's leadership, HSSC secured its third grant from The Duke Endowment in May, leading to the formation of the Carolinas Collaborative. HSSC member organizations are now working with Duke University, the University of North Carolina and Wake Forest Baptist Medical Center to solve the Carolinas' largest health challenges. In August, HSSC, its North Carolina colleagues and Vanderbilt University, were awarded a national PCORI research grant, another major coup expanding South Carolina researchers' national reach.

Information is power, and thanks to HSSC, information is making good health possible for all South Carolinians.

> “HSSC supports **TWELVE** SmartState Centers at Clemson, MUSC and USC.”

John Regalbuto

SMARTSTATE ENDOWED CHAIR IN RENEWABLE FUELS

SMARTSTATE CENTER FOR CATALYSIS FOR RENEWABLE FUELS

UNIVERSITY OF SOUTH CAROLINA

"Regalbuto and his Collaborators have more than **$5 MILLION** in National Science Foundation funding to advance sustainable **BIOFUELS**."

IN PURSUIT OF A **SUSTAINABLE FUTURE**

In early October, South Carolina was ravaged by a "once in a 1,000 years" storm.

To SmartState® Endowed Chair John Regalbuto, it was a reminder of severe weather attributable to global warming caused by ever-higher levels of atmospheric carbon dioxide from burning fossil fuels. He believes — and his research is focused on — creating fuel from sustainable sources that won't release new CO2 into the atmosphere and will therefore ease global warming.

Regalbuto is a world-renowned expert in catalysis, a hidden, but high impact science at the heart of energy, chemical and environmental industries. He was recruited to the University of South Carolina (USC) to lead the SmartState® Center for Catalysis for Renewable Fuels (CReF).

Regalbuto's goal is to develop the catalysts that convert non-food sources of biomass such as wood chips from forest waste; corn stover, the non-food portion of corn; and switch grass into fuels and chemicals. There are three main pathways for non-food biomass conversion: gasification followed by Fischer-Tropsch synthesis, pyrolysis followed by bio-crude upgrading, and liquid phase breakdown of plant sugars followed by liquid phase processing.

In 2015, the National Science Foundation awarded Regalbuto and his colleagues more than $5 million to advance research in sustainable fuels. The grants include $4 million for research infrastructure, an award to USC and the University of Kansas; a $560,000 grant for an industrial consortium on catalyst synthesis; and a $450,000 grant to Regalbuto and John Monnier, PhD, also of USC, for Bimetallic Catalyst Preparation.

Regalbuto's research is motivated by a win-win-win domino effect. Recycling agriculture and forest waste and utilizing marginal farmland for energy crops would achieve three things: reduce U.S. dependence on imported petroleum, substantially eliminate new CO2 emissions and help address global warming, and create jobs and spur the economy of rural America.

On the challenges of development and adoption of sustainable fuels:

> "The **PIONEERS** are the ones with arrows **IN THEIR BACKS**."

Regalbuto believes the current windfall of cheap energy in the form of shale oil and gas from fracking has distracted policymakers and businesses from the critical need to reduce greenhouse gas emissions. However, he hopes a little "divine intervention" from two "Popes" will reignite South Carolina and the world's alternative energy efforts. Regalbuto has met with S.C. Speaker Pro Tempore Tommy Pope to brief him on CReF's efforts and the national action plan for biomass research and development. When the Center for Catalysis and Renewable Fuels formally opened in the Horizon I Research Building in July, Regalbuto shared Pope Frances' recent call: We need long-sighted, strong backboned politicians to pick up the cry of sustainability.

Thanks to the SmartState® Program, South Carolina is playing a leadership role in this critical path to sustainable energy independence.

> "Instead of paying farmers **NOT TO GROW** crops, let's pay them to raise switch grass that can be used for biofuels. Even marginal farmland can be **PRODUCTIVE**."

Anjali Joseph, PhD, EDAC

SPARTANBURG REGIONAL HEALTHCARE SYSTEM, SMARTSTATE ENDOWED CHAIR IN ARCHITECTURE + HEALTH DESIGN

SMARTSTATE CENTER FOR HEALTH FACILITIES DESIGN AND TESTING

CLEMSON UNIVERSITY

“DR. ANJALI JOSEPH and colleagues at Clemson and MUSC recently received a $4 million grant to create a **LEARNING LAB** to advance surgical safety.”

MULTIDISCIPLINARY TEAMS + SMART DESIGN = SAFER SURGERY

For nearly a decade, Anjali Joseph, PhD, EDAC, led research at the Center for Health Design, a California-based non-profit research, education and advocacy organization, focusing on architecture's role in advancing health and safety.

When Clemson architecture professor David Allison approached her about applying for an endowed chair with the SmartState® Center for Health Facilities Design and Testing, Joseph was intrigued. She started her new position in January 2015.

The SmartState® Endowed Chair in Architecture + Health Design is a great fit for Joseph, who has dedicated her career to aligning the relationship between a building's function and the human experience. The vision of her SmartState® Center is to improve the quality of healthcare environments through rapid prototyping and research techniques that allow innovative design ideas to be tested and moved to real-world application through an evidence-based design process. The recent award of a major multidisciplinary project between Clemson, the Medical University of South Carolina (MUSC) and Health Sciences South Carolina (HSSC) will help move this vision to the next level.

In September, Joseph and her team were awarded a grant to create a learning lab at MUSC aimed at designing safer, more ergonomic hospital operating rooms. The initial grant is for $1 million, with an additional $3 million over the following three years. The grant is through the Agency for Healthcare Research and Quality, an entity dedicated to improving the nation's health care system.

The need for the study is significant. Operating rooms have changed little over the last 50 years despite rapid advances in surgical technology and teams. Hospital operating rooms are often cluttered and crowded, which can make them unsafe for patients and providers. While poor surgical outcomes can rarely be blamed on a single cause, poorly designed operating rooms are a contributor to surgical errors and hospital-acquired infections.

Joseph's team will include architects, design researchers, human factors engineers, operations management researchers, anesthesiologists, surgeons, and nurses. The team will interact with graduate students in Clemson University's Architecture + Health Program who will build upon research findings to develop innovative operating room design solutions.

> **MY PASSION** is improving the healthcare experience through **BETTER DESIGN** of healthcare facilities.

"This project is unique because it takes an integrated systems approach to improving patient safety in operating rooms," Joseph explained. "We are examining the impact of the physical environment of operating rooms in conjunction with other system components such as tasks and workflows, equipment design, and individual factors. We will then design, develop, and test various design and systems solutions and will implement these new ideas in surgical environments at MUSC."

Ultimately, these solutions will be applied to MUSC's new Ambulatory Surgery Center in Charleston. For Joseph and her team, this is just the beginning. Their goal is to continue studying and solving the diverse requirements of complex healthcare settings.

> Healthcare **ARCHITECTURE** and design is very dynamic, driven by America's **RAPIDLY CHANGING** healthcare system.

SMARTSTATE® PROGRAM **RETURN ON INVESTMENT**

The primary mission of the SmartState® Program is to generate high-skilled, high-wage jobs in South Carolina as part of the knowledge economy.

SmartState's established research centers help to expand the state's knowledge base by creating public-private partnerships, supporting start-up firms, and helping to retain highly skilled workers. Each of these efforts results in the creation of jobs that are among the highest paid in South Carolina.

Following the Great Recession of 2008, local regions with the highest rates of economic growth have typically had larger shares of their workforce employed in the knowledge economy. The skills associated with these jobs often include more advanced training in the fields of mathematics and science, complex problem solving, and creative and technological innovation. The commercialization of these ideas leads to economic growth and significant knowledge spillover effects.

As of 2015, the SmartState® Program is responsible for helping to create and support approximately 12,136 jobs in South Carolina, which are associated with nearly $2.4 billion in economic activity and $639 million in labor income for South Carolinians that would not exist otherwise. Approximately 4,936 (41%) of these positions are knowledge economy jobs created directly through the SmartState® Program, with the remaining 7,200 (59%) arising from additional spending activity generated through the economic multiplier effect.

The specific employment multiplier associated with these estimates is 2.5 — for every 10 knowledge economy jobs directly created through the SmartState® Program, an additional 15 jobs are created elsewhere in South Carolina. This multiplier effect is larger than the state average. Each new job created through the SmartState® Program increases total South Carolina employment by more than it would if that job had been created in another industry of comparable size.

The average annual salary associated with a SmartState® job in the knowledge economy is $69,213, roughly 70 percent higher than the average annual salary among all jobs in South Carolina. When examining the salaries of all jobs associated with the SmartState® Program, including those created through the economic multiplier effect, the average annual salary is estimated to be $53,468. This dollar amount is approximately 31% higher than the average annual salary among all South Carolina jobs.

Two key drivers for economic growth and development in the 21st century are innovation and technological development. The SmartState® Program creates and supports program centers designed specifically to encourage both of these activities through investments in research and development, startup companies, company recruitment, and retaining talented alumni. Ultimately, it is an ongoing expansion of the knowledge economy that will create additional high-wage, high-skilled jobs for South Carolinians. The SmartState® Program has clearly become a state leader in these efforts across the state.

"The SmartState Program is an essential component of South Carolina's knowledge economy, facilitating the ongoing development of high-wage jobs. Specifically, the SmartState Program has generated over 12,000 jobs since 2002 that pay annual salaries that are significantly higher than the state average."

– **DR. JOSEPH VON NESSEN, RESEARCH ECONOMIST**
Moore School of Business
University of South Carolina

"Though job creation is critically important for economic growth, both the quality and quantity of jobs matter. Since its inception in 2002, the SmartState® Program has generated both — more than 10,000 total jobs with annual salaries that are significantly above the state average."

— **DR. JOSEPH VON NESSEN**

RESEARCH ECONOMIST, MOORE SCHOOL OF BUSINESS, UNIVERSITY OF SOUTH CAROLINA

SMARTSTATE® PROGRAM BY THE NUMBERS

3
Research Universities
Clemson, MUSC, USC

6
Industry Clusters[1]

51
SmartState® Centers of Economic Excellence

54
SmartState® Endowed Chairs appointed
(of the 85 created)

$197.6M
State Funds Invested[2]

$2.3B
Total Economic Impact[3]

12,136
Total Employment (All jobs)[3]

$69,213
Average Salary of a Knowledge Economy Job[3]

67
Start-ups and Corporate Relocations[4]

1 Industry-focused research is conducted in six areas of global importance: Advanced Materials and Nanotechnology, Automotive and Transportation, Biomedical, Energy, Information Science, and Pharmaceutical.

2 Includes $180 million from the State Education Lottery appropriations and $17.6 million accrued interest from SmartState® Program endowment.

3 The figures reported are from the November 2015 Economic Impact of the SmartState® Program analysis conducted by the Darla Moore School of Business. Of the total 12,136 jobs, 4,936 are knowledge economy jobs created directly through the SmartState® Program including 602 SmartState® Personnel; 1,204 Start-up Company and Corporate Relocation Personnel; 25 Alumni placed with in-state employers; and 3,105 employed through Extramural Research Funding. The remaining 7,200 jobs are indirect employment arising from the economic multiplier effect. For more information about the economic impact analysis, see page 14.

4 See page 16 for a listing of investors, start-ups and corporate relocations.

Investors, Start-ups, and Corporate Relocations in SC

CORPORATE AND ORGANIZATIONAL INVESTORS

More than three dozen companies have invested $500,000 or more in the SmartState® Program.

- Abney Foundation
- BASF
- Bank of America Foundation
- Biomass Gas & Electric
- BlueCross BlueShield Foundation of SC
- BMW
- Comporium Group
- Daniel Island Company
- Dialysis Clinics, Inc.
- Duke Energy Foundation
- Electric Cooperatives of South Carolina
- Fluor Corporation
- Force Protection Industries
- General Atomics
- George B. Sibert Annuity
- GlaxoSmithKline
- Greenville Hospital System
- Health Sciences South Carolina
- J.E. Sirrine Foundation
- Kellogg Foundation
- Kentwool
- Michelin
- Okuma
- Palmetto Health
- PalmettoNet
- Research to Prevent Blindness
- Robert Wood Johnson Foundation
- Samuel Freeman / Donaldson Charitable Trust
- Santee Cooper
- Smith & Nephew
- Spartanburg Regional Healthcare System
- The Duke Endowment
- The Spaulding Paolozzi Foundation
- Timken
- Toyota
- Westinghouse

START-UP COMPANIES

Start-up companies that were founded as a result of research at USC, MUSC, and Clemson University:

- Advanced Photonic Crystals
- Cephos
- DF Werke, LLC
- Doxy.me
- Fibro Therapeutics, Inc.
- First String Research
- GeoMat, LLC
- Hydrogen Hybrid Mobility, LLC
- ImmoMod, Inc.
- Inquisatex Epitherapeutics, LLC
- IntrusinMyFamily.com
- MagAssemble, LLC
- MicroVide
- MitoChem Therapeutics, LLC
- MitoHealth
- NextGenEn
- NXT
- Palmetto Fuel Cell Technologies, LLC
- Parallel Permeation, Inc.
- Patient Guided Health Solutions, LLC
- Perfect Mixing, LLC
- Protara, LLC
- SAGE Energy Solutions
- Schnellgen, Inc.
- SemiAllogen, Inc
- SimTunes, LLC
- Smart Innovations, LLC
- South Carolina Science Solutions, LLC
- Specialty & Custom Fibers, Inc.
- Tetramer Technologies
- Vortex Biotechnology
- Zeriscope, Inc.
- 52 Inc.

CORPORATE RELOCATIONS

Companies that have relocated to South Carolina to take advantage of the expertise, resources, and graduates in the SmartState® Program:

- American Titanium Works (ATW) Manufacturing
- American Titanium Works (ATW) Technology Center
- BMW Information Technology Research Center (ITRC)
- CADFEM U.S.*
- Charge2Target
- CleanEnergy
- COE Optics
- Computech*
- Cooliemon Technologies*
- DreamWeaver*
- EHD Tech
- Environment and Health Inc. (EHG)
- Esys Automation
- Fields Group, LLC.*
- Focus Chemicals*
- Greenway Energy, LLC
- Innoventure
- IndySoft
- Intec U.S. Inc.
- JTEKT Technology Center
- Mallet Technology*
- Michelin
- Michelin Incubator
- Mumford Industries*
- OmniSource
- Proterra, Inc.
- Roding*
- Sage Automotive Interiors*
- Senex Biotechonology, Inc.
- Simpack, Inc.
- ThermoPur Technologies*
- Toho Tenax*
- Tigges*
- Trulite

* In May 2012, CU-ICAR opened the doors to the Center for Emerging Technologies (CET) facility, its first multi-tenant building. CET provides office, administrative, and laboratory space for transportation, technology, and energy sectors. These companies have positioned themselves on the CU-ICAR campus to be close to the SmartState® Endowed Chairs and their research teams.

SMART MOVE: SCIENCE CAFÉ COMES TO CHARLESTON

In restaurants and bars across the country, people are gathering not to cheer on their favorite sports teams. Instead, they're gathering to discuss and debate scientific topics with some of the brightest researchers and scientists in the world — and having a great time.

The movement, which originated in Boston, is called Science Café. EngenuitySC, based in Columbia, brought Science Café to South Carolina in 2007 with the help of a University of South Carolina professor. In 2012, EngenuitySC forged a relationship with the SmartState® Program, giving SmartState® Endowed Chairs a unique forum for sharing their research with the public.

Science Café has been so popular in the Midlands that the Medical University of South Carolina (MUSC) launched its own Science Café this September. Dr. Kenneth Tew, the John C. West Endowed Chair in Cancer Research, kicked off the series by speaking on the benefits and dangers of antioxidants. As guests enjoyed antioxidant–rich cocktails prepared by Fish restaurant, Dr. Tew apprised his audience of his research on antioxidants and the many misconceptions surrounding them.

MUSC will follow its Science Café launch with an evening with Dr. Joseph Helpern, the SmartState® Endowed Chair in Brain Imaging, in early 2016. His topic — *Image Matters: From Youth to Old Age, From Attention Deficit to Alzheimer's Disease - A Look Through the Eye of Magnetic Resonance Imaging* — may seem intimidating, but is already generating advance interest.

Loretta Lynch-Reichert, Director MUSC Office of Strategic Initiatives and Policy Management, believes the secret to Science Café's success is that people are naturally curious about science and excited to have a "backstage pass" to meet and interact with SmartState® Endowed Chairs. "Anyone can come, the topics are fascinating, and there's no cost other than patronizing the host restaurant. It's great entertainment," she said.

Charleston, like Columbia, will host Science Cafés throughout the winter, each featuring a SmartState® Endowed Chairs with a story to share.

SCIENCE CAFE

Dr. Kenneth Tew, John C. West Endowed Chair in Cancer Research, charms the crowd gather at Charleston's inaugural Science Café in September.

"We thought our first Science Café with Dr. Kenneth Tew would last about an hour. Nearly two hours later, guests were still asking questions. The public is very interested in the research at MUSC and our SmartState Endowed Chairs are very open to discussing their work and answering questions."

— **LORETTA LYNCH-REICHERT, MS, DIRECTOR**
MUSC Office of Strategic Initiatives and Policy Management

Nancy DeMore, MD, FACS

BMW SMARTSTATE ENDOWED CHAIR IN CANCER RESEARCH

SMARTSTATE CENTER FOR TOBACCO-RELATED MALIGNANCIES

MUSC
MEDICAL UNIVERSITY of SOUTH CAROLINA

> “Current breast cancer screening methods have a high rate of FALSE POSITIVES, increasing anxiety and breast biopsies. We want to CHANGE that.”

BREAST CANCER: THE QUEST FOR NO MORE FALSE POSITIVES

A 2011 study by the Breast Cancer Surveillance Consortium confirmed what many women already knew: mammography yields too many false positives.

According to the study, after ten years of annual screenings, more than half of women are called back for a second mammogram due to something suspicious in the first mammogram. Up to nine percent undergo biopsies for something suspicious that turns out not to be cancer.

Another breast cancer screening modality, MRI, is also associated with a high false positive rate. This lack of accuracy can cause inconvenience and anxiety for patients, not to mention that biopsies are painful and cause scars. Duplication of screenings and unnecessary biopsies are costly to the healthcare system.

Nancy DeMore, the BMW SmartState® Endowed Chair in Cancer Research at the Medical University of South Carolina (MUSC), is developing technology with her colleagues at the Hollings Cancer Center and University of North Carolina Chapel Hill with the hope to find a solution to this problem. Recently, the National Institutes of Health (NIH) awarded DeMore and her colleagues a three-year, $1.2 million grant to support their research, which involves using a molecularly targeted ultrasound contrast agent. The target is a protein that is expressed in the vasculature of breast cancer tumors, but not expressed in normal blood vessels. In pre-clinical studies, the contrast agent is taken up only by tumors and not in normal tissue.

DeMore has dedicated much of her research career to the field of angiogenesis, focusing on blood vessel growth to breast cancer tumors. It was through genomic profiling of malignant tumor endothelium that she discovered a novel protein overexpressed in breast tumor vasculature. The protein, called SFRP2, is expressed in the vasculature of certain types of breast cancer.

DeMore and her colleagues believe that by combining breast ultrasound with the application of a molecularly targeted contrast agent, whose target is specific to tumor vessels, they can better detect breast cancer lesions, thus providing an improved imaging modality that may reduce the number of false positives. Dr. Paul Dayton of UNC-Chapel Hill, DeMore and her team have generated an SFRP2 molecularly targeted ultrasound contrast agent. Preliminary data indicates that the contrast agent accumulates in the vasculature of tumors, with minimal interaction from normal vessels. The presence of this contrast agent can then be detected with high sensitivity using a clinical ultrasound system.

> “A surgeon **IMPACTS** one cancer patient at a time, while a researcher can **IMPROVE SURVIVAL** for thousands.”

DeMore is excited about the potential of the antibody and contrast agents, both of which she has patented. Improving the sensitivity of breast cancer screenings would greatly reduce the number of false positives. Greater specificity in tumor size and location would be a significant benefit to surgeons. She also has a personal motivation to see this new technology succeed. DeMore’s mother and grandmother both had breast cancer. “As a surgeon, I impact one patient at a time. As a researcher, I can possibly improve treatments for thousands.”

> “The NIH awarded a **$7.5 MILLION GRANT** to Dr. DeMore and her colleagues at MUSC and the University of North Carolina.”

Amy Landis, PhD

THOMAS F. HASH '69

SMARTSTATE ENDOWED CHAIR

SMARTSTATE CENTER IN SUSTAINABLE DEVELOPMENT

CLEMSON UNIVERSITY

"Dr. Landis is **INTERNATIONALLY RECOGNIZED** for sustainable development. She has more than $7 million in research dollars."

CREATING SUSTAINABLE IMPACT

Amy Landis is all about impact — as long as it's sustainable.

As an undergraduate studying chemistry, Amy Landis realized she wanted to make a greater impact on the world than a career in a lab would afford. So she earned a PhD in Civil and Materials Engineering at the University of Illinois Chicago and set her sights on a new and growing industry: sustainable development.

What sounds like a trendy buzzword is a serious field involving science, informatics and social design. Entire industries are seeking experts like Landis who joined Clemson University in June 2015 as the Thomas F. Hash '69 SmartState® Endowed Chair in Sustainable Development. Researchers from at least 14 different institutes, centers, and colleges within Clemson are involved in the SmartState® Center in Sustainable Development, led by Landis.They will address diverse areas such as the environment, economics, energy and health care.

Although Landis joined Clemson less than six months ago, she has hit the ground running. Of great interest to South Carolina, which produces more tires than any other state in the country, is her $8 million project with the United States Department of Agriculture (USDA) to create a domestic source of natural rubber for tires. Most natural rubber comes from Indonesia, Malaysia, or Thailand. According to Landis, a U.S. source of natural rubber would meet the "Triple Bottomline of Sustainability."

"In sustainable development, we look for three things: economic feasibility, whether or not it harms the environment or uses finite resources, and the societal impact. Does the project create job growth, improve the quality of jobs and increase diversity? The USDA tire project hits a home run," Landis said.

Landis and her colleagues have identified a shrub that grows in desert areas of the U.S. Southwest that can be used for rubber. In August, the team tested prototype tires made from the U.S.-sourced rubber on a test track in San Antonio, Texas. The tires performed equal to or better than rubber sourced from Asia.

> "We have found a U.S. **GROWN SOURCE OF RUBBER** for tires. In road tests, our prototypes deliver performance that's **EQUAL OR BETTER THAN** commercial tires."

"What's exciting is this creates new jobs in arid parts of the country. The plant is indigenous and doesn't harm the environment. South Carolina, with its tire and automotive industries, stands to benefit greatly from a local source of rubber," Landis said.

Landis is also working with the City of Greenville, the Greenville Chamber of Commerce, and businesses to create a sustainability plan for the community and its economy. Under consideration are long-term energy, infrastructure and transportation needs and the types of businesses the region wants to attract.

"Our intent is to guide people to sustainable economies using sustainable practices. When you explain the value to people, whether it's community leaders, businesses, students or faculty, people get very excited and are chomping on the bit to get started. The connection to community is very real," Landis said.

> "I am **PASSIONATE** about increasing **DIVERSITY** in STEM education. We all have the power to have an **IMPACT**."

SMARTSTATE®
CENTERS AND ENDOWED CHAIRS

The work of South Carolina's SmartState® Centers is exciting, groundbreaking, and of critical importance to the state, nation, and world. What follows is a brief overview of each Center.

TOTALS FOR SMARTSTATE® PROGRAM

- **51** SmartState® Program Centers Awarded
- **85** SmartState® Endowed Chairs Created
- **54** SmartState® Endowed Chairs Appointed
- **31** SmartState® Endowed Chairs Remaining to be Appointed

	Clemson University	University of South Carolina	MUSC Medical University of South Carolina
SmartState® Program Centers Awarded	13	18	20
SmartState® Endowed Chairs Created	16	28	41
SmartState® Endowed Chairs Appointed	9	21	24
SmartState® Endowed Chairs Remaining to be Appointed	7	7	17

Program totals reported as of November 2015. In cases of joint proposals, Centers awarded by institution are tallied by the fiscal agent. Endowed chairs are tallied based on the assigned institution. USC's assigned endowed chairs include one joint appointment with MUSC. On the pages that follow, information about each SmartState® Center is provided including the date the Center was approved, the institution(s) awarded, the state award amount that must be matched with an equal amount of non-state investment, the appointed endowed chair(s) as of November 2015, reported extramural research funding (federal and private awards) above the match, and a brief description of the research focus. Centers are grouped by industry cluster. For updated information on Centers and program totals, contact the S.C. Commission on Higher Education or visit SmartStatesc.org.

ADVANCED MATERIALS & NANOTECHNOLOGY

ADVANCED FIBER-BASED MATERIALS

Award Date: 2006

State Award Amount: $4 million

University: Clemson

Endowed Chair(s):
Dr. Marek Urban
J.E. Sirrine Foundation Endowed Chair in Advanced Fiber-Based Materials

Corporate Partner(s):
J.E. Sirrine Textile Foundation

External Funding Above Match:
$10.5 million

Research Focus:
To provide the vehicle for repositioning existing manufacturing resources to support new industry opportunities based on advanced fiber-based products.

ENVIRONMENTAL NANOSCIENCE AND RISK

Award Date: 2008

State Award Amount: $3 million

University: USC

Endowed Chair(s):
Dr. Jamie Lead

External Funding Above Match:
$1.6 million

Research Focus:
Understand the fundamental properties of nanomaterials and nanomaterials-environment interaction and use these principles to understand and help reduce impacts of nanomaterals as used as well as develop and innovate nanotechnological applications.

EXPERIMENTAL NANOSCALE PHYSICS

Award Date: 2003

State Award Amount: $4 million

University: USC

Endowed Chair(s):
Dr. Richard Webb

External Funding Above Match:
$5.1 million

Research Focus:
Perform basic and applied research of potential spintronic optoelectronic and nanoelectronic devices and/or materials for future applications in information processing, high-speed, high-density electronics, and bio, chemical and radiation sensing.

MULTIFUNCTIONAL MATERIALS & STRUCTURES (MFMS)

Award Date: 2013

State Award Amount: $2 million

University: USC

Endowed Chair(s):
Dr. Michael van Tooren

Research Focus:
The development and supply of engineered materials for high technology industries such as aerospace by providing a foundation of research and development that will enable and enhance growth in the engineered materials field. Specific examples of research and development include: Lightning strike and EMF management, structural integrity, energy storage, essential power for commercial aircraft, and multi-physics-based micro/nano mechanics of dielectric materials.

OPTICAL MATERIALS/PHOTONICS

Award Date: 2004

State Award Amount: $5 million

University: Clemson

Endowed Chair(s):
Dr. John Ballato
J. E. Sirrine Textile Foundation Endowed Chair in Optical Fiber.

Corporate Partner(s):
J.E. Sirrine Textile Foundation

External Funding Above Match:
$21.7 million

Research Focus:
Conduct materials research and recruit and mentor graduate students with a focus on domestic scholars. Identify and foster the latest technologies and initiate partnerships with top national research universities and laboratories, Aid South Carolina industry and economic development partners in the transfer of technology from Clemson to the public sector, and participate in the recruitment of optical technology firms to South Carolina.

POLYMER NANOCOMPOSITES

Award Date: 2004

State Award Amount: $3.5 million

University: USC

Endowed Chair(s):
Dr. Brian Benicewicz
Materials Science & Engineering

Corporate Partner(s):
Michelin North American, BASF, U.S. Navy, PBI Performance Products

External Funding Above Match:
$12.2 million

Research Focus:
Development of synthetic tools needed to precisely control the environment or interface between nanoparticles and polymer matrix applicable to optics, electronics, biological, medical, and structural material applications.

AUTOMOTIVE & TRANSPORTATION

AUTOMOTIVE DESIGN AND DEVELOPMENT

Award Date: 2004

State Award Amount: $5 million

University: Clemson

Endowed Chair(s):
Dr. Zoran Filipi
Timken Endowed Chair in Automotive Design & Development

Corporate Partner(s):
Hertz Corporation, Duke Energy

External Funding Above Match:
$5.9 million

Research Focus:
Focuses on the research and design of advanced powertrains for internal combustion engines and hybrid and electric vehicles, along with lightweight design and materials, functional integration and structural dynamics for vehicles.

AUTOMOTIVE MANUFACTURING

Award Date: 2003

State Award Amount: $5 million

University: Clemson

Endowed Chair(s):
Clemson is recruiting one endowed chair.

Corporate Partner(s):
BMW

External Funding Above Match:
$7.9 million

Research Focus:
Develops micro-electromechanical systems technologies for manufacturing and improving the efficiency of manufacturing large, complex objects. The goal is for the Center to be the premier automotive and motorsports research and educational facility in the world.

SUPPLY CHAIN OPTIMIZATION AND LOGISTICS

Award Date: 2006

State Award Amount: $2 million

University: Clemson

Endowed Chair(s):
Dr. Scott Mason
Fluor Endowed Chair in Supply Chain Optimization & Logistics

Corporate Partner(s): Fluor

External Funding Above Match:
$10.3 million

Research Focus:
Interdisciplinary research addressing the multifaceted problems associated with supply chains. Deliver tangible supply chain optimization and logistics products and services through theoretical and applied research.

VEHICLE ELECTRONIC SYSTEMS INTEGRATION

Award Date: 2004

State Award Amount: $3 million

University: Clemson

Endowed Chair(s):
Clemson is recruiting the *Michelin Endowed Chair in Vehicle Electronic Systems Integration*.

Corporate Partner(s):
Michelin

External Funding Above Match:
$1.7 million

Research Focus:
Research in automotive and vehicular electronics, particularly systems integration issues, electromagnetic compatibility and electromagnetic modeling.

AUTOMOTIVE SYSTEMS INTEGRATION

Award Date: 2003

State Award Amount: $5 million

University: Clemson

Endowed Chair(s):
Dr. Paul Venhovens
BMW Endowed Chair in Automotive Systems Integration

Corporate Partner(s): BMW, Mazda, GM and others

External Funding Above Match:
$3.7 million

Research Focus:
Automotive diagnostics and prognostics, sustainable mobility, concepts, methods and tools. Deriving a simple, flexible energy management control strategy for plug-in hybrid electric vehicles.

BIOMEDICAL

ADVANCED TISSUE BIOFABRICATION

Award Date: 2008

State Award Amount: $5 million

Universities: MUSC, USC, Clemson

Endowed Chair(s):

MUSC, USC, and Clemson are recruiting Endowed Chairs in *Biofabrication Biology* and *Biofabrication Engineering*.

Research Focus:

Develop innovative technologies and approaches that will enable repair, replacement, or restoration of diseased cells, tissues and organs.

BRAIN IMAGING

Award Date: 2003

State Award Amount: $5 million

Universities: USC, MUSC

Endowed Chair(s):

Dr. Chris Rorden, USC

Dr. Joseph Helpern, MUSC

MUSC is recruiting one additional endowed chair.

External Funding Above Match:

$27.4 million

Research Focus:

Creating a world-class brain imaging center. Initiated the first study using transcranial magnetic stimulation (TMS). Combined with functional MRI, TMS provides a short strong magnetic field useful for studying how the brain works. Specific studies include stroke-related brain injury and MRI physics techniques for clinical and neuroscience research.

PROSTATE CANCER DISPARITIES

Award Date: 2008

State Award Amount: $3.6 million

University: MUSC, USC, SCSU

Endowed Chair(s):

Dr. Chanita Hughes-Halbert, MUSC
AT&T Distinguished Endowed Chair in Cancer Equity in Cancer Disparities

MUSC and USC are each recruiting one endowed chair in *Cancer Disparities*.

Corporate Partner(s): AT&T Foundation

External Funding Above Match:

$32.5 million

Research Focus:

Facilitate statewide partnerships in cancer prevention and control research, clinical trials, and training to significantly decrease disparities in prostate cancer incidence and mortality in South Carolina.

CHILDHOOD NEUROTHERAPEUTICS

Award Date: 2006

State Award Amount: $5 million

Universities: USC, MUSC

Endowed Chair(s):

Dr. Jeffrey Twiss, USC
Child and Adolescent Neurochemistry

Manuel Casanova
Translational Neurotherapeutics

USC is recruiting one endowed chair in *Translational Clinical Research*.

MUSC is recruiting one endowed chair in *Neurodevelopmental Disorders*.

External Funding Above Match:

$7.2 million

Research Focus:

Prevention of brain damage in premature infants and curing infant brain diseases through cellular engineering. Also working on cognitive behavioral tasks in transgenic mice to determine if therapeutics can improve functional development outcomes, which may someday help children with ADHD.

CLINICAL EFFECTIVENESS AND PATIENT SAFETY

Award Date: 2006

State Award Amount: $5 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. John Schaefer, MUSC
Lewis Blackman Endowed Chair for Patient Simulation & Research for Health Sciences South Carolina

Dr. Jihad Obeid, MUSC
Biomedical Informatics

USC is recruiting one endowed chair.

External Funding Above Match:

$12.1 million

Research Focus:

Quality and safety of patient care, and improving the medical informatics aspects of data acquisition and the evaluation of health information technology on the quality and safety of clinical care processes and outcomes. The Center also focuses on developing South Carolina as a training center for physicians and other health professions using human simulators and sophisticated software-based training scenarios.

BIOMEDICAL

HEALTHCARE QUALITY

Award Date: 2007

State Award Amount: $5 million

Universities: USC, MUSC

Endowed Chair(s):

Dr. Les Lenert, MUSC
Medical Bioinformatics

Dr. Xiaoming Li, USC
Translational Clinical Research.

Corporate Partner(s):

The Duke Endowment

External Funding Above Match:

$18.3 million

Research Focus:

Creating a unique and comprehensive clinical data store that collects data from providers, enhances data usability, and makes it available in an easily accessible form for participants to use for clinical improvement and research purposes.

HEALTH FACILITIES DESIGN AND TESTING

Award Date: 2007

State Award Amount: $2 million

University: Clemson, MUSC

Endowed Chair(s):

Dr. Anjali Joseph, Clemson University
Architecture & Health Research.

MUSC is recruiting one endowed chair in *Clinical Practice and Human Factors.*

External Funding Above Match:

$1.4 million

Research Focus:

The impact of health facility design on health and healthcare delivery and the creation of architectural settings that provide better support for the health, safety, and wellbeing of patients and staff.

INFLAMMATION AND FIBROSIS RESEARCH

Award Date: 2010

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):

Carol Feghali-Bostwick, Ph.D.
Kitty Trask Holt Endowed Chair for Scleroderma Diseases

MUSC is recruiting one endowed chair in *Inflammation Research.*

External Funding Above Match:

$14.2 million

Research Focus:

Develop new therapies and education programs for inflammatory and fibrosing rheumatic diseases such as lupus, scleroderma, and rheumatoid arthritis.

MARINE GENOMICS

Award Date: 2003

State Award Amount: $4 million

Universities: MUSC, College of Charleston

Endowed Chair(s):

Dr. Gavin Naylor, MUSC
Bioinformatics

MUSC is recruiting one endowed chair.

External Funding Above Match:

$8.9 million

Research Focus:

Monitoring and predicting the impact of environmental changes on marine biosystems, which can, in turn, affect human health. Specific areas of study include environmental causation in wildlife, human disease and susceptibility, and mapping variability in genomes and populations; as well as research of shark and ray species.

MOLECULAR PROTEOMICS IN CARDIOVASCULAR DISEASE AND PREVENTION

Award Date: 2006

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):

Dr. Sheldon E. Litwin
Countess Alicia Spaulding Palozzi Chair in Cardiovascular Imaging

MUSC is recruiting the *Volpe SmartState® Endowed Chair in Cardiovascular Biomarker Development for Diagnosis & Prevention.*

External Funding Above Match:

$4.5 million

Research Focus:

Translation advances in basic bench science to clinical bedside care to improve the health care of the citizens of South Carolina. Priorities include diagnostic techniques, therapeutic management strategies, relations of protein signatures to clinical outcomes for risk assessment, and treatment of disease manifestation.

NEUROSCIENCE

Award Date: 2003

State Award Amount: $3 million

University: MUSC

Endowed Chair(s):

MUSC is recruiting the *William E. Murray Endowed Chair in Neuroscience*

MUSC is recruiting the *Josephine Tucker Morse Endowed Chair in Parkinson's Disease.*

External Funding Above Match:

$14.5 million

Research Focus:

Brain neuromodulatory systems and their roles in cognitive performance, drug abuse, sleep and affective disorders. Other areas of research are movement disorders such as Ataxia, Choro, Bradykinesia and multiple system atrophy.

BIOMEDICAL

PROTEOMICS

Award Date: 2003

State Award Amount: $4 million

University: MUSC

Endowed Chair(s):

Dr. Richard Drake

MUSC is recruiting one additional endowed chair.

External Funding Above Match:

$21.5 million

Research Focus:

Develop and use high-end analytical technologies to understand the biologic profile of protein expression in health and disease. Developing enzyme-based analytical methods to effectively detect biomolecules in tissues and tissue microarray platforms.

REGENERATIVE MEDICINE

Award Date: 2004

State Award Amount: $5 million

Universities: MUSC, USC, Clemson

Endowed Chair(s):

Dr. Martin Morad, USC
BlueCross BlueShield of SC Foundation Chair in Cardiovascular Health

Dr. Stephen Duncan, MUSC
Regenerative Medicine and Cell Biology.

Clemson is recruiting the *Hansjörg Wyss Endowed Chair in Bioengineering*.

External Funding Above Match:

$40.6 million

Research Focus:

Regenerative medicine approach for cardiovascular applications and provide expertise in clinical trials, statistics and/or assay development. Application of regenerative medicine and tissue engineering approaches to orthopaedic and neural diseases. Regeneration of tissue and organs for repairing, replacing, and maintaining organ function.

REHABILITATION AND RECONSTRUCTION SCIENCES

Award Date: 2007

State Award Amount: $5 million

University: USC

Endowed Chair(s):

Dr. John Brooks

Corporate Partner(s):

Smith&Nephew

External Funding Above Match:

$15.2 million

Research Focus:

Medical health needs in orthopaedic disorders, exercise and sports-related injury prevention, treatment, and rehabilitation. The Center investigates the biologics of tissue-engineered materials and implantable devices to find solutions to musculoskeletal maladies.

RENAL DISEASE BIOMARKERS

Award Date: 2008

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):

MUSC is recruiting one endowed chair in *Renal Biomarkers* and one endowed chair in *Translational Nephrology Research*.

External Funding Above Match:

$4.7 million

Research Focus:

Identifying biomarkers that identify or predict prognosis for acute kidney injury, diabetic neuropathy, lupus nephritis, and focal segmental alomerulosclerosis.

SENIORSMART®

Award Date: 2007

State Award Amount: $5 million

Universities: USC, Clemson

Endowed Chair(s):

Dr. Sue Levkoff, USC
SmartHOME®

USC is recruiting one endowed chair in *SmartBRAIN®*.

Clemson is recruiting one endowed chair in *SmartWHEELS®*.

External Funding Above Match:

$7.3 million

Research Focus:

Three areas of research include: *SmartBRAIN®* (maintaining intellectual activity), *SmartWHEELS®* (independent mobility outside the home) and *SmartHOME®* (independent mobility inside the home) to foster independent living among seniors.

BIOMEDICAL

STROKE

Award Date: 2007

State Award Amount: $5 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. Robert Adams, MUSC
Stroke

Dr. Mark Chimowitz, MUSC
Countess Alicia Paolozzi Endowed Chair in Translational Neurology

Dr. Souvik Sen, USC
Clinical Neurology

External Funding Above Match:

$19.5 million

Research Focus:

Enhancing stroke treatment, prevention, and recovery. This Center is developing new stroke-related therapeutics, drug discovery, and biotechnology, and is a leader in stroke telemedicine.

TECHNOLOGY CENTER TO ENHANCE HEALTHFUL LIFESTYLES

Award Date: 2009

State Award Amount: $3 million

Universities: USC, MUSC

Endowed Chair(s):

Dr. Frank Trieber, MUSC
Technology Applications for Disease Prevention, Management, and Risk Reduction

Delia West, USC
Technology Application for Health Behavior Change.

External Funding Above Match:

$13.6

Research Focus:

Develop and test lifestyle interventions for improving health, preventing illness and managing chronic health problems caused by physical inactivity, poor diets, and other lifestyle behaviors.

TOBACCO-RELATED MALIGNANCIES

Award Date: 2007

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):

Dr. Nancy DeMore
BMW Chair in Cancer Research and *Burtschy Family Distinguished Endowed Chair in Lung Cancer Research*.

MUSC is recruiting one endowed chair.

Corporate Partner(s):

BMW

External Funding Above Match:

$52.1 million

Research Focus:

Devoted to discovering tobacco-related malignancy biomarkers via clinical trials with a specific focus on tobacco-related cancers. Additionally, the Center is evaluating the specificity and sensitivity of novel biomarkers by molecular epidemiologic techniques across the diverse populations of South Carolina.

TRANSLATIONAL BIOMEDICAL INFORMATICS

Award Date: 2013

State Award Amount: $2 million

University: MUSC

Endowed Chair(s):

MUSC is recruiting one endowed chair.

Research Focus:

The new Center will provide expertise in translational biomedical informatics essential for cutting-edge, innovative methodologies to link genetic/genomic data with vast amounts of clinical data. The contributions of the center to data sharing/analysis will decrease cost and increase efficiency in research and healthcare delivery and provide a robust IT platform for industry partnerships and new company formation.

VISION SCIENCE

Award Date: 2005

State Award Amount: $4.5 million

Universities: MUSC

Endowed Chair(s):

Dr. Barbel Rohrer
Chair in Gene and Pharmaceutical treatment of Retinal Degenerative Diseases

MUSC is recruiting one endowed chair.

Corporate Partner(s):

Alcon Labs, Taligen, Alexion Pharmaceuticals

External Funding Above Match:

$21.8 million

Research Focus:

New treatments for macular degeneration, development of new anti-glaucoma agents and innovations in cataract surgery. The Center also focuses on using advances in bioengineering and material sciences to improve the diagnosis, treatment, and prevention of eye diseases.

ENERGY & ALTERNATIVE FUELS

CATALYSIS FOR RENEWABLE FUELS

Award Date: 2005

State Award Amount: $3 million

University: USC

Endowed Chair(s):
Dr. John Regalbuto

External Funding Above Match:
$9.2 million

Research Focus:
Developing catalysts that allow production of alternative fuels from renewable sources, thereby reducing dependence on imported oil and carbon fuel. The Center focuses on synthesizing inorganic catalysts for converting biomass to biofuels and synthesizing electrocatalysts for solar fuels and fuel cells.

GENERAL ATOMICS CENTER FOR THE DEVELOPMENT OF TRANSLATIONAL NUCLEAR TECHNOLOGY

Award Date: 2009

State Award Amount: $3 million

University: USC

Endowed Chair(s):
Theodore Besmann
Energy and Nuclear Security.

Corporate Partner(s):
General Atomics

External Funding Above Match:
$4.8 million

Research Focus:
The production of biofuels and coal to liquid fuels using nuclear process heat for more efficient production and the reduction of wastes associated with recycling of used fuel, seeking more long term strategies to manage used fuel, recovery of energy value in used fuel, and eliminating concerns over proliferation associated with recycling used fuel.

INNOVATION AND COMMERCIALIZATION

Award Date: 2004

State Award Amount: $5 million

University: USC

Endowed Chair(s):
USC is recruiting one endowed chair in *Discovery* and *Innovation*.

Corporate Partner(s):
Office of Naval Research (projects)

External Funding Above Match:
$21.6 million

Research Focus:
Advance the science and use of clean, secure and renewable energy technologies and transportation fuel, including hydrogen fuel cells.

NUCLEAR SCIENCE AND ENERGY

Award Date: 2008

State Award Amount: $3 million

University: USC

Endowed Chair(s):
Dr. Dan Gabriel Cacuci
Nuclear Power and Advanced Materials

Corporate Partner(s):
Duke Energy, Progress Energy, SCANA, Westinghouse

External Funding Above Match:
$6.6 million

Research Focus:
Performance, efficiency, and maintenance issues at existing and future nuclear power plants using expertise modeling and simulation related to nuclear fuels and materials.

SMART GRID TECHNOLOGY

Award Date: 2013

State Award Amount: $5 million

University: Clemson

Endowed Chair(s):
Clemson is recruiting one endowed chair.

Corporate Partner(s):
Duke Energy

External Funding Above Match:
$739,331

Research Focus:
Develop technology to better manage global electric grid systems.

SOLID OXIDE FUEL CELLS

Award Date: 2006

State Award Amount: $3 million

University: USC

Endowed Chair(s):
USC is recruiting one endowed chair.

External Funding Above Match:
$55.1 million

Research Focus:
Develop solid oxide fuel cells for use in large, high-power systems such as industrial sites and electricity generating stations as well as for mobile power for computers, cell phones, and other electronics.

STRATEGIC APPROACHES TO THE GENERATION OF ELECTRICITY (SAGE)

Award Date: 2007

State Award Amount: $5 million

University: USC

Endowed Chair(s):
Dr. Jochen Lauterbach

External Funding Above Match:
$9.8 million

Research Focus:
Developing, improving, and advancing technologies to enhance the environmental performance of electricity production. Other work focuses on converting CO2 to chemicals, fuel cell and hydrogen storage-related research, and chemical production from coal to biomass.

INFORMATION SCIENCE

CYBERINSTITUTE

Award Date: 2008

State Award Amount: $2 million

University: Clemson

Endowed Chair(s):
Clemson is recruiting the *C. Tycho Howle Endowed Chair in Collaborative Computing Environments*

Corporate Partner(s):
Omnibond Systems, LLC

External Funding Above Match:
$4.1 million

Research Focus:
Connecting research and scholarship, particularly in the fields of human computer interaction, data storage, interpretation, and visualization to the commercial sector via strategic industrial partnerships. Conduct research in conjunction with the Clemson University Cyber-Institute.

DATA ANALYSIS, SIMULATION, IMAGING, AND VISUALIZATION

Award Date: 2010

State Award Amount: $2 million

University: USC

Endowed Chair(s):
Dr. Wolfgang Dahmen
Williams-Hedberg-Hedberg Chair of Mathematics

External Funding Above Match:
$1.9 million

Research Focus:
Develop technology for transforming data into knowledge concentrating on inline data processing, multi-sensor data acquisition, tissue modeling, atomic scale modeling, and bioimaging.

OPTOELECTRONICS

Award Date: 2008

State Award Amount: $2 million

University: Clemson

Endowed Chair(s):
Dr. Eric Johnson
PalmettoNet Endowed Chair in Optoelectronics

Corporate Partner(s):
Advanced Photonic Crystal, Tetramer Technologies

External Funding Above Match:
$3.8 million

Research Focus:
Improving devices, systems, and protocols used in high-speed optical communications networks.

SUSTAINABLE DEVELOPMENT

Award Date: 2010

State Award Amount: $4 million

University: Clemson

Endowed Chair(s):
Dr. Amy Landis
Thomas F. Hash '69 Endowed Chair in Sustainable Development.

External Funding Above Match:
$2.1 million

Research Focus:
Developing new technologies to support real-time monitoring and management of natural and built environments through the Intelligent River™ Project. The Center has created a wireless sensor that can monitor and transmit environmental data in real time.

TOURISM AND ECONOMIC DEVELOPMENT

Award Date: 2005

State Award Amount: $2 million

University: USC

Endowed Chair(s):
Dr. Simon Hudson

Corporate Partner(s):
Rawle Murdy
US Travel Association (USTA)

External Funding Above Match:
$303,459

Research Focus:
Tourism is a $17 billion industry in South Carolina. The Center conducts cutting-edge tourism and hospitality research initiatives that will improve South Carolina's competitiveness as a tourism destination.

URBAN ECOLOGY AND RESTORATION

Award Date: 2006

State Award Amount: $2 million

University: Clemson

Endowed Chair(s):
Dr. Robert F. Baldwin
Margaret H. Lloyd SmartState Chair in Urban Ecology

External Funding Above Match:
$6.4 million

Research Focus:
Applied research in environmental science and engineering, habitat restoration and water quality management; environmental industry growth; and urban ecology projects in South Carolina.

PHARMACEUTICAL

CANCER DRUG DISCOVERY

Award Date: 2005

State Award Amount: $5 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. John LeMasters, MUSC
GlaxoSmithKline Distinguished Endowed Chair

Dr. Patrick Woster, MUSC
Medicinal Chemistry

Dr. Mark Hamann, MUSC
Charles & Carol Cooper Chair in Pharmacy

USC is recruiting one endowed chair in *Structural Biology* and *Pharmacy.*

Corporate Partner(s):

GlaxoSmithKline

External Funding Above Match:

$17.5 million

Research Focus:

Advanced biomedical screening technologies to identify disease mechanisms and targets, and also screening drug candidates. Structural biology for target analysis, chemical biology for designing drug candidates, and advanced biomedical screening technologies.

CANCER STEM CELL BIOLOGY AND THERAPY

Award Date: 2008

State Award Amount: $5 million

Universities: MUSC, Clemson

Endowed Chair(s):

Dr. Zihai Li, MUSC
Abney Endowed Chair Remembering Sally Abney Rose

Dr. Xue Zhong Yu, MUSC
Biomedical Engineering

External Funding Above Match:

$9.9 million

Research Focus:

Developing new technologies for isolating, growing, and manipulating cancer stem cells. This will enable the Center to find ways to use adult stem cells from bone marrow or organs to treat cancer.

GASTROINTESTINAL CANCER DIAGNOSTICS

Award Date: 2005

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):

Dr. Carolyn Britten
Charles Westerfield Coker Distinguished Chair in Gastrointestinal Malignancy

MUSC is recruiting the *Grace E. DeWolff Endowed Chair in Medical Oncology*

Corporate Partner(s):

Roche Carolina, Bank of America

External Funding Above Match:

$12.3 million

Research Focus:

Clinical and translational gastrointestinal oncology and biomarker development and gastrointestinal (GI) malignancies. Bringing state-of-the-art translational medicine to all GI cancer patients in South Carolina, thereby decreasing the overall impact of cancer mortality and morbidity and closing disparity gaps throughout the state.

LIPIDOMICS, PATHOBIOLOGY AND THERAPY

Award Date: 2009

State Award Amount: $5 million

University: MUSC

Endowed Chair(s):

Dr. J. Alan Diehl
Lipidomics & Pathobiology

Dr. Besim Ogretman
Lipidomics Drug Discovery.

External Funding Above Match:

$26.8 million

Research Focus:

Develop models for translational research and study of lipidomics and their pathobiology with an emphasis on cancer and inflammation.

MEDICATION SAFETY AND EFFICACY

Award Date: 2008

State Award Amount: $2 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. Charles Bennett
Frank P. and Josie M. Fletcher Professor of Pharmacy

External Funding Above Match:

$4 million

Research Focus:

Increasing drug safety and effectiveness, as well as decreasing medication errors by identifying the incidence and significance of adverse drug events.

TRANSLATIONAL CANCER THERAPEUTICS

Award Date: 2004

State Award Amount: $5 million

Universities: MUSC, USC

Endowed Chair(s):

Dr. Kenneth Tew, MUSC
John C. West Endowed Chair in Cancer Research

Dr. Igor Roninson, USC
Drug Efficacy

External Funding Above Match:

$21.3 million

Research Focus:

Development of new approaches in cancer treatment, including the discovery and development of new drugs. Research also focuses on utilizing mouse models predisposed to cancer to study the impact of gene misregulation and therapeutic agents on tumor development, and the identification and inhibition of new cancer drug targets.

John Brooks, PhD

SMARTSTATE ENDOWED CHAIR

SMARTSTATE CENTER FOR EFFECTIVENESS RESEARCH IN ORTHOPEDICS

UNIVERSITY OF SOUTH CAROLINA

"Doctors and patients try to make the **BEST CHOICES**, but without information about how treatments work in the **REAL WORLD**, decisions are subjective. We want to **CHANGE** that."

A METHODOLOGICAL **MERCENARY**

John Brooks has a lot of questions. And Upstate surgeons are helping him find the answers.

In the 2010, The New York Times published an article in which a medical expert said the rate of hip and knee replacement surgeries in the elderly was too high and the country was spending too much money on these procedures and causing too much pain for seniors.

John Brooks, PhD, is a nationally recognized healthcare economist and the SmartState® Endowed Chair at the SmartState® Center for Effectiveness Research in Orthopedics. He says there is no evidence that the rate of joint replacement surgery is too high or too low in seniors — or in any other patient demographic.

"No one has quantified what rate is right or wrong. Physicians and patients look at the options and make a decision on what they believe is the best path forward," Brooks explained. "However, with 719,000 knee replacements and 332,000 hip replacements performed each year in the United States, it's a question that should be answered."

Brooks is the person to do it. He was recruited by the University of South Carolina (USC) and the Greenville Health System (GHS). GHS is home to the USC School of Medicine Greenville and the Steadman Hawkins Clinic of the Carolinas, the Upstate's premier orthopedics practice. The corporate partner in Brooks' SmartState® Endowed Chair is medical device company Smith & Nephew. All have a vested interest in providing patients with the most appropriate care.

The standard approach to determining what is "right" for patients is randomized control trials. For example, in a randomized drug trial, one group gets the pill being tested while another gets a placebo. Because of their invasive nature, randomized controlled trials are rarely feasible for orthopedic conditions.

So Brooks and Steadman Hawkins orthopedic surgeons are applying econometrics — collecting and analyzing real world data on patient treatment choices — to answer whether current treatment rates are too high or too low.

> "Why is one procedure chosen **TWICE AS OFTEN** as another? Which rate is right? What is the cost? **ECONOMETRICS** will help answer these **QUESTIONS**."

"Currently, there is tremendous variations in treatment. Ten percent of patients with torn rotator cuffs have surgery, which is expensive; 40 percent have therapy and 50 percent do nothing. What are the ramifications? We need to find out," Brook said.

Brooks is establishing a data collection system at Steadman Hawkins to understand why treatment choices were made, to document all diagnoses and treatment and to document patient outcomes. The data will be analyzed to determine best practice. The initial study will focus on new patients with shoulder pain.

The ultimate goal is to use real world data to determine what approaches result in the most favorable outcomes and creating data based guidelines for surgeons. "Physicians want to do the best for each patient. Working with GHS and Steadman Hawkins, we have the opportunity to answer a lot of important questions and make orthopedic care better for patients and the healthcare system."

> "The **GREENVILLE HEALTH SYSTEM** and Steadman Hawkins orthopedic surgeons are working with SmartState to determine the most **EFFECTIVE TREATMENTS**."

SMARTSTATE®
ENDOWED CHAIRS

South Carolina's SmartState® Centers are led by endowed chairs; they are engineers, scientists, and researchers who are recognized experts in their respective fields.

The role of SmartState® Endowed Chairs is to serve as catalyst for the state's knowledge economy. Eighty-five endowed chairs have been approved to fill positions at Clemson, MUSC, and USC across 51 SmartState® Centers. As of November 2015, 54 chairs are filled. The SmartState® Program welcomed 13 new endowed chairs: Dr. John Ballato, Dr. Robert F. Baldwin, Dr. Theodore Besmann, Dr. Manuel Casanova, Dr. Wolfgang Dahmen, Dr. Stephen Duncan, Dr. Mark Hamann, Dr. Anjali Joseph, Dr. Amy Landis, Dr. Xiaoming Li, Dr. Besim Ogretman, Dr. Barbel Rohrer, and Dr. Michael van Tooren, We invite you to meet the SmartState® Endowed Chairs.

ROBERT ADAMS
Stroke
MUSC

ROBERT F. BALDWIN
Urban Ecology + Resoration
Clemson

JOHN BALLATO
Optical Materials/ Photonics
Clemson

BRIAN BENICEWICZ
Polymer Nanocomposites
USC

CHARLES BENNETT
Medication Safety and Efficacy
USC

THEODORE BESMANN
General Atomics
USC

CAROLYN BRITTEN
Gastrointestinal Cancer Diagnostics
MUSC

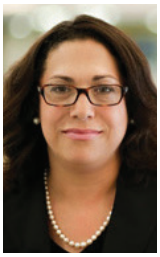
JOHN BROOKS
Rehabilitation and Reconstruction Science
USC

DAN GABRIEL CACUCI
Nuclear Science and Energy
USC

MANUEL CASANOVA
Childhood Neurotherapeutics
USC

MARK CHIMOWITZ
Stroke
MUSC

WOLFGANG DAHMEN
Data Analysis Simulation Imaging and Visualization
USC



NANCY DEMORE
Tobacco-related Malignancies
MUSC

J. ALAN DIEHL
Lipidomics Pathobiology and Therapy
MUSC

RICHARD DRAKE
Proteomics
MUSC

STEPHEN A. DUNCAN
Regenerative Medicine
MUSC

CAROL FEGHALI-BOSTWICK
Inflammation & Fibrosis Research
MUSC

ZORAN FILIPI
Automotive Design and Development
Clemson

MARK HAMANN
Cancer Drug Discovery
MUSC

JOSEPH HELPERN
Brain Imaging
MUSC

SIMON HUDSON
Tourism and Economic Development
USC

CHANITA HUGHES-HALPERT
Prostate Cancer Disparities
MUSC

ERIC JOHNSON
Optoelectronics
Clemson

ANJALI JOSEPH
Health Facilities Design and Testing
Clemson

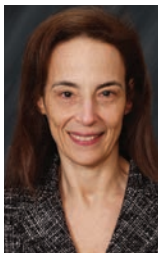
AMY LANDIS
Sustainable Development
Clemson

JOCHEN LAUTERBACH
Strategic Approaches to the Generation of Electricity (SAGE)
USC

JAMIE LEAD
Environmental Nanoscience and Risk
USC

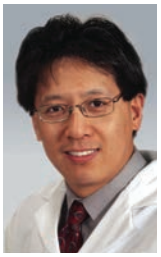
JOHN LEMASTERS
Cancer Drug Discovery
MUSC

LES LENERT
Healthcare Quality
MUSC



SUE LEVKOFF
SeniorSMART
USC

XIAOMING LI
Healthcare Quality
USC



ZIHAI LI
Cancer Stem Cell Biology and Therapy
MUSC

SHELDON E. LITWIN
Molecular Proteomics in Cardiovascular Disease and Prevention
MUSC

SCOTT MASON
Supply Chain Optimization and Logistics
Clemson

MARTIN MORAD
Regenerative Medicine
USC

GAVIN NAYLOR
Marine Genomics
MUSC

JIHAD OBEID
Clinical Effectiveness and Patient Safety
MUSC

BESIM OGRETMAN
Lipidomics Pathobiology and Therapy
MUSC

JOHN REGALBUTO
Catalysis for Renewable Fuels
USC

BARBEL ROHRER
Vision Science
MUSC

IGOR RONINSON
Translational Cancer Therapeutics
USC

CHRIS RORDEN
Brain Imaging
USC

JOHN SCHAEFER
Clinical Effectiveness and Patient Safety
MUSC

SOUVIK SEN
Stroke
USC

KENNETH TEW
Translational Cancer Therapeutics
MUSC

FRANK TRIEBER
Technology Center
to Enhance Healthful
Lifestyles
MUSC

JEFFREY TWISS
Childhood
Neurotherapeutics
USC

MAREK URBAN
Advanced Fiber
Materials
Clemson

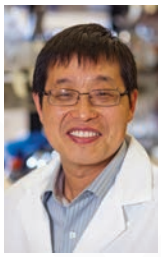
MICHAEL VAN TOOREN
Multifunctional
Materials & Structures
USC

PAUL VENHOVENS
Automotive Systems
Integration
Clemson

RICHARD WEBB
Experimental
Nanoscale Physics
USC

DELIA WEST
Technology Center
to Enhance Healthful
Lifestyles
USC

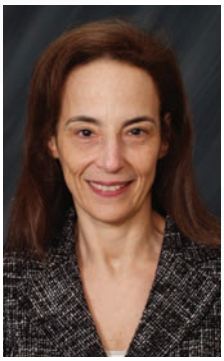
PATRICK WOSTER
Cancer Drug Discovery
MUSC



XUE ZHONG YU
Cancer Stem Cell
Biology and Therapy
MUSC

SMARTSTATE® COUNCIL OF CHAIRS

Dear Friends,



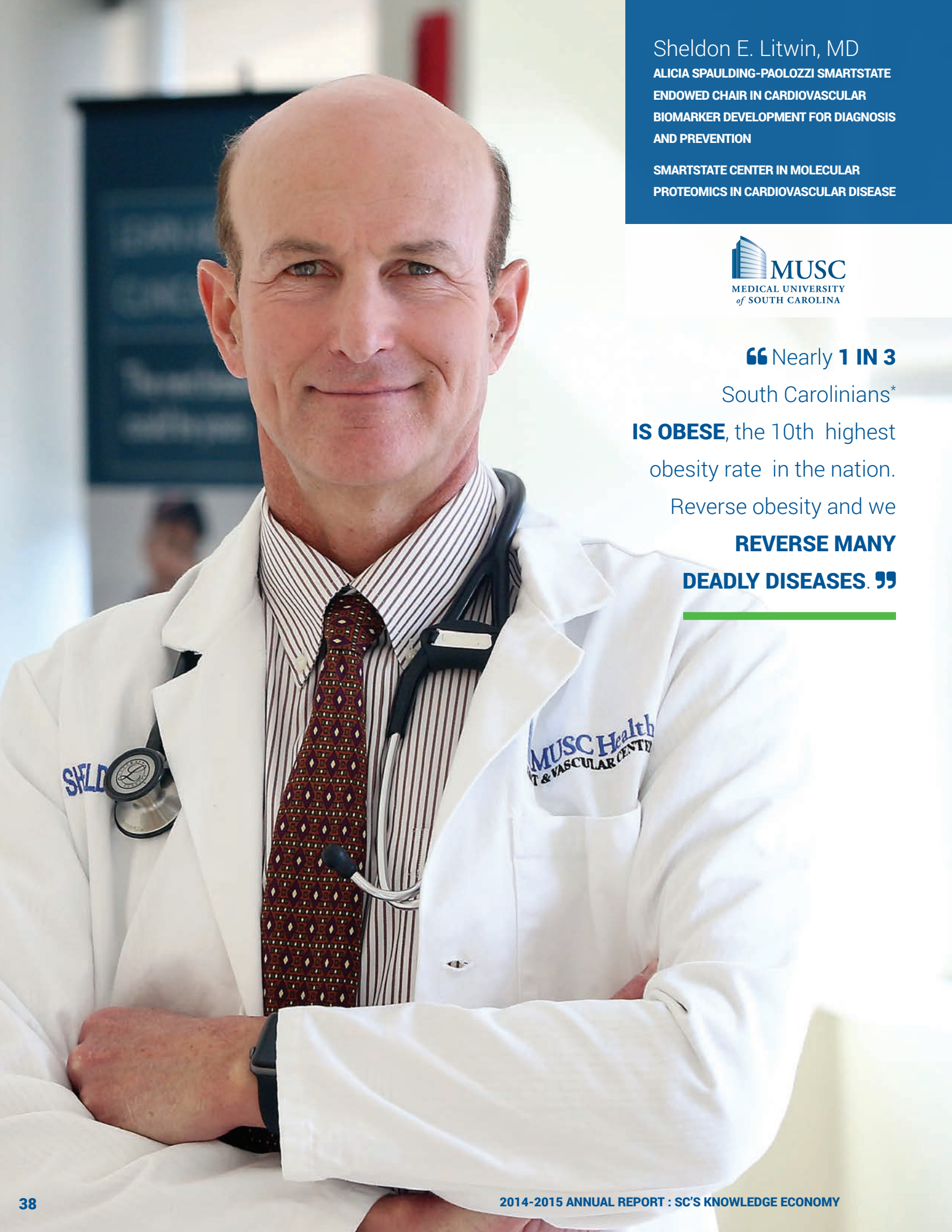
I am honored to speak on behalf of the SmartState® Council of Chairs, a diverse group men and women who are experts in the fields of advanced materials and nanotechnology, automotive design and engineering, biomedical sciences and public health, information science, energy and alternative fuels, pharmaceuticals and drug development.

South Carolina is now home to 54 SmartState® Endowed Chairs, each chair holder specifically recruited from the top research universities in the nation to serve as catalysts in igniting and fueling South Carolina's Knowledge Economy. It is a mantle my colleagues and I are well prepared to wear. Many of the SmartState® Chairs brought with them existing multi-million dollar research grants and laboratories. Others have attracted tens of millions in funding from the federal government, private foundations and corporations, funding that fuels research, innovation, and educational and career opportunities for students and citizens of our state.

SmartState® Endowed Chairs have embraced groundbreaking partnerships, creating unprecedented synergy between South Carolina's research universities, business and healthcare communities that are creating new opportunities for our state. We are now a national leader in automotive manufacturing, health informatics, sustainable fuels, and other areas. We have attracted new companies with better jobs and good salaries. South Carolina has achieved its goal of a Knowledge Economy; it feels great!

We would like to thank the South Carolina General Assembly for creating the SmartState® Program. This unique program has elevated our state's research universities and has attracted the research stars you see on these pages. Success breeds success and the SmartState® Endowed Chairs look forward to continuing our momentum.

Sue Levkoff
Chair, Council of Chairs
SmartState® Program



Sheldon E. Litwin, MD

ALICIA SPAULDING-PAOLOZZI SMARTSTATE ENDOWED CHAIR IN CARDIOVASCULAR BIOMARKER DEVELOPMENT FOR DIAGNOSIS AND PREVENTION

SMARTSTATE CENTER IN MOLECULAR PROTEOMICS IN CARDIOVASCULAR DISEASE

MUSC
MEDICAL UNIVERSITY of SOUTH CAROLINA

"Nearly **1 IN 3** South Carolinians* **IS OBESE**, the 10th highest obesity rate in the nation. Reverse obesity and we **REVERSE MANY DEADLY DISEASES**."

ADDRESSING THE **BATTLE OF THE BULGE**

In 1990, South Carolina's adult obesity rate was 12 percent.

Thirty-five years later, that number has nearly tripled (32.1 percent), resulting in major health issues for the Palmetto State. South Carolina now ranks seventh in the nation for diabetes, eighth for hypertension, and has high rates of heart disease, arthritis and cancer.*

Coming to the Medical University of South Carolina (MUSC) from Utah, which has the second lowest obesity rate in the nation, Sheldon E. Litwin, MD, was shocked at the difference in people in the Palmetto State. At the same time, the Spaulding-Paolozzi SmartState® Endowed Chair in Cardiovascular Biomarker Development for Diagnosis and Prevention was motivated to make a difference.

A self-described compulsive exerciser — he cycles, rows or works out at the gym three hours a day — Litwin's focus is heart disease. However, instead of treating heart attacks, he focuses on preventive cardiology.

"As cardiologists, we haven't dealt with obesity. About half of the patients with clear signs of congestive heart failure (CHF), have normal pumping capacity of the heart muscle, making them difficult to diagnose. I believe the main problem is very often obesity; excess weight places a burden on the heart, lungs and kidneys, ultimately leading to high pressures in the heart during diastole (when the heart fills with blood). This can cause fluid accumulation in the lungs, abdomen and extremities, making it difficult to breathe and move," Litwin explained.

These patients also tend to suffer from sleep apnea, high blood pressure and diabetes. Added Litwin, "Currently there is no effective pharmacologic therapy for this syndrome, also known as heart failure with preserved ejection fraction (HFpEF). Weight loss may be the obvious overlooked therapy."

Litwin has launched Weight Loss as Therapy for Heart Failure, a 15-week lifestyle modification program at MUSC aimed at reversing participants' heart disease through weight loss and increased exercise. The plan is to enroll 50 people. "Lifestyle modification is hard. Most people ultimately regain the weight they lose through diet and exercise alone. If we prove that weight loss can safely improve the condition of patients with established heart failure, then we can begin to study whether weight loss medications or surgery can help sustain weight loss over time," Litwin said.

> "If a person loses just **TEN PERCENT** of body weight, we see **SIGNIFICANT BENEFITS** to the cardiovascular system."

Litwin is also starting a clinic for patients who have HFpEF, and is involved in several clinical trials evaluating novel approaches to this condition. He hopes to offer options to help patients and physicians who frequently struggle to treat this common but challenging condition.

Most of the HFpEF patients Litwin talks with are very interested in the weight loss project. "People are frustrated by their breathlessness and recognize the value of a different approach. Helping patients to manage obesity has not traditionally been a large part of a cardiologists practice. Today, I think it may be the most important thing we can do."

> "There is **NO ESTABLISHED TREATMENT** for about half the cases of congestive heart failure. **LOSING WEIGHT** may be an effective therapy."

IN CLOSING

South Carolina's knowledge economy has only just begun.

In preparing the 2014-2015 SmartState® Program annual report, we heard from many people who have had a hand in creating South Carolina's knowledge economy.

There was incredible pride, even a sense of wonder at the accomplishment. There was also a powerful reminder: a knowledge economy is not a destination, but an ongoing journey.

Today it seems the only thing faster than the speed of light is the speed of change. Keeping up with change requires non-stop observation, innovation and adjustment. There is no status quo.

South Carolina and the world will continue to depend on smart thinkers and do-ers to address the growing demands for sustainable energy, transportation and food sources; health care that meets the needs of individuals and entire populations; cyber security and security of the world at large.

South Carolina's SmartState® Program has proven itself up to the challenge.

> "Knowledge has to be improved, challenged, and increased constantly, or it vanishes."
>
> **– PETER DRUCKER**

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The SmartState® Program annual report is prepared annually for the South Carolina General Assembly and the South Carolina Budget and Control Board by the SmartState® Review Board and the South Carolina Commission on Higher Education in accordance with S.C. Code of Laws §2-75-10.

In accordance with S.C. Code of Laws §1-11-425, the following information is provided: Number of reports printed: 300. Cost per report: $6.58. Total printing cost: $1,978.24.

SMARTSTATESC.ORG
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